

Fourth Semester
B.Sc Programme
UNIVERSITY OF CALICUT

Core Course Botany

Methodology and Perspectives in Plant Science

Dr. Sheeja T. Tharakan • Dr. Rekha K.
Dr. Bindhu K.B. • Dr. Manju Madhavan • Dr. Vimal Mohan

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GENDER INEQUALITY IN HENRIK IBSEN'S *A DOLL'S HOUSE*

Hima Harry

Henrik Ibsen was born on 20th March 1828. He was a Norwegian Playwright and Theatre director. He is often considered as "the father of realism". In 1862, he was moved to Italy, where he wrote the tragedy *Brand* and then moved to Germany, where he wrote his most famous work *A Doll's House*. He was a Norwegian playwright of the late 19th century. His plays criticized society's values and dealt with modern subjects within the form of the well-made play.

Henrik Ibsen is regarded as the founder of modernism in theatrical works. Ibsen can raise the drama from the position of pure entertainment to that of an excellent means of self-discovery and enlightenment. Ibsen uses the retroactive method by which a situation is developed rather than a story told. His play opens just before the crisis, and the preceding events are recollected rather than presented on *A Doll's House* is a realistic drama. This play deals with the family conflicts of the nineteenth century. This play highlights the votive role of a woman in marital life. A woman cannot have any rights and privileges in the modern society. An entire society is controlled by masculine powers on that time. A woman and her conduct are judged according to the law made by men. Nora has committed forgery to save her husband. Unfortunately

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Torvald Helmer is not ready to support her wife. This forces her to leave her husband, children, and a beautiful house. Nora is actually searching for her own identity. She is a freedom seeker. She declares her independence from family. Nora is regarded as a vessel to show women's strong character and equal power and strength with men. Thus this play, *A Doll's House* exhibits the problems of social injustices assigned to women in a male-dominated society. It explores the status of women in contemporary society. The play is written in three main acts. All actions are taken place in Helmer's residence. It is clear that women do play a bigger role in supporting men and their family through hard work and sacrifice.

A Doll's House is a realistic drama. It exposes the confined role of women during the time of its writing. Throughout the play, *A Doll's House* in which Henrik Ibsen depicts an apparent theme of gender conflict. Nora constitutes a feministic representation in a cramped manner. Gender Inequality is the primary theme reflected in the work of Henrik Ibsen. This play highlights how society treats men and women separately. A woman plays the role of a house-maker at that time. Nora also performs the role of cooking, cleaning, and maintaining the house in the first act. Torvald Helmer, Nora's husband, appears to be a critic of her silly deeds. He is not a supporter of her wishes and dreams.

Torvald is more delighted about his new job and position in the bank. He discusses his happiness with Nora "It is wonderful to feel that one has a perfectly safe job, and a big enough income. It's delightful to think of, isn't it?" (Ibsen6). Here Torvald assumes his role as a bread-winner. He considers an income producer is more superior to a house-keeper. Torvald is the symbol of power in the house. He holds the key to the mailbox, criticizes the extravagance nature of Nora and controls all major things in the house. Nora, his wife is merely a child or a commodity for him. This attitude is reflected through his words like 'lark', squirrel, and 'spendthrift'. In the third act, Nora explains that she expected Torvald to take responsibility for the forged signature she used to get the loan. But he fails to

understand the oblation role of a woman. Finally, she is made a scapegoat of the crime. This misunderstanding, however, is a significant disparity in the marital life of Torvald and Nora.

A Doll's House is a feministic play. This play promotes the rights and privileges of women. Nora is the leading character of the play. She exposes her weakness and strength throughout the play, she acts like a doll. She is acted as a moral support of her husband. She feels very happy about the new job of her husband. Her words reflect her happiness "He is to take his work in the Bank at the New Year, and then he will have a big salary and lots of commissions. After this we can live quite differently- we can do just as we like." (Ibsen9)

Nora was a very loving wife. Her past life with Torvald was not satisfactory. Eight years ago her husband, Helmer had fallen seriously ill and she had been forced to borrow money from Krogstad, villain of the play. She was forced to sign for her father and committed the crime of forgery. She used to spend money for the medical treatment of her dear husband. She has regularly been paying monthly installments to her creditor, Krogstad. Her courageous attitude and strength make the life of her husband safe and secure. When the crisis arose, Torvald could not tolerate with the act of forgery done by his wife, Nora. He was not a helping hand for her. He was frightened and more worried about his prestige and pride than his wife. In the end of the third act, Nora is in a shocked state. She expected positive support for her husband's side. But Torvald could not keep any moral sense regarding Nora's act of forgery.

Nora is obviously searching for her own identity. She is completely transformed herself in to a matured woman. She takes her decision openly. She leaves her husband and her children for liberation and identity. She says "Now it's all over. I have put the keys here. The maids know all about everything in the house better than I do. Tomorrow, after I have left her, Christine will come here and pack up my own things that I brought with me from home. I will have them

sent after me" (Ibsen 81). Her sense of pride and determination makes her a strong feminine representative of contemporary society.

A Doll's House was an accusation of contemporary middle-class marriage. Nora is the leading character in the play. Ibsen portrays a web of complications in modern marital life. Nora is introduced as a doll wife in the play. She is regarded as a mere commodity under the hands of her husband. Torvald cannot tolerate with his wife's lavish lifestyle. She spent too much money on purchasing Christmas tree and buying presents for her children. Helmer became angry about these small things. He used to question her "Bought, did you say? All these things? Has my little spendthrift been wasting money again?" (Ibsen2). His words express his treatment of his wife as a doll. Helmer develops a possessive attitude towards Nora. He fails to recognize her virtuous and brave activities for saving his life. He condemns her for the act of forgery. He thinks about his moral values and social status. Helmer's reaction to Krogstad's revelation of Nora's act of forgery shows that Torvald is completely egocentric and self-centered man. Nora, the representative of modern wife acts as a strong and powerful woman. She is the real helper and saviour of the life of Torvald. She completely burst herself in to depression because of the identification of her husband's real character. But immediately, she can overcome all her troubles. She stands up herself as a Phoenix. Nora and her sacrificial role made her a successful heroine of the story.

Ibsen's career as a dramatist covers a period of fifty years. Ibsen changes his gaze from Romanticism to the modern realities of the world around him. He discusses contemporary social and family crisis as the subjects of this play. Ibsen selects one of the burning topics for this play. He deals woman's place in the society. It leads to the growing movement for the emancipation of women. His sensible attitude towards women reflects his emotional belief in human freedom and security. *A Doll's House* has been properly structured by Ibsen. The play has only three acts. The plot of the play revolves around

the minimum number of characters. Ibsen introduced two feminine figures in the play. The heroine, Nora and her old friend, Mrs. Christine Linde. Their past and present life is clearly pictured in the first act.

The protagonist, Nora, is guilty of committing forgery, for which she is being tortured mentally by Krogstad. She had undertaken these activities for saving the life of her husband. But Torvald Helmer considered Nora as a liar and criminal. However, she is truly saved by the presence of her old friend, Mrs. Linde, who makes a change in the character of Krogstad. Nora's sense of pride does not allow her to compromise with her husband. Finally, she leaves her home and children to learn the ways of the world. This drama is clearly expressing a personal alienation. It is a showcase of social message. This play is logically connected where characters are clearly delineated and interrelated. He is carefully arranged settings, events and character portrayals. The realistic picturization of his plays, the reliability of his characters, and delicacy of his themes reflect to his photographic skills at which Ibsen so consciously portrayed. Nora Helmer, Torvald Helmer, Krogstad, Mrs. Linde and Dr. Rank are common and ordinary characters. Ibsen introduced them realistically.

A Doll's House advocates the theme of social disintegration and tragedy of modern wife. Nora, the prominent figure of the play loves her family and beautiful house. She is a suffering soul. She is fully acted as the burning candle of her family integration. Nora blindly expects a protective hand from the side of her husband. At the end of the play, she realizes Torvald's hypocritical nature and love for her. He is very ambitious and promoter of his social and family status. He disregards the purposeful deeds of Nora. She is a symbol of a doll for him. He never supports Nora's crime of forgery. Nora makes out the real nature of her husband. She decides to leave her marital life. She says "Listen, Torvald. I have heard that when a wife deserts her husband's house, as I am doing now, he is legally freed from all obligations towards her. In any case, I set you free from all obligations. You are not to feel

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around most slightly, any more than I shall. There must be every freedom on both sides" (Ibsen 80). Thus she leaves the house with a strong mind to overcome all her problems and subjugates of her family life.

The mid-nineteenth century witnessed a new development in realistic play written in prose, which specified on modern human life. Ibsen made the drama of equal significance to the novel as a record and analysis of contemporary life. His characters speak in prose. Their dialogues are natural and common. He avoided the technique of soliloquy and other unnatural devices. Ibsen's characters revealed the study of human hearts and psychology. He introduces an intelligent woman who rebels against social restrictions and wants more life than family life and children. By its setting, characterisation, and realistic dialogue *A Doll's House* belongs to the realistic and feministic type of plays. Ibsen chooses his characters with flesh and blood and weaves them come out with strong social conventions and practices which fetter the liberty of the individuals in society. The play presents the problem and leaves the solution to the characters. It signifies the problem of man-woman relationship through the institution of marriage. It enforces the concept of Gender Inequality in contemporary society.

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BARRIERS TO ONLINE LANGUAGE LEARNING DURING THE PANDEMIC

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Abstract

The English Language is considered as the second Language in India. The mastery of English language is not an easy process. It needs an essential understanding of four skills of a language. Listening, Speaking, Reading and Writing are basic skills of a Language. A person's inability to communicate in a proper way is regarded as a Language barrier. These barriers are absolutely led a person to misunderstand and miscalculate ideas, actions and knowledge. The online classes are not easier than the classes offered in the traditional class room. The online classes require more self-motivation. This learning can be a hard task for the learners. They have to face technical glitches and content queries during these classes. Online language learning barriers prevent free and spontaneous overflow of information and news. The understanding of these four skills of a language enable a person to communicate language with fruitfully. Thus this study tends to focus on the understanding of Listening barriers, Speaking barriers, Reading barriers and Writing barriers. The language barrier is most difficult and obvious barrier now. It demands a herculean task for recording and uploading lectures and seminars. So language barriers to eLearning are not to be ignored.

Keywords: Barrier, Listening Barrier, Speaking Barrier, Reading Barrier and Writing Barrier

Language Barriers are become a hindrance for the effective communication. These barriers can create miscommunications between the communicators. They can make communication more cumbersome. An Online language learning process does not make a good rapport between the people who are sharing together. This study is analysing about the barriers to online Language Learning. English language is a global language. So the learning and understanding of English Language is very essential in the fields of economics, politics, technology and business purposes. This has provided a wide range opportunity for our English speaking people to communicate better with other people. The English language learning is essential for our daily part of communication. Thus English Language barriers can be a challenge for the working people of different states of India.

The students are facing innumerable challenges in Online classes. Hearing loss, lack of clarity and unreliable production of messages are some examples of language learning disabilities. Language is a means of communication. It is an self-expression also. The self-expression demands the physical and mental involvements of the human body. These involvements are not possible in online classes. Our expressions are limited with live screen and power point presentations. The proper communication makes a person to communicate opinions and ideas in a logical and systematic way. So systematic arrangements and time fixations are seemed to be important for these online classes.

The most of the Online classes are seemed to be impersonal. The face to face interaction is the best process of learning. This quality is limited in Online classes. These class communications impact the actual performance of the students. Students can easily show their academic dishonesty in their studies. time conceptions in front of a computer screen may be harmful for learners and teachers in their teaching and learning process.

Listening Barrier

Listening is a skill of understanding the vocal sounds and messages produced by the speaker. Hearing impairments is the main reason behind the breaking of information. Many students are acted to pay attention in the classes. This may be a threatening for Online teaching and learning process. Listening barriers disturb the proper development of listening skills. Ignoring the body language and suprasegmental features such as stress, tone of speech, rising and falling Intonations are also badly affected clear listening process. Our psychological aspects of the human beings can also influence the online listening classes. Common belief system, inculcate values and knowledge, personal and impersonal struggles are also led to poor involvement of listening activities during this time.

Effective listening is clearly an important skill practice now. Business men and employees need effective listening practices to promote their business needs. Both teachers and students need to develop mutual understanding practices for the clarification of the classroom communication in the online classes. Thus Listening barrier becomes an obstacle for the online class room interactions.

Speaking Barrier

Speaking is the productive skill of a language. Fear, lack of confidence, unclear sounds and pronunciations are some speaking barriers of language learning process in India. Students are facing many physical impediments for learning a language. They can not produce the message clearly and regularly. India is a developing country. Most of the students of India are not have proper internet and computer facilities. This may create problems in teaching and learning process. Speaking is an act of producing sounds and messages orally. The teachers of a language may lose their confidence and courage to present their online classes. This pessimistic nature leads to unclear thoughts and information. These emotional troubles are transformed into speaking barriers.

Reading Barrier

Reading skill is a skill of comprehending graphic or written words of a Language. English reading skill is also a complex skill. The ability to make out the story of the chapters, identification of the word and sentence is considered as the sub skills of a reading skill. These key skills are not easy to practice through the online classes. Reading barrier is a barrier which affected the comprehension of written language. A reading skill is mainly supported and promoted by the textbook readings and analyses. In online classes, textbooks are merely performed the secondary roles. In online learning, all classes are limited with worksheets and activities. So students are showing inability to understand how the information fits together in a meaningful way. Online classes are insufficient for the phonological features of the languages. These barriers are absolutely inadequate for Reading.

Students who have difficulty with attention often have problems in reading comprehension. They are facing troubles in their learning material. They are finally disturbed and lost their attention in their studies. Information processing disturbances and Visual processing disturbances are the main reasons behind the reading difficulties. Teacher are also facing to challenges to identify the struggling readers among the students.

Writing Barrier

Writing skill is a spontaneous activity. In online classes, we have to face time and technology limitations. A student cannot connect his ideas with past experiences here. Teacher cannot provide proper motivations through online classes. This may affect the psychological aspects of the learners. Poor parents can not afford to create a smooth environment for their children regularly. These suffering situations are emerging in India now.

In the modern classes, the distractions of digital technology and the demands for multitasking in learning platform leave little opportunity for learners to fully focus on learning. Insufficient explanations and inadequate online facilities dismiss writing activity of children. Limited technological knowledge of students and parents poorly influenced writing skill practices.

Lack of past experience in online classes is a major trouble now. Teachers cannot provide proper motivation through the online classes. So students need not achieve the desired outcomes. Note making and note taking process are traditional writing skill practices. But these traditional practices are not easy to copy in the modern online writing practices. Students don't get any additional help in the writing formations.

It is not easy to make the online course inspiring and interesting. Students want to expand their knowledge through writing practices. They want to create a right environment in e-learning process. Many issues are arisen during the writing practices. Teacher are forced to take assessments and feedbacks for modern technological education process. Writing practices are the most common challenges that e-learning professionals face. Teachers are facing troubles to check spellings and grammatical mistakes. These writing challenges are clearly bounded with teaching and learning process.

Conclusion

Language is the proper means of communication. Language barriers can create many obstacles in communication process. Language is the real process of communication by which the meanings and concepts are perceived and interpreted. But there may be some faults in the Online communication Process that prevents the real message to attain its success. Students are unique because of their idiosyncrasies. This is mainly because of differences in experiences, values and their personalities. Students' feelings and experiences are not easy to communicate properly through the online language learning. This may create many challenges in the field of new digital platform.

A good communication and learning demands perfect coordination and understanding between the sender and the receiver. The Psychology of the two parties are also involved in the communication process. The mutual relationship between the teacher and the students and their environments are important for the success of language learning. In an Online communication process, teachers are communicated students with digital platform. The

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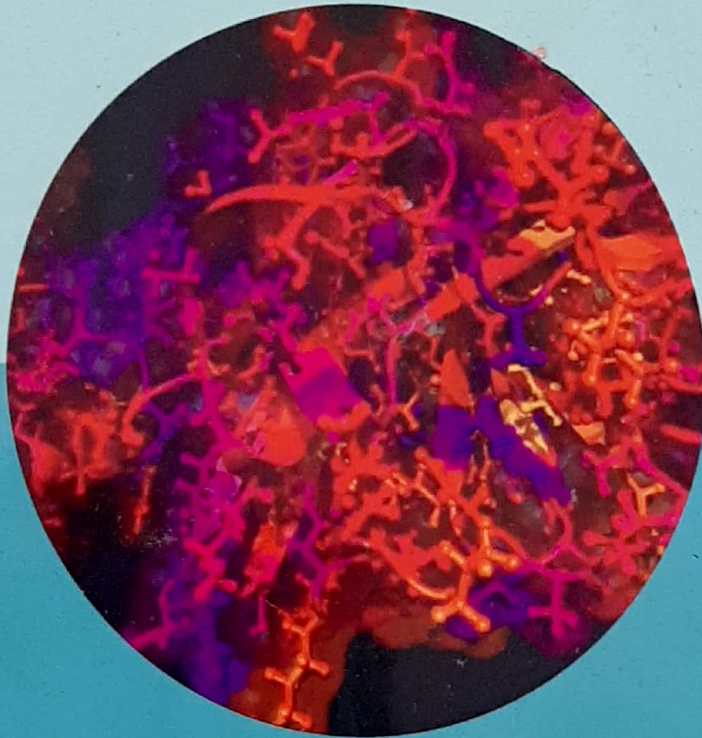
language communication can promote listening and reading for the understandings of the content. It can promote speaking and writing skills for the production and involvement of the good communication. Thus, listening barriers, speaking barriers, reading barriers and writing barriers are obviously regarded as the obstacles of Online language learning process.

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PANDEMIC FRUITION: THE ANIMUS AND THE CONVICTION

Edited by

**Dr. S. Patchainayagi
Dr. V. Vijayalakshmi**

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THE LANGUAGE OF PANDEMIC: THE SPOKEN AND THE UNSPOKEN

Ms. Linda P. Joseph

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Time never stands still. The actuality of existence is such that life moves on and human race somehow adapts to the changes demanded by their temporal and spatial reality. Metaphorically, there are times when 'Time' stands still, leaving the present and bearers of present perplexed, frozen and once way past the phase of initial bewilderment, driven to an existential crisis. Every chapter of history that one may leaf through, attest to the fact that certain phenomenon tend to replicate in due time for due course. Revolutions, dictatorships, wars, rebellion, plague, famine, epidemic, all find a fissure to make their way through the 'ordinariness of human existence' swirling the world into chaos and permanently altered. Each century is marked by this feature of 'recurrence' of one form or other and it somehow 'connects' humans, bygone and existing.

Our race, as history of yesteryears testifies, is not new to pandemics. There has been a number of unfortunate occurrences in the form of plagues and epidemics, a few with no evidence on origin/disputed case of origin and often characterized with confounding nature, that have time and again intruded into the 'normality' of our lives, often changing the entire course of history. The 'fittest' survive, equipped with the power of resilience. Such is the nature of any phenomenon attributed with the epithets of 'unanticipated' or 'unknown' or 'unprecedented'. However all these uncalled for actualities employ a language that essentially communicates to humans certain universal truths and in spite of the mental/physical crisis that each may undergo, advertently or otherwise, they get equipped to cope with these larger truth - the reality of loss, remembrance, survival and hope.

So what is the essential nature of a pandemic and what is subsumed in the experience of one? The word 'pandemic' originates from the Greek word '*pan*', meaning 'all' and '*demos*' meaning 'people' or 'population'. It is the difference in scale or proportion of reach that results in an epidemic becoming pandemic. "Global pandemics with high mortality and morbidity occur when a virulent new viral strain emerges, against which the human population has no immunity" (Rewar et al., 2015).

WHO conceives pandemic as the worldwide spread of a new disease. A pandemic has the potential to 'reach' and 'infect' high proportion of population that may not largely possess immunity against the new disease, thereby reaping havoc at a much faster pace than anticipated. There have been many significant disease outbreaks recorded in history, and the modern century had borne the brunt of a number of virulent influenza pandemics and epidemics such as Spanish Flu (1918), Asian Flu (1957), Kong Flu (1968), Russian Flu (1977), Swine Flu (2009), Ebola, Zika, Covid-19, to name a few deadly of them all.

A pandemic can call for a complete 'lockdown' of our normalcy and thus when the 'uncalled for' happens, it radically alters our perceptions on what we deem as 'normal'. There

is a 'virus-centric thinking' that naturally pervades our conversations and reflections and it somehow becomes pertinent to assume a sense of 'preparedness' to deal with the crisis at hand. When Covid - 19 was first officially reported in 2019 December, it was, for most, an epidemic that involved a 'problem' for people stationed at Wuhan, China. It took mere weeks for the epidemic to shape shift into a pandemic as it assumed severity, spreading far and wide. The present records report that as on July 2, 2020 there are 216 countries /areas/territories with cases, 10, 533, 779 confirmed cases, with 512 842 confirmed deaths and the report varies every day drastically.

This pandemic has changed our lives in ways unanticipated, in the blink of an eye. The language of pandemic is such that it rectifies, re-adapts, and replaces most of the approved / practiced / believed notions, systems and norms. There is a new grammar and vocabulary that we, as of present, are learning to get acquainted with every single day since the official 'lockdown' began in our respective locales. This pandemic has redefined our responsibilities and equally unveiled all the deficiencies that our 'systems' / 'institutions' conceals. There is a visible shift in our mode of communication, novel changes in spheres of education and employment and new dimensions are getting adapted into how we manage a crisis.

There are in effect a number of new terms or re-defined terms that have entered into our dictionary, both literal, as of words and metaphorical, as of existence. Starting from the very name of the disease, Covid -19, which the dictionary by Merriam-Webster delineates as the 'new name for new diseases'- an abbreviated form of corona virus disease 2019, there are various terms that relates to the status of disease diagnosis such as 'index case', 'index patient', 'patient zero', 'contact tracing', 'community spread', 'hot spots' and 'super-spreading', all of which are getting adapted into our sense of familiarity.

Amidst the diverse discussions on how to contain the disease- a few authentic, a few nonsensical, a few misinformed- we could find certain approaches to keep a personal shield against this disease, in the form of social distancing, wearing masks, maintaining hygiene and if required subjecting to imposed/self-quarantine.

All of these changes have impacted our perceptions on all those routine practices. We humans have this congenital craving for contact and closeness which often sustains and grant meaning to our existence. As social beings, our reality and sense of self gets shaped to a larger extend by the 'conversation' we maintain with others in our spheres of action. It is not that communication as a whole has ceased. It is more about the changes incurred in the nature of communication i.e., principally and ironically by way of social distancing. The term, in the present scenario, invokes a sense of solidarity as we collectively assume the responsibility of ensuring the safety of ourselves and fellow beings as with those who choose to subject to quarantine. Quarantine is not an unknown practice; in fact it has been on the go for long as a mechanism to contain the rapid spread of infectious outbreaks, legalized by all jurisdictions to safeguard life. The experience of undergoing quarantine could vary based on our attitude to the same. For some it could be as harnessing and depressing to their morale and desire to live and for some others, a space for 'reflection', often testing and strengthening their ability of resilience.

Studies over a period have informed how detrimental the impact of a lockdown could be on the mental health of people as their movements get controlled and subjected to surveillance. It is taken as a 'violation' of privacy and freedom of movement. The fear of

uncertainty becomes villainous as prospects for better future seems bleak. Above all the obsessive anxiety and compulsive behaviours over the possibility of contracting the diseases gets aggravated if misinformed. Betty Pfefferbaum and Carol S. North, in their article "Mental Health and the Covid-19 Pandemic" points out that "uncertain prognosis, looming severe shortages of resources for testing and treatment and for protecting responders and health care providers from infection, imposition of unfamiliar public health measures that infringe on personal freedoms, large and growing financial losses, and conflicting messages from authorities are among the major stressors that undoubtedly will contribute to widespread emotional distress and increased risk for psychiatric illness associated with covid -19." There are a number of cases cited where people who could not accommodate the idea of 'stay home, stay safe', openly and senselessly protesting in the streets voicing for their 'freedom' and crimes of all sorts become more visible.

In addition to the adverse implications a sudden lockdown could trigger on an individual's choice of action, pandemics and the resultant control measures equally unsettle all other spheres of action on a global scale. Urban centres become the prime target locales of disease spread. As shops, businesses, smaller and larger enterprises cease to operate, it heightens the economic crisis. A number of industries that depends on physical availability of resources equally face a backlash. There is massive scale of unemployment and social disruption that in itself requires due attention. Tourism, transportation, health, education and governance, all faces severe threat as the lack of prospects, inadequacies and divide become apparent.

The language of pandemic is such that it brings out these gaps existing in all spheres, necessitating a change. This pandemic brought to light the often sidestepped reality of the marginalized. In India, the crisis of migrant workers who walked miles to reach their place of residence, without food and means of transportation turned out to be the most projected image of 'lack' and 'deficiency' that we shamefully possess. Most media reports on how disproportionately the pandemic impacts the people, particularly who are displaced and therefore vulnerable. The refugees, both documented and undocumented, find themselves living, in large numbers, cramped into camps or openly in streets with no access to basic services, healthcare or adequate information. This 'divide' between the rich and poor gets more visibility with the less sensible displaying their 'boredom' in being constrained to the 'luxury' of houses/apartments through social media, while a majority on other hand desperately tries to meet their livelihood. On a larger scale the difficulties faced by much poorer nations with weak infrastructure and those governments bearing enormous debts get exacerbated.

This pandemic is not solely a medical issue; it is very much a threat to global security and is a matter of social concern. The commission on a Global Health Risk Framework for the Future (GHRF) in *The Neglected Dimension of Global Security - A Framework to Counter Infectious Diseases Crises*, states thus: "Pandemics cause devastation to human lives and livelihoods much as do wars, financial crises. Pandemic prevention and response, therefore, should be treated as an essential tenet of both national and global security - not just as a matter of health" (Kern, 2016). It is pertinent to better our governance, upgrade our healthcare system, ensure a balanced economy, make optimum utilization of available resources, initiate comprehensive and inclusive networks and educate the mass for the days to come. The situation demands transparency in decisions taken and implemented by the

government for ensuring equity. The situation necessitates all the stakeholders to recheck the availability of resources or invent new alternatives so as to ensure our sustenance. In the sphere of education, the pandemic scenario brought in sound changes as most universities, colleges and schools have commenced adopting the online mode of teaching - learning methodology. There are several technology-backed businesses, sectors such as ed-tech, digital health, online learning platforms, online gaming stacks which are profiting amidst the pandemic scenario.

As is often echoed, there is an initiation into a phase understood as 'new normal' with many adhering to the policies of 'staying home and thus staying safe', 'working from home', and 'gaining education via online'. There is also a conscious effort to reach out, if not physically, to others which confers universality to this experience. As the 'new normal' may soon become too normal in days to come, it is important to not lose touch with the larger truths 'communicated' through this collective experience.

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The flame

Looking at the sun
Flames flared up
Instantly burning myself
without delay, agony begins
Foraged the whole world to quench the heat
Wondered if wild wind could help
It augmented flames twice or thrice.
Ran to a river and drowned deep
Flames shone so bright in it.
Buried under earth to be innocuous
Flora kindled blazes gleamed and glistened.
Rose to the mountain, dipped in snow
vanished all the snowflakes swiftly by.
Alas! The world stood aside.
Couldn't dim the mighty light
Flames flared fierce and ferocious
With hope in heart,
I walked alone to the stars.

Haiku poems

Look to your left
Look to your right
Get ready for the battle.

Close your eyes
Look!
See the light within.

A puddle,
Jump in-
Splash!

Dreams wandering
alone,
along the moor.

Hey you,
Get out of the way
IT'S COMING!

Spiders, relax
My house
is yours too.

Fish:
out of water
could play with the bee.

Cold autumn
in the twilight rain
I stood.

Cry of birth
Whimper of death
The night is brief.

I killed a fly
turned around,
froze.

Keerthy Sophiya P.



Mrs. Keerthy Sophiya Ponnachan, hailing from Thrissur, Kerala works as an Assistant Professor in the Department of English at Carmel College, Mala. She has showcased her talent in acting, modeling compeering and dubbing. She has always been a creative soul and has excelled both in academic and nonacademic fields since her childhood. Her motto is to never give up in life and to work consistently towards your dreams. She is extremely passionate about literature and her teaching career. She has handled a number of extension and consultancy classes for both students and teachers. Her dream is to uplift the women in rural area through education and make them self-sufficient to support their family. She is currently pursuing her Ph.D. at Vimala College, Thrissur. She is married to Mr. Vinod Paul and now she is a mother of two baby boys.

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ബോധനം

ആഖ്യാനങ്ങൾക്കുമപ്പുറം

എഡിറ്റർ :
മിഥുൻ കെ എസ്



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ബാല്യാവിഷ്കാരവും പരിസ്ഥിതിസങ്കല്പവും 'ദൈവത്തിന്റെ കണ്ണി'ൽ - ഒരു പഠനം

ഡോ. മെറിൻ ഫ്രാൻസിസ്

മലയാളസാഹിത്യചരിത്രത്തിൽ പാരിസ്ഥിതികബോധത്തിന് അദ്വിതീയമായ സ്ഥാനമുണ്ട്. രചനാസങ്കേതമായും പ്രമേയപശ്ചാത്തലത്തിനു സ്വാഭാവികതയും മനോഹാരിതയും സൃഷ്ടിക്കുന്ന സൗന്ദര്യഘടകമായും പലവിധത്തിൽ പ്രകൃതി അവിടെ ലയിച്ചു കിടക്കുന്നു. പ്രകൃത്യനുഭവമായ ഈ അവബോധം ആർഷസംസ്കാരാർജ്ജിതമാണെന്നുതന്നെ പറയാം. നഷ്ടപ്പെടുപോയ പാരിസ്ഥിതികലാവണ്യത്തേയും പ്രകൃതിയുടെ സുരക്ഷയേയും തിരികെ കണ്ടെത്താൻ വെമ്പുന്ന സർഗ്ഗസാഹിത്യത്തിന്റെ മഹത്തായ ശ്രമങ്ങൾകൊണ്ട് സമ്പന്നമാണ് മലയാളനോവൽ. ഇന്നും അതിനായുള്ള ശ്രമങ്ങൾ നാം വളരെ കാര്യക്ഷമമായി രചനകളിൽ ഉൾച്ചേർക്കുന്നു. ആവർത്തിച്ചുവരുന്ന പ്രളയമായും മറ്റും, പ്രകൃതി നമുക്കുമേൽ തിരിച്ചടികൾ നൽകുന്ന ഈ വർത്തമാനകാലസാഹചര്യത്തിൽ, പ്രകൃതിയേയും അതിൽനിന്നും അടർത്തിയെടുക്കാനാകാത്ത സംസ്കൃതിയേയും കുറിച്ചുള്ള നിഗൂഢമായ സൗന്ദര്യാനുഭവങ്ങൾക്ക് ജീവൻനൽകുന്ന ഏതാനും മലയാളനോവലുകൾ കാലത്തെ അതിജീവിച്ചും നമ്മുടെ സംവേദനമണ്ഡലത്തിൽ സവിശേഷസ്ഥാനം അലങ്കരിക്കുന്നതിന്റെ പ്രസക്തി ഇവിടെ വ്യക്തമാകുന്നു. മനുഷ്യനും പ്രകൃതിയും തമ്മിലുള്ള വൈകാരിക ബന്ധത്തിന്റെ നിർമ്മല പരിവേഷം വായനക്കാരനിലേക്കു പകർന്നു അത്തരമൊരു നോവലാണ് എൻ.പി. മുഹമ്മദിന്റെ 'ദൈവത്തിന്റെ കണ്ണി'. പരിസ്ഥിതി മൂല്യാധിഷ്ഠിതമായ സവിശേഷ ആഖ്യാനതന്ത്രങ്ങളും

സൗന്ദര്യാത്മകമായ ഇതിവൃത്താവിഷ്കരണവും പരസ്പരപൂരകങ്ങളായി വർത്തിക്കുന്ന ഈ നോവലിൽ ജീവാത്മാ- പരമാത്മാ ബന്ധത്തിന്റെ നിഗൂഢതലങ്ങളും ക്രിയാത്മകമായി ഒത്തുചേരുന്നു.

പരിസ്ഥിതി എന്ന ആശയത്തിന്റെ പരിധികൾ അനന്ദിനം വിപുലമായിക്കൊണ്ടിരിക്കുന്നു. പ്രകൃതിയും സംസ്കാരവും ഒരേ നാണയത്തിന്റെ ഇരുവശങ്ങളാണെന്നും പാർശ്വവത്ക്കരിക്കപ്പെടുന്ന ഇവരണ്ടും വീണ്ടെടുക്കപ്പെടേണ്ടവയുമാണെന്നുമുള്ള ശക്തമായ ആന്തരികചിന്ത നോവലിന്റെ വായനാനുഭവമായി എന്നും നിലനിൽക്കുന്നു. തുറന്ന കാഴ്ചകളിലൂടെയും വ്യക്തമായ കേൾവികളിലൂടെയും അനുഭവങ്ങളെ സ്വായത്തമാക്കുന്ന ബാല്യത്തിന്റെ കാഴ്ചപ്പാടുകൾ നോവലിൽ നിർണ്ണായകമാണ്. സൂര്യനെ ദൈവത്തിന്റെ കണ്ണായി സങ്കല്പിക്കുന്ന നിഷ്കളങ്കനായ അഹമ്മദ് എന്ന ബാലനിലൂടെയാണ് ഇവിടെ ആഖ്യാനം മുന്നേറുന്നത്. മിസ്റ്റിക് പ്രകൃതി സങ്കല്പത്തോടൊപ്പം മലബാർ മുസ്ലീങ്ങളുടെ സാമൂഹിക-സാംസ്കാരിക പരിതസ്ഥിതികളെക്കൂടി വരച്ചിടാൻ എൻ.പി. മുഹമ്മദിന് ശക്തമായി സാധിച്ചു. ആഖ്യാനതലത്തിന്റെ വൈവിധ്യമാർന്ന വേഷപ്പകർച്ചകളിൽ ഇതൾവിരിയുന്ന അതീന്ദ്രിയമായ പ്രപഞ്ചസങ്കല്പങ്ങൾ എത്ര വിചിത്രമാണെന്ന തിരിച്ചറിവ് ഇവിടെ നമുക്ക് ലഭിക്കുന്നു.

പ്രകൃതിയോടിണങ്ങിയ പ്രമേയമായതിനാൽ നോവലിൽ ബാലാഖ്യാനമെന്ന ആഖ്യാനതന്ത്രത്തിന് ഏറെ പ്രസക്തിയുണ്ട്. പരിസ്ഥിതിയിലുൾച്ചേർന്ന ജീവചൈതന്യത്തെ കണ്ടെത്താൻ ബാലമനസ്സിന്റെ നിഷ്കളങ്കതയ്ക്കു ശക്തമായി അവിടെ സാധിക്കുന്നു. ബാല്യത്തിന്റെ ബോധമണ്ഡലവുമായി ഇണങ്ങിച്ചേരുന്ന ഭാവനകളുടെ വിശാലതനമ്മെ അതിശയിപ്പിക്കുന്നു. ഇതിനുദാഹരണങ്ങളാണ്, പടച്ചോന്റെ കണ്ണാണ് സൂര്യൻ, തന്തപ്പിലാവ് അല്ലാഹു പിടിച്ച കടയാണ്, മുളയിലകൾ കൈവിരലുകൾ പോലെയാണ്, വളഞ്ഞ മൂക്കു പോലെയാണ് പച്ചണ്ടി, ആകാശത്ത് ആരോ ചൂട്ടുവീശുന്നതാണ് ഇടിമിന്നൽ എന്നീ പ്രയോഗങ്ങൾ.

പ്രകൃതിക്കനേരെയുള്ള ജിജ്ഞാസ കലർന്ന ഒട്ടനേകം ചോദ്യങ്ങളും അഹമ്മദെന്ന ബാലനാണ്. പ്രകൃതിയിലെ വിസ്മയങ്ങളെ ബാല്യത്തിന്റെ നിറങ്ങളാൽ വരച്ചെടുക്കാൻ നോവലിസ്റ്റിനു കഴിഞ്ഞിരിക്കുന്നതിന്റെ ശക്തമായ ഉദാഹരണം 'പടച്ചോന്റെ കണ്ണായ സൂര്യൻ തന്നെ'. പ്രകൃതിസൗന്ദര്യത്തിൽ മുഴുകിനടക്കുന്ന അഹമ്മദിന്റെ ഭാവന ചിരകവിരിയുന്നത് പ്രകൃതിയെ തൊട്ടെടുക്കുന്ന അവന്റെ സുന്ദരമായ വർണ്ണനകളിലൂടെയാണ്. പുല്ലിലും പുഴുവിലും പ്രകൃതിയുടെ നിഗൂഢചൈതന്യത്തെ ദർശിക്കാൻ അവനെ പ്രാപ്തനാക്കിയ അലൗകിക ചൈതന്യം പ്രപഞ്ചം തന്നെയാണ്. അവൻ നടത്തുന്ന വർണ്ണനകൾ ഇതിനു തെളിവാണ്. കോഴിക്കോട്ടുനിന്നും പരപ്പനങ്ങാടിയിലേക്കു എത്തിച്ചേർന്നതിനുശേഷം അവനെ സ്വീകരിച്ചത് പ്രകൃതിയുടെ വിസ്മയങ്ങളാണ്.

പച്ചവിരിപ്പിട്ട നെൽപ്പാടം, കവുങ്ങും മാവും തെങ്ങും നിറഞ്ഞ തൊടികൾ, പാടത്തെ വയൽവരമ്പിൽകൂടി കൂട്ടുകാരൊത്ത് പുഴയിൽ കുളിക്കാൻ പോകുന്ന ആരാവാരം, പരന്ന കുടപോലെയുള്ള വരിക്കപ്പിലാവ്. കിണറ്റിനു മുമ്പിൽ ആകാശം തൊടുന്ന മാവ്, ആകാശത്തു നിന്നും മഴ, മഴക്കമ്പികളായി താഴെ വീഴുന്നു എന്നീ നിരീക്ഷണങ്ങൾ ശ്രദ്ധിക്കുക.

നിഷ്കളങ്കമായ ജിജ്ഞാസയിൽ നിന്നുയിർക്കൊള്ളുന്ന പ്രകൃതി നിരീക്ഷണങ്ങളും രസകരങ്ങളാണ്. തന്തപ്പിലാവു കുടവിരിച്ചതു പോലെയൊന്നും വർണ്ണിക്കുന്ന അഹമ്മദിൽ, അതു പിടിക്കുന്നതാരാണെന്നു സംശയമുണ്ടാകുന്നു. വെള്ളം ആകാശത്തുനിന്നും മഴയായി ചാടുന്നതിനെപ്പറ്റി അനേകം നിരീക്ഷണങ്ങൾ അവൻ രൂപപ്പെടുത്തിയിരിക്കുന്നു. പ്രകൃതിയിലെ ഏറ്റവും ചെറിയ ജീവിക്കുപോലും അതിന്റേതായ വലിയ വിലയുണ്ടെന്നുള്ള പരിസ്ഥിതിബോധത്തിന്റെ കാതലായ ചിന്ത ഈ നോവലിന്റെ ജീവധാരയായി വർത്തിക്കുന്നു. പയറിനു തടം കോരുന്നതിനിടയിൽ ഞാണ്ടുളിനു മുറിവേറ്റപ്പോഴും കറിവെയ്ക്കാനായി കോഴിയെ കൊല്ലുമ്പോഴും അവൻ വേദനിച്ചു. പുതങ്ങൾ മണ്ണിനടിയിലാണെങ്കിലും മഴ പെയ്താൽ അവ നനയില്ലേയെന്ന്

അവൻ വ്യാകുലപ്പെട്ടു. മഴ വാ പൂട്ടാതെ കരഞ്ഞാൽ കിതച്ചു പോകി
ല്ലേ? എന്ന സംശയവും നിഷ്കളങ്ക മനസിന്റേതാണ്.

ബാലാഖ്യാനത്തിലൂടെ അനാവൃതമാകുന്ന നിഷ്കളങ്കമായ പ്രകൃ
തിസങ്കല്പങ്ങൾ, ഇനിയും മനുഷ്യൻ തിരിച്ചറിയേണ്ട ഗഹനങ്ങളായ
അനേകം അർത്ഥതലങ്ങളിലേക്കാണ് വിരൽ ചൂണ്ടുന്നത്. പ്രകൃതിയും
മനുഷ്യനും തമ്മിലുണ്ടാകേണ്ട അനിവാര്യമായ ഒരു വിശുദ്ധ ഐക്യ
സങ്കല്പമാണ് ദൈവത്തിന്റെ കണ്ണ് നമുക്കു മുന്നിൽ അവതരിപ്പിക്കുന്നത്.
കേരളത്തിലെ പരിസ്ഥിതി പ്രവർത്തനപ്രസ്ഥാനങ്ങളുടെ ചരിത്രത്തിൽ
പ്രത്യക്ഷമായും പരോക്ഷമായും പലരും കൂട്ടിച്ചേർത്ത് വായിച്ച ഈ
നോവൽ സമർപ്പിക്കപ്പെട്ടിരിക്കുന്നത്, പരിസ്ഥിതിനാശത്തിൽ
ഉത്കണ്ഠപ്പെടുന്നവർക്കാണ്. ബാല്യത്തോടുൾച്ചേർന്നുകൊണ്ട് പ്രകൃ
തിയുടെ മാനവിക ചൈതന്യത്തെ മുർത്തമായി കണ്ടെടുക്കാനാണ്
എൻ.പി. മുഹമ്മദ് ഈ സാഹിത്യസൃഷ്ടിയിൽ ശ്രമിച്ചത്. ഒ.എൻ.
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തീവ്രമായ ഉത്കണ്ഠകളിലൊന്ന് പരിസ്ഥിതിയെക്കുറിച്ചായിരുന്നു
എന്ന സ്വന്തം തിരിച്ചറിവ് സർഗ്ഗാത്മകമായി രൂപം കൊണ്ടതാണ്'
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പ്രകൃതിയുടെയും നൈസർഗ്ഗികതകളെ തമ്മിൽ ഐക്യപ്പെടുത്തിയ
ഈ ഒരു നിർമ്മല ജീവിതദർശനം ആവിഷ്കരിച്ചതിലൂടെ ശുദ്ധമായ
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ഗ്രന്ഥസൂചി

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Category of Chain Bundles



P. G. Romeo and Riya Jose

Abstract In this paper, we describe the category of chain bundles $\mathcal{CB}_{\mathcal{C}}$ in a category \mathcal{C} with zero object. The objects of $\mathcal{CB}_{\mathcal{C}}$ are

$$\cdots M_{i+1} \rightrightarrows M_i \rightrightarrows M_{i-1} \cdots \rightrightarrows M_0 = \mathbf{0}$$

where $M_i \in \nu\mathcal{C} \ \forall i$ and $\overset{Hom(M_{i+1}, M_i)}{\rightrightarrows}$ denotes the homset $Hom(M_i, M_j)$; in particular, the homsets includes sets of the form $Hom(M_i, M_i)$ and all possible composite of morphisms in \mathcal{C} . The morphisms in this category are appropriate maps (functors) between objects of $\mathcal{CB}_{\mathcal{C}}$ called chain bundle maps.

Keywords Category · Subobject · Chainbundle · Cochain bundle · Chain bundle map · Factorization · Category of chains

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Category theory gained an important position in present-day mathematics. It is a powerful tool which is still developing and it helps us to see the universal components of a family of structures of a given kind and how structures of different kinds are interrelated. Categories were introduced by Samuel Eilenberg and Saunders Mac Lane in the year 1945. Here, we are discussing certain categories which are termed as category of chain bundles. There are various situations we come across chains (sequences of objects and morphisms) in mathematics. In this paper, we introduce the category of chain bundles with an aim to include all situations dealing with chains in a general categorical frame work.

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In first section, we provide all basic terminology and results regarding categories, and in the second section, we define chain bundles and construct category of chain bundles. It is also shown that this category is with subobjects and has subcategory with factorization. In third section, preorder chains which are obtained from category of chain bundles, and in the last section some categorical properties of category of chain bundles are discussed.

1 Preliminaries

In the following, we briefly recall some basic notions related to category theory and go through category with subobjects.

Definition 1 A category \mathcal{C} consists of the following data:

1. a class $\nu\mathcal{C}$ called the class of vertices or objects
2. a class \mathcal{C} of disjoint sets $\mathcal{C}(a, b)$, one for each pair $(a, b) \in \nu\mathcal{C} \times \nu\mathcal{C}$, an element $f \in \mathcal{C}(a, b)$ is called a morphism (arrow) from a to b , written $f : a \rightarrow b$; $a = \text{dom } f$ and $b = \text{cod } f$.
3. For $a, b, c \in \nu\mathcal{C}$, a map

$$\circ : \mathcal{C}(a, b) \times \mathcal{C}(b, c) \rightarrow \mathcal{C}(a, c)$$

$$(f, g) \rightarrow f \circ g$$

called the composition of morphisms in \mathcal{C} .

4. For each $a \in \nu\mathcal{C}$, a unique $1_a \in \mathcal{C}(a, a)$ is called the identity morphism on a .

These must satisfy the following axioms:

Cat1: The composition is associative: for $f \in \mathcal{C}(a, b)$, $g \in \mathcal{C}(b, c)$ and $h \in \mathcal{C}(c, d)$ we have

$$f \circ (g \circ h) = (f \circ g) \circ h$$

Cat2: For each $a \in \nu\mathcal{C}$, $f \in \mathcal{C}(a, b)$, $g \in \mathcal{C}(c, a)$

$$1_a \circ f = f \text{ and } g \circ 1_a = g$$

We can identify $\nu\mathcal{C}$ as a subclass of \mathcal{C} . With this identification, it is possible to define categories in terms of morphisms(arrow) alone. The category \mathcal{C} is said to be small if the class \mathcal{C} is a set.

For any category \mathcal{C} an opposite category denoted as \mathcal{C}^{op} may be defined as follows:

$$\nu\mathcal{C}^{op} = \nu\mathcal{C}, \mathcal{C}^{op}(a, b) = \mathcal{C}(b, a) \forall a, b \in \nu\mathcal{C}$$

and the composition $*$ in \mathcal{C}^{op} is given by

$$g * h = h \circ g \forall g, h \in \mathcal{C}^{op} = \mathcal{C}$$

for which $h \circ g$ is defined.

- Example 1** (1) **Set**: the category in which vertices are sets and morphisms are maps.
 (2) **Grp**: the category in which vertices are groups and morphisms are homomorphisms.
 (3) **Mod_R**: vertices are right R -modules and morphisms are R homomorphisms.
 (4) **Cat**: vertices are (small) categories and morphisms are (small) functors.

Definition 2 A covariant functor $F : \mathcal{C} \rightarrow \mathcal{D}$ from a category \mathcal{C} to a category \mathcal{D} consists of a *vertex map* $\nu F : \nu\mathcal{C} \rightarrow \nu\mathcal{D}$ which assigns to each $a \in \nu\mathcal{C}$, a vertex $\nu F(a) \in \nu\mathcal{D}$ and a *morphism map* $F : \mathcal{C} \rightarrow \mathcal{D}$ which assigns to each morphism $f : a \rightarrow b$ in \mathcal{C} , a morphism $F(f) : \nu F(a) \rightarrow \nu F(b) \in \mathcal{D}$ such that

$$Fn.1. F(1_a) = 1_{\nu F(a)} \forall a \in \nu\mathcal{C}$$

$Fn.2. F(f)F(g) = F(fg)$ for all morphisms $f, g \in \mathcal{C}$ for which the composite fg exists.

F is a contravariant functor if νF is as above and the morphism map assigns to each $f : a \rightarrow b$ in \mathcal{C} , a morphism $F(f) : \nu F(b) \rightarrow \nu F(a) \in \mathcal{D}$ such that they satisfy axiom $Fn.1.$ and $Fn*.2.$, i.e., $F(g)F(f) = F(fg)$ for all morphisms $f, g \in \mathcal{C}$ for which the composite fg exists.

Example 2 A category \mathcal{D} is a subcategory of a category \mathcal{C} if the class \mathcal{D} is a subclass of \mathcal{C} and the composition in \mathcal{D} is the restriction of the composition in \mathcal{C} to \mathcal{D} . In this case, the inclusion $\mathcal{D} \subseteq \mathcal{C}$ preserves composition and identities and so represents a functor of \mathcal{D} to \mathcal{C} which is called the *Inclusion functor* of \mathcal{D} into \mathcal{C} .

Definition 3 A morphism f in a category \mathcal{C} is a monomorphism if

$$gf = hf \Rightarrow g = h \forall g, h \in \mathcal{C}$$

and a morphism f in \mathcal{C} is called a split monomorphism if it has a right inverse. Every morphism in a concrete category whose underlying function is an injection is a monomorphism. A morphism f in a category \mathcal{C} is an *epimorphism* if

$$fg = fh \Rightarrow g = h \forall g, h \in \mathcal{C}$$

and a morphism f in \mathcal{C} is called a split epimorphism if it has a left inverse. Every morphism in a concrete category whose underlying function is a surjection is an epimorphism.

Definition 4 A *Preorder* \mathcal{P} is a category such that for any $p, p' \in \mathcal{P}$, $\mathcal{P}(p, p')$ contains at most one morphism. In this case, the relation \subseteq on the class $\nu\mathcal{P}$ defined by

$$p \subseteq p' \Leftrightarrow \mathcal{P}(p, p') \neq \emptyset \tag{1}$$

is a quasiorder. When \mathcal{P} is a preorder, $\nu\mathcal{P}$ will stand for the quasiordered class $(\nu\mathcal{P}, \subseteq)$. Conversely given a quasiorder \leq on the class X , the subset

$$\mathcal{P} = \{(x, y) = \in X \times X : x \leq y\}$$

of $X \times X$ is a preorder such that the quasiordered class $\nu\mathcal{P}$ defined above is order isomorphic with (X, \leq) . If the relation \subseteq on \mathcal{P} is antisymmetric then we shall say that \mathcal{P} is a *strict preorder*.

Definition 5 Let \mathcal{C} be a category. A choice of subobjects in \mathcal{C} is a subcategory $\mathcal{P} \subseteq \mathcal{C}$ satisfying the following:

- (a) \mathcal{P} is a strict preorder with $\nu\mathcal{P} = \nu\mathcal{C}$.
- (b) Every $f \in \mathcal{P}$ is a monomorphism in \mathcal{C} .
- (c) If $f, g \in \mathcal{P}$ and if $f = hg$ for some $h \in \mathcal{C}$ then $h \in \mathcal{P}$.

When \mathcal{P} satisfies these conditions, the pair $(\mathcal{C}, \mathcal{P})$ is called a category with subobjects.

When \mathcal{C} has subobjects, unless explicitly stated otherwise, $\nu\mathcal{C}$ will denote the choice of subobjects in \mathcal{C} . The partial order defined by equation (1) is called the preorder of inclusions or subobject relation in \mathcal{C} and is denoted by \subseteq . If $c, d \in \nu\mathcal{C}$ and $c \subseteq d$ the unique morphism from c to d is the inclusion $j_c^d : c \rightarrow d$.

Example 3 In categories $Set, Grp, Vect_K, Mod_R$ the relation on objects induced by the usual set inclusion is a subobject relation.

Definition 6 A morphism f in a category \mathcal{C} with subobjects is said to have *factorization* if f can be expressed as $f = pm$ where p is an epimorphism and m is an embedding.

Factorization of a morphism need not be unique. Every morphism f with factorization has atleast one factorization of the form $f = qj$ where q is an epimorphism and j is an inclusion. Such factorizations are called *canonical factorization*. A category \mathcal{C} is *category with factorization* if \mathcal{C} has subobjects and if every morphism in \mathcal{C} has factorization. The category has *unique factorization property* if every morphism in \mathcal{C} has unique canonical factorization.

Example 4 If $f : X \rightarrow Y$ is a mapping of sets and $f(X) = Imf$ the $f(X) \subseteq Y$ and we can write $f = f^0 j_{f(X)}^Y$. Here f^0 denote the mapping of X onto $f(X)$ determined by f . Since surjective mappings are epimorphisms in Set , this gives a canonical factorization of f in Set which is clearly unique. Thus Set is a category with unique factorization.

Example 5 Since surjective continuous mappings are epimorphisms in Top , it follows as above example that this category has factorization property. However, if Y is dense in X , $h = j_Y^X$ is an epimorphism in Top and $h = 1_Y j_Y^X = j_Y^X 1_X$. Then both $1_Y j_Y^X$ and $j_Y^X 1_X$ are canonical factorizations of h in Top . Thus Top doesnot have unique factorization property.

Proposition 1 Let \mathcal{C} be category with factorization. Suppose that the morphism $f \in \mathcal{C}$ has the following property:

(*Im.*) f has a canonical factorization $f = xj$ such that for any canonical factorization $f = yj'$ of f , there is an inclusion j'' with $y = xj''$. Then the factorization $f = xj$ is unique.

Remark 1 A morphism f in a category with factorization is said to have *image* if f satisfies the condition (*Im*) of the proposition above. In this case, the unique canonical factorization $f = xj$ with the property (*Im*) is denoted by $f = f^0j_f$ where f^0 is called the *epimorphic component* of f and j_f is called the *inclusion* of f . The unique vertex $Imf = codf^0 = domj_f$ is called the *image* of f . Since categories *Set*, *Grp*, etc., has unique factorization, morphisms in these categories have images. Though the category *Top* doesnot have unique factorization, it can be seen that every morphism in *Top* also has image.

Definition 7 A groupoid \mathcal{G} is a small category in which every morphism is an isomorphism. A groupoid \mathcal{G} is said to be connected if for all $a \in \nu\mathcal{G}$, $H_a = \mathcal{G}(a, a) \neq \phi$.

Example 6 Every group G is a groupoid with exactly one vertex.

Definition 8 A bundle is a triple (E, p, B) , where $p : E \rightarrow B$ is a map. The space E is called *base space*, the space B is called the *total space*, and the map p is called the *projection* of the bundle. For each $b \in B$, the space $p^{-1}(b)$ is called the *fibres* of the bundle over $b \in B$.

Example 7 The empty function defines a bundle.

Example 8 Product bundle over B with fibre F is $(B \times F, p, B)$, where p is the projection on the first factor.

2 Category of Chain Bundles

Let \mathcal{C} be a category with zero. Here the category of chains as well as the category of chain bundles in \mathcal{C} are described and it is shown that when the category \mathcal{C} is with subobjects and factorization, the category of chain bundles is also a category with subobjects and having a subcategory admitting factorization.

Definition 9 Let \mathcal{C} be category with zero. A chain in the category \mathcal{C} is of the form

$$\cdots M_3 \rightrightarrows M_2 \rightrightarrows M_1 \rightrightarrows M_0 = \mathbf{0}$$

where $M_i \in \nu\mathcal{C} \ \forall i$ and \rightrightarrows denotes the homset $Hom(M_{i+1}, M_i)$. Chain also consists of all homsets of the form $Hom(M_i, M_i)$ and all possible composite of morphisms. A chain in category \mathcal{C} is a subcategory of \mathcal{C} .

A cochain in a category \mathcal{C} is a subcategory of the form

$$0 = M_0 \rightrightarrows M_1 \rightrightarrows M_2 \rightrightarrows M_3 \cdots$$

Definition 10 A chain map between two chains in \mathcal{C} is a functor F between the two whose vertex map $\nu F = \{f_i : M_i \rightarrow N_i\}$ is a sequence of morphisms in \mathcal{C} and morphism map is a map between homsets of \mathcal{C} , such that resulting diagram commutes

$$\begin{array}{ccccccc} \cdots & \rightrightarrows & M_3 & \rightrightarrows & M_2 & \rightrightarrows & M_1 & \rightrightarrows & 0 \\ & & f_3 \downarrow & & \downarrow f_2 & & \downarrow f_1 & & \downarrow f_0 \\ \cdots & \rightrightarrows & N_3 & \rightrightarrows & N_2 & \rightrightarrows & N_1 & \rightrightarrows & 0 \end{array}$$

Similarly, we can define cochain map.

A **category of chains** is a category whose objects are chains in \mathcal{C} and morphism between two chains are chain maps. We denote this category by \mathcal{C}_C . Note that each triple (M_i, p, M_j) where $p \in Hom(M_i, M_j)$ in

$$\cdots M_3 \rightrightarrows M_2 \rightrightarrows M_1 \rightrightarrows M_0 = 0$$

forms a bundle and from here onwards we call the chain, a **chain bundle**. The chain map between two chain bundles are called **chain bundle map**.

Definition 11 Let \mathcal{C} be a category with zero. A category whose objects are chain bundles in \mathcal{C} and morphism between two chain bundles are chain bundle maps is called a category of chain bundles. We denote this category as \mathcal{CB}_C

Example 9 \mathcal{C} be the category of submodules of \mathbb{Z} and \mathcal{CB}_C be category of chain bundles in \mathcal{C} . Consider the two chain bundles

$$3\mathbb{Z} \xrightarrow{\frac{2}{3}a} 2\mathbb{Z} \xrightarrow{\frac{5}{2}b} 5\mathbb{Z} \xrightarrow{0} 0 \quad \text{and} \quad 6\mathbb{Z} \xrightarrow{\frac{2}{3}a'} 4\mathbb{Z} \xrightarrow{\frac{1}{4}b'} \mathbb{Z} \xrightarrow{0} 0$$

A morphism F between these to chain bundles is as follows:

$$\begin{array}{ccccccc} 3\mathbb{Z} & \xrightarrow{\frac{2}{3}a} & 2\mathbb{Z} & \xrightarrow{\frac{5}{2}b} & 5\mathbb{Z} & \xrightarrow{0} & 0 \\ 2 \downarrow & & \downarrow 2 & & \downarrow \frac{1}{5} & & \downarrow 0 \\ 6\mathbb{Z} & \xrightarrow{\frac{2}{3}a'} & 4\mathbb{Z} & \xrightarrow{\frac{1}{4}b'} & \mathbb{Z} & \xrightarrow{0} & 0 \end{array}$$

$$\nu F(3\mathbb{Z}) = 6\mathbb{Z}, \nu F(2\mathbb{Z}) = 4\mathbb{Z}, \nu F(5\mathbb{Z}) = 2\mathbb{Z}, \nu F(0) = 0$$

$$F\left(\frac{2}{3}a\right) = \frac{2}{3}a, F\left(\frac{5}{2}b\right) = \frac{1}{4}b, F(0) = 0.$$

Another morphism G between these to chain bundles is as follows:

$$\begin{array}{ccccccc}
 3\mathbb{Z} & \xrightarrow{\frac{2}{3}a} & 2\mathbb{Z} & \xrightarrow{\frac{5}{2}b} & 5\mathbb{Z} & \xrightarrow{0} & \mathbf{0} \\
 4\downarrow & & \downarrow 4 & & \downarrow \frac{2}{5} & & \downarrow 0 \\
 6\mathbb{Z} & \xrightarrow{\frac{2}{3}a'} & 4\mathbb{Z} & \xrightarrow{\frac{1}{4}b'} & \mathbb{Z} & \xrightarrow{0} & \mathbf{0}
 \end{array}$$

$$\nu G(3\mathbb{Z}) = 6\mathbb{Z}, \nu G(2\mathbb{Z}) = 4\mathbb{Z}, \nu G(5\mathbb{Z}) = 2\mathbb{Z}, \nu G(\mathbf{0}) = \mathbf{0}$$

$$G\left(\frac{2}{3}a\right) = \frac{2}{3}a, G\left(\frac{5}{2}b\right) = \frac{1}{4}b, G(0) = 0.$$

Remark 2 The two morphisms in the above example are same when considered as functors but are different when considered as chain bundle maps.

Example 10 \mathcal{C} be category of subgroups of symmetric group S_3 and $\mathcal{CB}_{\mathcal{C}}$ be the category of chain bundles in \mathcal{C} . Consider the two chain bundles

$$S_3 \xrightarrow{0} A_3 \xrightarrow{0} \mathbf{0} \quad \text{and} \quad K \xrightarrow{Hom(K, S_3)} S_3 \xrightarrow{0} \mathbf{0}$$

$K = \{e, (2, 3)\} \subset S_3$. A morphism F between these to chain bundles is as follows:

$$\begin{array}{ccccc}
 S_3 & \xrightarrow{0} & A_3 & \xrightarrow{0} & \mathbf{0} \\
 0\downarrow & & \downarrow p & & \downarrow 0 \\
 K & \xrightarrow{Hom(K, S_3)} & S_3 & \xrightarrow{0} & \mathbf{0}
 \end{array}$$

$\nu F(S_3) = K, \nu F(A_3) = S_3, \nu F(\mathbf{0}) = \mathbf{0}$. p can be any morphism from A_3 to S_3 . The map $0 : S_3 \rightarrow A_3$ can be mapped to any $g : K \rightarrow S_3$.

Example 11 Consider category of chain bundles \mathcal{CB}_{Vect_K} of the category of vector

spaces. $c : \mathbb{R}^2 \xrightarrow{\begin{bmatrix} a \\ b \end{bmatrix}} \mathbb{R} \xrightarrow{0} \mathbf{0}$ and $d : \mathbb{R}^3 \xrightarrow{\begin{bmatrix} a \\ b \\ c \end{bmatrix}} \mathbb{R} \xrightarrow{0} \mathbf{0}$ are two chain bundles in \mathcal{CB}_{Vect_K} .

A morphism F between c and d is as follows:

$$\begin{array}{ccccc}
 \mathbb{R}^2 & \xrightarrow{\begin{bmatrix} a \\ b \end{bmatrix}} & \mathbb{R} & \xrightarrow{0} & \mathbf{0} \\
 f_3\downarrow & & \downarrow f_2 & & \downarrow 0 \\
 \mathbb{R}^3 & \xrightarrow{\begin{bmatrix} a \\ b \\ c \end{bmatrix}} & \mathbb{R} & \xrightarrow{0} & \mathbf{0}
 \end{array}$$

Any $T \in Hom(\mathbb{R}^2, \mathbb{R})$ is a linear transformation

$$T \begin{bmatrix} x & y \end{bmatrix} = \begin{bmatrix} x & y \end{bmatrix} \begin{bmatrix} a \\ b \end{bmatrix} = ax + by$$

and $T' \in Hom(\mathbb{R}^3, \mathbb{R})$ is a linear transformation

$$T [x \ y \ z] = [x \ y \ z] \begin{bmatrix} a \\ b \\ c \end{bmatrix} = ax + by + cz.$$

F has the vertex mapping $(f_3, f_2, 0)$, where f_3 is the linear transformation given by

$$f_3 [x \ y] = [x \ y] \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} = [x \ y \ 0]$$

and f_2 is the linear transformation given by

$$f_2(x) = x$$

Morphism mapping between homset $Hom(\mathbb{R}^2, \mathbb{R})$ and $Hom(\mathbb{R}^3, \mathbb{R})$ is given by

$$\begin{bmatrix} a \\ b \end{bmatrix} \mapsto \begin{bmatrix} a \\ b \\ 0 \end{bmatrix}$$

Definition 12 Let \mathcal{C} be a category with subobjects. Let $M_1, M_2, M'_1, M'_2 \in \nu\mathcal{C}$ such that $M'_1 \subset M_1, M'_2 \subset M_2$. A morphism $f : M'_1 \rightarrow M'_2$ is said to be corestriction of a morphism $g : M_1 \rightarrow M_2$ to inclusion $j : M'_2 \rightarrow M_2$ if $(g|_{M'_1})^0 = f$.

Definition 13 A chain bundle c' :

$$\dots M'_3 \rightrightarrows M'_2 \rightrightarrows M'_1 \rightrightarrows M'_0 = \mathbf{0}$$

is a subchain bundle of the chain bundle c :

$$\dots M_3 \rightrightarrows M_2 \rightrightarrows M_1 \rightrightarrows M_0 = \mathbf{0}$$

if M'_i is a subobject of M_i and for each $f' \in Hom(M'_i, M'_j)$ there is an $f \in Hom(M_i, M_j)$ such that f' is corestriction of f to $j : M'_j \rightarrow M_j$.

The relation “is a subchain bundle” is a strict preorder on vertex class of category of chain bundles.

Let \mathcal{C} is a category with subobjects and $\mathcal{CB}_{\mathcal{C}}$ be the category of chain bundles. For c' a subchain bundle of c there exists a chain bundle map F from c' to c such that $\nu F = \{j : M'_i \rightarrow M_i\}$ and for each $f' \in Hom(M'_i, M'_j)$, $F(f') = f$, where f is a morphism in $Hom(M_i, M_j)$ of which f' is the corestriction. Also F is injective on each homset.

$$\begin{array}{ccccccc}
 c' : & \cdots & \rightrightarrows & M'_3 & \rightrightarrows & M'_2 & \rightrightarrows & M'_1 & \rightrightarrows & \mathbf{0} \\
 \downarrow F & & & \downarrow j & & \downarrow j & & \downarrow j & & \downarrow j \\
 c : & \cdots & \rightrightarrows & M_3 & \rightrightarrows & M_2 & \rightrightarrows & M_1 & \rightrightarrows & \mathbf{0}
 \end{array}$$

Let \mathfrak{P} be a choice of subchain bundles in \mathcal{CB}_C , then $(\mathcal{CB}_C, \mathfrak{P})$ is a category with subobjects, since

- (1) \mathfrak{P} forms a strict preorder with $\nu\mathfrak{P} = \nu\mathcal{CB}_C$.
- (2) Every $F \in \mathfrak{P}$ is a monomorphism since νF consists of inclusions and morphism map of F are injective on each homset.
- (3) If $F = HG$ where $F, G \in \mathfrak{P}$, then $H \in \mathfrak{P}$

For,

$$\begin{array}{ccccccc}
 c'' : & \cdots & \rightrightarrows & M''_i & \rightrightarrows & M''_j & \rightrightarrows & \cdots & \rightrightarrows & M''_1 & \rightrightarrows & \mathbf{0} \\
 \downarrow H & & & \downarrow h_i & & \downarrow h_j & & & & \downarrow h_1 & & \downarrow 0 \\
 c' : & \cdots & \rightrightarrows & M'_i & \rightrightarrows & M'_j & \rightrightarrows & \cdots & \rightrightarrows & M'_1 & \rightrightarrows & \mathbf{0} \\
 \downarrow G & & & \downarrow j_{M'_i}^{M''_i} & & \downarrow j_{M'_j}^{M''_j} & & & & \downarrow j_{M'_1}^{M''_1} & & \downarrow 0 \\
 c : & \cdots & \rightrightarrows & M_i & \rightrightarrows & M_j & \rightrightarrows & \cdots & \rightrightarrows & M_1 & \rightrightarrows & \mathbf{0}
 \end{array}$$

$$\begin{array}{ccccccc}
 c'' : & \cdots & \rightrightarrows & M''_i & \rightrightarrows & M''_j & \rightrightarrows & \cdots & \rightrightarrows & M''_1 & \rightrightarrows & \mathbf{0} \\
 \downarrow F & & & \downarrow j_{M''_i}^{M'_i} & & \downarrow j_{M''_j}^{M'_j} & & & & \downarrow j_{M''_1}^{M'_1} & & \downarrow 0 \\
 c : & \cdots & \rightrightarrows & M_i & \rightrightarrows & M_j & \rightrightarrows & \cdots & \rightrightarrows & M_1 & \rightrightarrows & \mathbf{0}
 \end{array}$$

If $F = HG$, then we have $j_{M_i}^{M''_i} = h_i j_{M'_i}^{M''_i} \Rightarrow h_i = j_{M'_i}^{M''_i}$, i.e., each component of νH are inclusions. Also morphism map of H satisfies the condition that $F(h)$ has corestriction h since

$$h = j_{M'_i}^{M''_i} F(h) = j_{M'_i}^{M''_i} j_{M'_i}^{M''_i} G(H(h)) = j_{M'_i}^{M''_i} H(h)$$

hence c'' becomes subchain bundle of c' and $F \in \mathfrak{P}$.

Thus we have the following lemma.

Lemma 1 *If C is a category with subobjects, then category of chain bundles in C , \mathcal{CB}_C forms a category with subobjects where being subchain bundle is the subobject relation.*

Example 12 Consider the chain bundle $c : 3\mathbb{Z} \rightrightarrows 2\mathbb{Z} \rightrightarrows 8\mathbb{Z} \rightrightarrows \mathbf{0}$ in category of chain bundles in category of submodules of \mathbb{Z} . c itself is a subobject.

$$\begin{array}{ccccccc}
 3\mathbb{Z} & \xrightarrow{\frac{2}{3}a} & 2\mathbb{Z} & \xrightarrow{4b} & 8\mathbb{Z} & \xrightarrow{0} & \mathbf{0} \\
 i \downarrow & & \downarrow i & & \downarrow i & & \downarrow i \\
 3\mathbb{Z} & \xrightarrow{\frac{2}{3}a} & 2\mathbb{Z} & \xrightarrow{4b} & 8\mathbb{Z} & \xrightarrow{0} & \mathbf{0}
 \end{array}$$

$c' : 6\mathbb{Z} \rightrightarrows 4\mathbb{Z} \rightrightarrows 16\mathbb{Z} \rightrightarrows \mathbf{0}$ is a subobject of c .

$$\begin{array}{ccccccc}
 6\mathbb{Z} & \xrightarrow{\frac{2}{3}a'} & 4\mathbb{Z} & \xrightarrow{4b'} & 16\mathbb{Z} & \xrightarrow{0} & \mathbf{0} \\
 i \downarrow & & \downarrow i & & \downarrow i & & \downarrow i \\
 3\mathbb{Z} & \xrightarrow{\frac{2}{3}a} & 2\mathbb{Z} & \xrightarrow{4b} & 8\mathbb{Z} & \xrightarrow{0} & \mathbf{0}
 \end{array}$$

Morphism map is identity on each homsets. Thus we get an inclusion from c' to c .

Whereas $c'' : 9\mathbb{Z} \rightrightarrows 4\mathbb{Z} \rightrightarrows 16\mathbb{Z} \rightrightarrows \mathbf{0}$ is a not a subobject of c . Though each vertex of c'' is a subobject of c , the morphisms in $Hom(9\mathbb{Z}, 4\mathbb{Z})$ is not corestriction of that in $Hom(3\mathbb{Z}, 2\mathbb{Z})$.

$$\begin{array}{ccccccc}
 9\mathbb{Z} & \xrightarrow{\frac{4}{3}a'} & 4\mathbb{Z} & \xrightarrow{4b'} & 16\mathbb{Z} & \xrightarrow{0} & \mathbf{0} \\
 i \downarrow & & \downarrow i & & \downarrow i & & \downarrow i \\
 3\mathbb{Z} & \xrightarrow{\frac{2}{3}a} & 2\mathbb{Z} & \xrightarrow{4b} & 8\mathbb{Z} & \xrightarrow{0} & \mathbf{0}
 \end{array}$$

Category with Factorization

Let \mathcal{C} be category with factorization and $\mathcal{CB}_{\mathcal{C}}$ the category of chain bundles. For $c, d \in \mathcal{CB}_{\mathcal{C}}$ and $F : c \rightarrow d$ then $\nu F = \{f_i : M_i \rightarrow N_i\}$ admits a factorization $f_i^0 j$ and corresponding chain bundle c' forms a subchain bundle of d .

$$\begin{array}{ccccccccccc}
 c : & & \cdots & \rightrightarrows & M_i & \rightrightarrows & M_j & \rightrightarrows & \cdots & \rightrightarrows & M_1 & \rightrightarrows & \mathbf{0} \\
 & & \downarrow F & & & & f_i \downarrow & & \downarrow f_j & & & \downarrow f_1 & & \downarrow 0 \\
 d : & & \cdots & \rightrightarrows & N_i & \rightrightarrows & N_j & \rightrightarrows & \cdots & \rightrightarrows & N_1 & \rightrightarrows & \mathbf{0}
 \end{array}$$

Let the chain bundle map F be full and for each $g \in Hom(M_i, M_j)$ there exists $F(g)' \in Hom(N'_i, N'_j)$ which is the corestriction of $F(g)$ to j , define $E : g \mapsto F(g)' = (F(g)|_{N'_i})^0$, then $F(g) = J((F(g)|_{N'_i})^0) = J(E(g))$ and so $F = EJ$ is a factorization., i.e., $\mathcal{CB}_{\mathcal{C}}$ has a subcategory with factorization.

$$\begin{array}{ccccccccccc}
 c : & & \cdots & \rightrightarrows & M_i & \xrightarrow{g} & M_j & \rightrightarrows & \cdots & \rightrightarrows & M_1 & \rightrightarrows & \mathbf{0} \\
 & & \downarrow E & & & & f_i^0 \downarrow & & \downarrow f_j^0 & & \downarrow f_1^0 & & \downarrow 0 \\
 c' : & & \cdots & \rightrightarrows & N'_i & \xrightarrow{F(g)'} & N'_j & \rightrightarrows & \cdots & \rightrightarrows & N'_1 & \rightrightarrows & \mathbf{0} \\
 & & \downarrow J & & & & j_i \downarrow & & \downarrow j_j & & \downarrow j_1 & & \downarrow 0 \\
 d : & & \cdots & \rightrightarrows & N_i & \xrightarrow{F(g)} & N_j & \rightrightarrows & \cdots & \rightrightarrows & N_1 & \rightrightarrows & \mathbf{0}
 \end{array}$$

Remark 3 Similarly we can construct category of cochain bundles \mathcal{CCB} and can show that it is a category with subobjects.

Example 13 Consider the following chain bundles and functor F between them in the chain bundle category of submodules of \mathbb{Z} .

$$\begin{array}{ccccccc}
 3\mathbb{Z} & \xrightarrow{\frac{2}{3}a} & 2\mathbb{Z} & \xrightarrow{\frac{5}{2}b} & 5\mathbb{Z} & \xrightarrow{0} & 0 \\
 4\downarrow & & \downarrow 4 & & \downarrow \frac{5}{2} & & \downarrow 0 \\
 6\mathbb{Z} & \xrightarrow{\frac{2}{3}a'} & 4\mathbb{Z} & \xrightarrow{\frac{1}{4}b'} & \mathbb{Z} & \xrightarrow{0} & 0
 \end{array}$$

$$\nu F(3\mathbb{Z}) = 6\mathbb{Z}, \nu F(2\mathbb{Z}) = 4\mathbb{Z}, \nu F(5\mathbb{Z}) = \mathbb{Z}$$

$$F\left(\frac{2}{3}a\right) = \frac{2}{3}a, F\left(\frac{5}{2}b\right) = \frac{1}{4}b,$$

Also F can be factorized as $G \circ H$ where G is an epimorphism and H is an inclusion as follows:

$$\begin{array}{ccccccc}
 3\mathbb{Z} & \xrightarrow{\frac{2}{3}a} & 2\mathbb{Z} & \xrightarrow{\frac{5}{2}b} & 5\mathbb{Z} & \xrightarrow{0} & 0 \\
 4\downarrow & & \downarrow 4 & & \downarrow \frac{5}{2} & & \downarrow 0 \\
 12\mathbb{Z} & \xrightarrow{\frac{2}{3}a'} & 8\mathbb{Z} & \xrightarrow{\frac{1}{4}b'} & 2\mathbb{Z} & \xrightarrow{0} & 0 \\
 i\downarrow & & \downarrow i & & \downarrow i & & \downarrow i \\
 6\mathbb{Z} & \xrightarrow{\frac{2}{3}a'} & 4\mathbb{Z} & \xrightarrow{\frac{1}{4}b'} & \mathbb{Z} & \xrightarrow{0} & 0
 \end{array}$$

$$\nu G(3\mathbb{Z}) = 12\mathbb{Z}, \nu G(2\mathbb{Z}) = 8\mathbb{Z}, \nu G(5\mathbb{Z}) = 2\mathbb{Z}, G\left(\frac{2}{3}a\right) = \frac{2}{3}a, G\left(\frac{5}{2}b\right) = \frac{1}{4}b$$

$$\nu H(12\mathbb{Z}) = 6\mathbb{Z}, \nu H(8\mathbb{Z}) = 4\mathbb{Z}, \nu H(2\mathbb{Z}) = \mathbb{Z}, H\left(\frac{2}{3}a'\right) = \frac{2}{3}a', H\left(\frac{1}{4}b'\right) = \frac{1}{4}b'$$

Next we consider the case when the category \mathcal{C} is a groupoid \mathcal{G} . Then the chain bundles $\mathcal{CB}_{\mathcal{G}}$ obtained from \mathcal{G} is described and it is shown that $\mathcal{CB}_{\mathcal{G}}$ is a groupoid. Since \mathcal{G} has no zero object we consider category $\mathcal{G} \cup \mathbf{0}$ by adjoining a zero object $\mathbf{0}$ to $\nu\mathcal{G}$. Consider the category $\mathcal{CB}_{\mathcal{G}}$ of chain bundles formed from $\mathcal{G} \cup \mathbf{0}$. Consider two chain bundles

$$c : \dots M_3 \rightrightarrows M_2 \rightrightarrows M_1 \rightrightarrows \mathbf{0}$$

and

$$d : \dots N_3 \rightrightarrows N_2 \rightrightarrows N_1 \rightrightarrows \mathbf{0}$$

in $\mathcal{CB}_{\mathcal{G}}$. If there exists a vertex mapping between vertices of these chain bundles then it will induce a chain bundle map between c and d and it is invertible. Consider the following chain bundle map F between two chain bundles

$$\begin{array}{ccccccc}
 \dots & \rightrightarrows & M_3 & \rightrightarrows & M_2 & \rightrightarrows & M_1 & \rightrightarrows & \mathbf{0} \\
 & & f_3\downarrow & & \downarrow f_2 & & \downarrow f_1 & & \downarrow f_0 \\
 \dots & \rightrightarrows & N_3 & \rightrightarrows & N_2 & \rightrightarrows & N_1 & \rightrightarrows & \mathbf{0}
 \end{array}$$

$$F(f) = f_i^{-1} f f_{i-1}^{-1} \text{ for each } f \in Hom(M_{i+1}, M_i) \text{ and for any } g \in Hom(N_{i+1}, N_i), F^{-1}(g) = f_3 g f_2^{-1}.$$

3 Category of Preorder Chains

\mathcal{C} be a category and $\mathcal{CB}_{\mathcal{C}}$ the category of chain bundles. Let

$$c : \cdots M_3 \rightrightarrows M_2 \rightrightarrows M_1 \rightrightarrows M_0 = \mathbf{0}$$

be a chain bundle in $\mathcal{CB}_{\mathcal{C}}$. By choosing atmost one morphism from each homset in the chain bundle, we obtain a sequence of chains called preorder chains.

$$\cdots M_{i+1} \rightarrow M_i \rightarrow \mathbf{0}, M_{i-1} \rightarrow \cdots M_j \rightarrow \mathbf{0}, \dots, M_{j-1} \rightarrow \cdots M_1 \rightarrow \mathbf{0}$$

Define preorder chain maps as follows:

Definition 14 A chain map between two preorder chains is a sequence of morphisms in \mathcal{C} , $\{f_i : N_i \rightarrow M_i\}$ such that the resulting diagram commutes.

$$\begin{array}{ccccccc} \cdots & \longrightarrow & N_3 & \longrightarrow & N_2 & \longrightarrow & N_1 & \longrightarrow & \mathbf{0} \\ & & f_3 \downarrow & & \downarrow f_2 & & \downarrow f_1 & & \downarrow f_0 \\ \cdots & \longrightarrow & M_3 & \longrightarrow & M_2 & \longrightarrow & M_1 & \longrightarrow & \mathbf{0} \end{array}$$

Note that the preordered chains obtained from a category of chain bundles $\mathcal{CB}_{\mathcal{C}}$ is again a category whose objects are preorder chains and morphisms are chain maps between such chains.

Example 14 Consider the chain bundle in category of submodules of \mathbb{Z} .

$$c : 18\mathbb{Z} \rightrightarrows 9\mathbb{Z} \rightrightarrows 3\mathbb{Z} \rightrightarrows 8\mathbb{Z} \rightrightarrows 4\mathbb{Z} \rightrightarrows 2\mathbb{Z} \rightrightarrows 5\mathbb{Z} \rightrightarrows \mathbf{0}$$

By choosing only inclusions from each homset we obtain the chains:

$$18\mathbb{Z} \rightarrow 9\mathbb{Z} \rightarrow 3\mathbb{Z} \rightarrow \mathbf{0}, 8\mathbb{Z} \rightarrow 4\mathbb{Z} \rightarrow 2\mathbb{Z} \rightarrow \mathbf{0}, 5\mathbb{Z} \rightarrow \mathbf{0}.$$

Given a category \mathcal{C} and the category of chain bundles $\mathcal{CB}_{\mathcal{C}}$. By choosing a morphism from each homset we obtain chains, depending on the choice we have different collection of chains from $\mathcal{CB}_{\mathcal{C}}$. Let $\nu\Gamma$ be one such collection of chains obtained from $\mathcal{CB}_{\mathcal{C}}$, we obtain a category Γ whose vertex class is $\nu\Gamma$ and morphisms between two preorder chains is chain map defined above.

Example 15 Let \mathcal{C} be category of abelian groups. Consider the category $\mathcal{CB}_{\mathcal{C}}$. Choose preorder chain from a chain bundle

$$c : \cdots C_{n+1} \rightrightarrows C_n \rightrightarrows C_{n-1} \rightrightarrows \cdots \rightrightarrows \mathbf{0}$$

by choosing one ∂_i from each homset $Hom(C_{i+1}, C_i)$ such that $\partial_{i+1} \circ \partial_i = 0$. If we can choose such a ∂_i from each homset we obtain a chain of the form

$$c_1 : \cdots C_{n+1} \xrightarrow{\partial_{n+1}} C_n \xrightarrow{\partial_n} C_{n-1} \xrightarrow{\partial_{n-1}} \cdots$$

Note that given a chain bundle category \mathcal{CB}_C , it is possible to obtain a category Γ whose vertices are preorder chains from chain bundles in \mathcal{CB}_C and morphisms between two preorder chains is a sequence of morphisms in C from vertices of first preorder chain to that of second one which make the resulting diagram commutative. The category of chain complexes in C then coincides with the category Γ .

For a category C with subobjects, so is \mathcal{CB}_C and also the category of preorder chains obtained from it are categories with subobjects.

Definition 15 A preorder chain c' :

$$\cdots M'_3 \xrightarrow{f'_3} M'_2 \xrightarrow{f'_2} M'_1 \xrightarrow{f'_1} M'_0 = \mathbf{0}$$

is a sub preorder chain of the preorder chain c :

$$\cdots M_3 \xrightarrow{f_3} M_2 \xrightarrow{f_2} M_1 \xrightarrow{f_1} M_0 = \mathbf{0}$$

if M'_i is a subobject of M_i and for each $f'_{i+1} : M'_{i+1} \rightarrow M'_i$ there is a $f_{i+1} : M_{i+1} \rightarrow M_i$ such that f'_{i+1} is corestriction of f_{i+1} .

Lemma 2 The relation “is a sub preorder chain” which is a strict preorder on vertex class of category of preorder chains.

Lemma 3 If C is a category with subobjects, then category of preorder chains obtained from chain bundles in C is a category with subobjects where being sub preorder chain is the subobject relation.

Example 16 Let C be category of submodules of \mathbb{Z} . Consider category of chain bundles \mathcal{CB}_C . Γ be category of preorder chains obtained from \mathcal{CB}_C by choosing inclusions from each homset. In Γ , $c' : 16\mathbb{Z} \rightarrow 8\mathbb{Z} \rightarrow 4\mathbb{Z} \rightarrow \mathbf{0}$ is a subobject of $c : 8\mathbb{Z} \rightarrow 4\mathbb{Z} \rightarrow 2\mathbb{Z} \rightarrow \mathbf{0}$.

$$\begin{array}{ccccccc} 16\mathbb{Z} & \xrightarrow{i} & 8\mathbb{Z} & \xrightarrow{i} & 4\mathbb{Z} & \xrightarrow{0} & \mathbf{0} \\ i \downarrow & & \downarrow i & & \downarrow i & & \downarrow i \\ 8\mathbb{Z} & \xrightarrow{i} & 4\mathbb{Z} & \xrightarrow{i} & 2\mathbb{Z} & \xrightarrow{0} & \mathbf{0} \end{array}$$

If C is a category with factorization, then so is the category of preorder chains Γ obtained from \mathcal{CB}_C . F be a chain map in Γ , then factorization of components in νF induces a factorization of F .

4 Some Categorical Properties of Chain Bundles

General categorical properties like product, coproduct, kernel, cokernel, etc. need not carry over to the bundle categories. However, under certain restrictions some of these categorical properties may carry over to bundle categories.

Let \mathcal{C} be a category with products. Then product in $\mathfrak{CB}_{\mathcal{C}}$ may be defined termwise. For two chain bundles having different lengths we add zeros as vertices to left of chain bundle to make length of both equal. Consider the following chain bundles c and d :

$$c : \cdots M'_3 \rightrightarrows M'_2 \rightrightarrows M'_1 \rightrightarrows M'_0 = \mathbf{0}$$

$$d : \cdots M_3 \rightrightarrows M_2 \rightrightarrows M_1 \rightrightarrows M_0 = \mathbf{0}$$

The product $c \times d$ is the chain bundle

$$c \times d : \cdots M'_3 \times M_3 \rightrightarrows M'_2 \times M_2 \rightrightarrows M'_1 \times M_1 \rightrightarrows M'_0 \times M_0 = \mathbf{0} \times \mathbf{0}$$

For any $F : l \rightarrow c$ and $G : l \rightarrow d$ where l is the chain bundle

$$l : \cdots N_3 \rightrightarrows N_2 \rightrightarrows N_1 \rightrightarrows N_0 = \mathbf{0},$$

there exists a chain bundle map $L : l \rightarrow c \times d$ such that for any $k \in \text{Hom}(N_i, N_j)$ and $L(k) \in \text{Hom}(M'_i \times M_i, M'_j \times M_j)$ there corresponds a $F(k) \in \text{Hom}(M'_i, M'_j)$ and $G(k) \in \text{Hom}(M_i, M_j)$

In a similar manner, one can define coproducts in $\mathfrak{CB}_{\mathcal{C}}$.

Example 17 \mathcal{C} be the category of submodules of \mathbb{Z} and $\mathfrak{CB}_{\mathcal{C}}$ be category of chain bundles in \mathcal{C} . Consider the two chain bundles

$$c : 3\mathbb{Z} \xrightarrow{\frac{2}{3}a} 2\mathbb{Z} \xrightarrow{\frac{5}{2}b} 5\mathbb{Z} \xrightarrow{0} \mathbf{0} \quad \text{and} \quad d : 6\mathbb{Z} \xrightarrow{\frac{2}{3}a'} 4\mathbb{Z} \xrightarrow{\frac{1}{4}b'} \mathbb{Z} \xrightarrow{0} \mathbf{0}$$

The product $c \times d$ is the chain bundle

$$c : 3\mathbb{Z} \times 6\mathbb{Z} \xrightarrow{\frac{2}{3}a, \frac{2}{3}a'} 2\mathbb{Z} \times 4\mathbb{Z} \xrightarrow{\frac{5}{2}b, \frac{1}{4}b'} 5\mathbb{Z} \times \mathbb{Z} \xrightarrow{0,0} \mathbf{0} \times \mathbf{0}$$

For any $l : m\mathbb{Z} \xrightarrow{\frac{n}{m}a''} n\mathbb{Z} \xrightarrow{\frac{p}{n}b''} p\mathbb{Z} \xrightarrow{0} \mathbf{0}$ in $\nu\mathfrak{CB}_{\mathcal{C}}$ and for any $F : l \rightarrow c$ and $G : l \rightarrow d$ there exists a chain bundle map $L : l \rightarrow c \times d$ such that the following diagram commutes

$$\begin{array}{ccccc}
 & & l & & \\
 & F \swarrow & \downarrow L & \searrow G & \\
 c & \xleftarrow{\pi_1} & c \times d & \xrightarrow{\pi_2} & d
 \end{array}$$

Let \mathcal{C} be a category having kernels and $c : \dots M_3 \rightrightarrows M_2 \rightrightarrows M_1 \rightrightarrows \mathbf{0} \in \mathcal{CB}_{\mathcal{C}}$. The kernel of c is given by

$$ker(c) : \dots ker(M_3) \rightrightarrows ker(M_2) \rightrightarrows ker(M_1) \rightrightarrows \mathbf{0}$$

provided there exists a chain bundle map $K : ker(c) \rightarrow c$ whose morphism map satisfies the condition $KF = 0$ for any chain bundle map $F : c \rightarrow d$.

$$\begin{array}{ccccccc}
 ker(c) : \dots & \rightrightarrows & ker(M_3) & \rightrightarrows & ker(M_2) & \rightrightarrows & ker(M_1) & \rightrightarrows & \mathbf{0} \\
 & & \downarrow k_3 & & \downarrow k_2 & & \downarrow k_1 & & \downarrow k_0 \\
 c : \dots & \rightrightarrows & M_3 & \rightrightarrows & M_2 & \rightrightarrows & M_1 & \rightrightarrows & \mathbf{0}
 \end{array}$$

Similarly one can define cokernels in $\mathcal{CB}_{\mathcal{C}}$.

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APPLICATIONS OF BIG DATA AND MACHINE LEARNING IN SMART GRID

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Abstract— This paper conducts a comprehensive study on the application of big data and machine learning in the electrical power grid introduced through the emergence of the next-generation power system the smart grid (SG). Connectivity lies at the core of this new grid infrastructure, which is provided by the Internet of Things (IoT). This connectivity, and constant communication required in this system, also introduced a massive data volume that demands techniques far superior to conventional methods for proper analysis and decision making. The IoT-integrated SG system can provide efficient load forecasting and data acquisition technique along with cost-effectiveness. Big data analysis and machine learning techniques are essential to reaping these Benefits. In the complex connected system of SG, [1]cyber security becomes a critical issue; IoT devices and their data turning into major targets of attacks. Such security concerns and their solutions are also included in this paper. Key information obtained through literature review is tabulated in the corresponding sections to provide a clear synopsis; and the findings of this rigorous review are listed to give a concise picture of this area of study and promising future fields of academic and industrial research, with current limitations with viable solutions along with their effectiveness.

Introduction

The electrical power system is poised to move towards the next generation smart grid (SG) system, and thus this topic has acclaimed significant attention in the research community. SG is the integration of information and digital communication technologies with power grid systems to enable bi-directional communication and power that can enhance security, reliability, and efficiency of the power system. Smart grid solutions aim at calculation of optimum generation transmission-distribution pattern and storing power system data.[2] For the growing concern about environment along with efficient generation and distribution, distributed energy resources (DER) with smart micro grid can be a potential solution. It can be said that distributed smart micro grid can bring additional benefits for global power system planning.[2] In other words, SG is the integration of technologies, systems and processes to make power grid intelligent and automated and the figure shows basic constructions of conventional grid and smart grid to demonstrate their dissimilarities. This paper presents a concise picture of the electricity grids transition towards the smart grid, the ensuing rise in IoT usage, and the challenges this new system brings forward.

In the internet of things each object has its own identity in the digital world. Everything is connected through a complex network. IoT comprises of smart objects which possess self-awareness, interaction with the environment and data processing. Smart devices are capable to communicate with other such devices in this system. Most

common smart devices employed in the grid, such as the smart meter, falls into this category. These devices provide the detailed data required for accurate information and automated decision support which give the smart grid the unique capabilities it demonstrates over the legacy system. The most obvious trials are of course the handling of the huge amount of data in this connected system, their proper analysis and safety, as well as protecting this new power grid from attacks generated in both physical and cyber dimensions. This work can act as a base for future academic and industrial researchers, while pointing out the current limitations with possible solutions along with their effectiveness.

1. SMART GRID

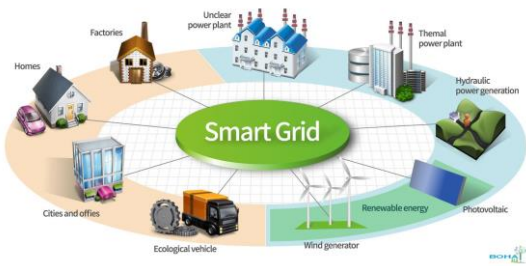
The smart grid refers to an advanced electricity supply bond which runs from a major power plant to all the way inside your home. For example, there are many power plants in the United States and these power plants produce electricity by using the wind energy, nuclear energy, hydro, natural gas and from other resources.[4] These producing stations produce electricity at a fixed electrical voltage and this certain level of voltage is enhanced to very high voltages so that the power transmissions efficiency is enhanced over long distances. When this electrical power gets near your town or city or village then the high electrical voltage is decreased in a process called stepped down, the voltage value is decreased in an electrical substation for the distribution in an area.

The most important concept of the smart grid is to include the capabilities of monitoring, analysis, control and communication in the national electrical delivery system to improve the output of the system while decreasing the consumption of energy

A. Features of the Smart Grid

The smart grid has the numerous range of factor and the features of the smart grid are as below

- Reliability
- Flexibility in network topology
- Efficiency
- Load adjustment/ load balancing
- Peak curtailment/ leaving
- Time of use pricing
- Sustainability
- Market



B. Components of the Smart Grid

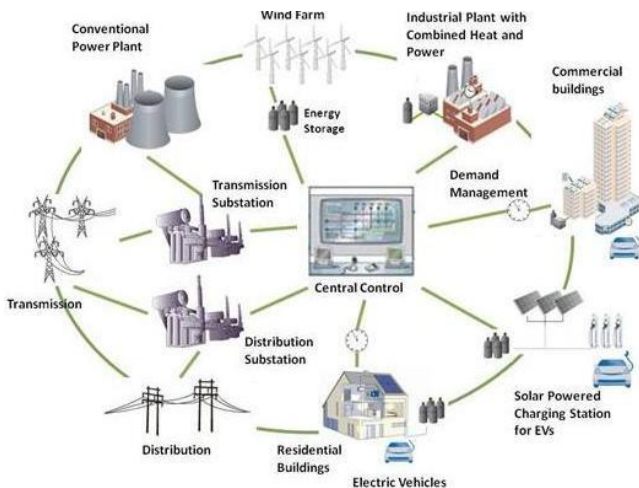
The commonly used components of smart grid as follows

- Smart meter

Is a generic term for electronic meters with a communication link. "Advanced Metering Infrastructure" (AMI) allows remote meter configuration, dynamic tariffs, power quality monitoring and load control.

- Phasor measurement

A phasor measurement unit (PMU) is a device used to estimate the magnitude and phase angle of an electrical phasor quantity (such as voltage or current) in the electricity grid using a common time source for synchronization.



- Information transfer

In telecommunications, information transfer is the process of moving messages containing user information from a source to a sink via a communication channel. In this sense, information transfer is equivalent to data transmission which highlights more practical, technical aspects

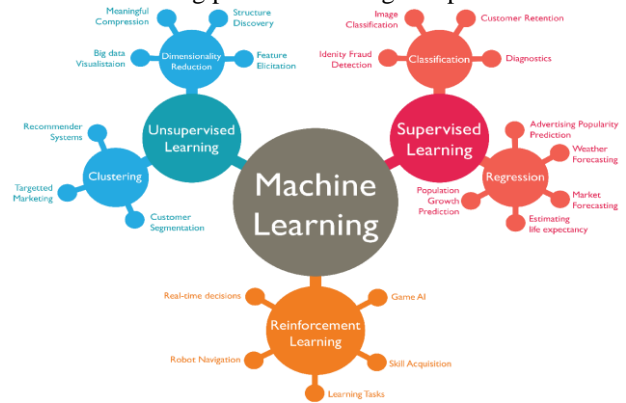
- Distributed generation

The concept of distributed generation (DG), power generated from numerous micro-scale sources for local distribution or to be fed back into the main grid, certainly makes for an enticing picture.

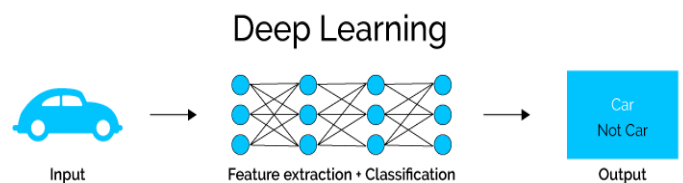
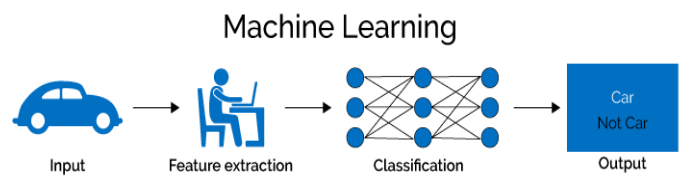
2. MACHINE LEARNING

Machine learning (ML) is the scientific study of algorithms and statistical models that computer systems use to perform a specific task without using explicit instructions, relying on patterns and inference instead. It is seen as a subset of

artificial intelligence. Machine learning algorithms build a mathematical model based on sample data, known as "training data", in order to make predictions or decisions without being explicitly programmed to perform the task. Machine learning algorithms are used in a wide variety of applications, such as email filtering and computer vision, where it is difficult or infeasible to develop a conventional algorithm for effectively performing the task. Machine learning is closely related to computational statistics, which focuses on making predictions using computers.



The study of mathematical optimization delivers methods, theory and application domains to the field of machine learning. Data mining is a field of study within machine learning, and focuses on exploratory data analysis through unsupervised learning. In its application across business problems, machine learning is also referred to as predictive analytics



3. BIG DATA

Big data can be defined as the massive datasets that are collected from a variety of data sources for business needs to reveal new insights for optimized decision making. It consists of large data set that cannot be managed efficiently by the common DBMS. Big data challenges include capturing data, data storage, data analysis, search, sharing, transfer, visualization, querying, updating, information privacy and data source. Big data was originally associated with three key concepts: volume, variety, and velocity.

Big data can be described by the following characteristics

- Volume

- Variety
- Velocity

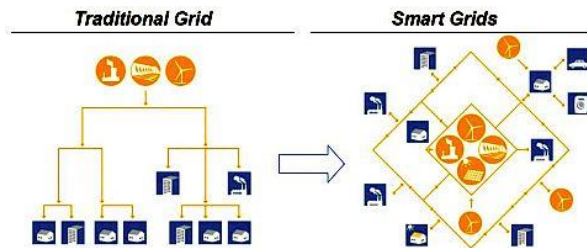


4. STRUCTURE OF CONVENTIONAL GRID AND SMART GRID

In the conventional system power flows from in one direction only; but for smart grid, there is no strict structure. Generation can occur at the consumer side too, such as the wind and the solar farms at the outer periphery of the topology. Power flow can also be bidirectional, demonstrated by the energy storages and the house in this illustration.

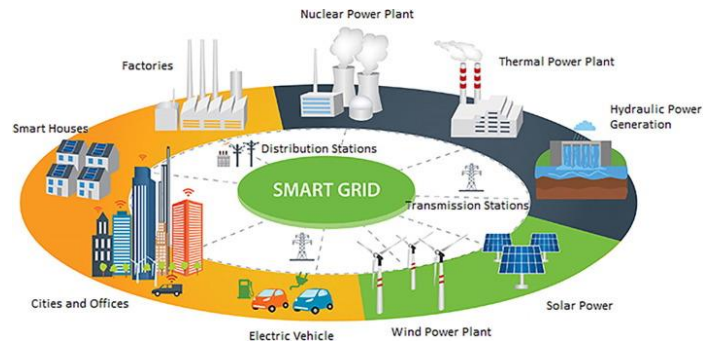
A. Conventional grid

The Conventional Grid System remains one of Civil Air Patrol's lasting contributions to Search and Rescue. The CAP (Conventional) Grid system was originally developed in the early 1960s by CAP members in Washington State.



B. Smart grid

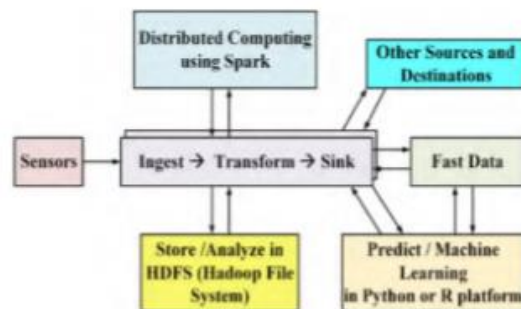
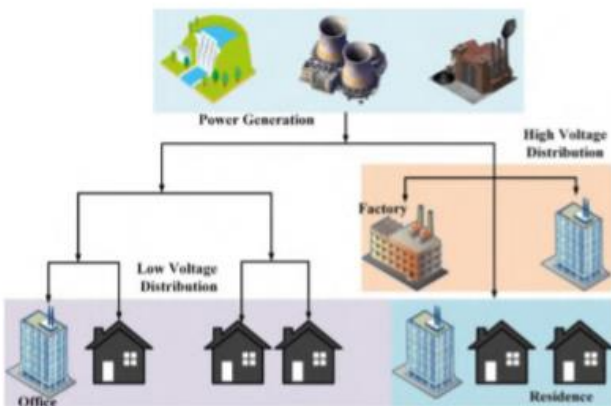
The smart grid is an alliance of hardware, management and reporting collection of programs; in the world of the smart grid, the consumers and profit firms have the equipment to manage, monitor and respond to the energy problems.



5. APPLICATION OF INTERNET OF THINGS (IOT) IN DISTRIBUTED POWER SYSTEM

The underpinnings those make the smart grid do so many things that the legacy grid is incapable of are a lot of connected devices, which are capable exchanging information, and receive commands to act in a certain way. This extensive communication is made possible by the internet, and all these devices are connected to their respective networks. Devices connected to the internet are currently part and parcels of the daily life, and more and more of such devices are emerging every day. An example of such devices can be smart thermostats.

These devices, which use the internet to stay connected to resources located elsewhere physically, and carry out their tasks through the resulting exchange, are termed as IoT devices. IoT stands for internet of things which can be dened as the interrelated system that links up such devices, and facilitate data transfer without any human intervention. IoT is an inter connection of sensing and actuating devices providing the ability to share information across platforms through an unied framework, developing a common operating picture for enabling innovative applications. This is achieved by seamless ubiquitous sensing, data analytics and information represent action with cloud computing as the unifying framework. Each of those objects has its own embedded computing system which enables it to be identified and to be interconnected with each other.

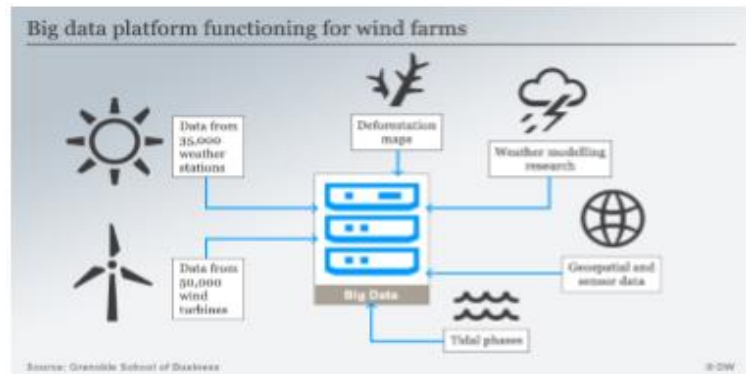


6. MACHINE LEARNING APPLICATION IN SMART GRID

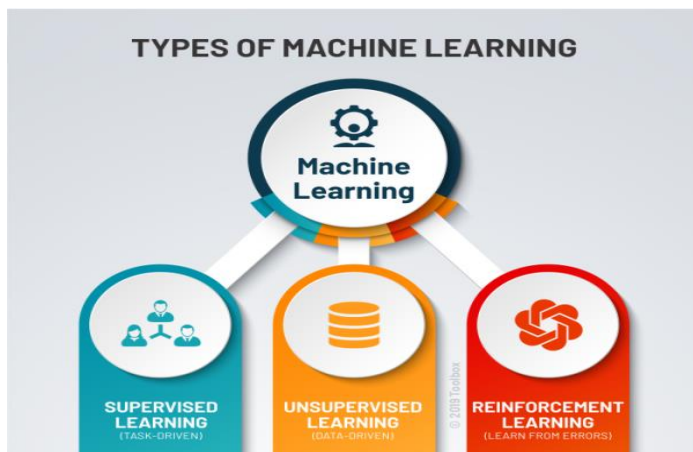
The obvious question that arises from the big data generation from smart grid is efficient ways to analyze them for extracting valuable information. Without the extraction of useful information, the collected data holds little or no value. Machine learning appears as the tool required for the tall task of going through the massive amount of data generated in an IoT-based grid system. It is the final piece of the smart grid system which is driven by data collection, analysis, and decision making.

Machine learning techniques provide an efficient way to analyze, and then make appropriate decisions to run the grid; and thus enables the smart grid to function as it is intended to. Machine learning (ML) is a term which refers to learning and making predictions from available data by a system. It is comprised of various algorithms which analyze the available data through a set of instructions to produce data-driven predictions and/or decisions. Machine learning undergoes the rigorous process of designing and programming explicit algorithms with expected performance. Machine learning functionalities include predictions of consumption, price, power generation, future optimum schedule, fault detection, adaptive control.

in the output of wind power plant, which leads to instability in the grid.



Hence proper forecasting is required for wind energy based power grids, and can aid in making operational strategies. Previously, several prediction models such as fuzzy modeling, auto regressive moving average, artificial neural network, K-nearest neighbor classification, computational fluid dynamics pre-calculated flow fields, extreme learning machine, adaptive neuro-fuzzy inference system, combination of relevance vector machine and differential empirical mode. This proposed system was validated by applying on a 74MW wind farm at Oklahoma, United States.



7. SMART GRID WITH BIG DATA ANALYSIS

Integrating IoT devices in every sector of the grid infrastructure is a mandatory step for moving towards smart grid. It has also been stated that the defining feature of these devices is their ability to communicate with other devices and control centers, and send useful information. Thus, an unprecedented amount of data gets generated in an interconnected network, posing challenges to the conventional methods of data transfer, storage, and analysis. Monitoring of transmission line, generation unit, substation state, smart metering, and data acquisition from smart home—all produce a large amount of data from the smart grid, which are to be stored in a cloud-based system for proper analysis. Cloud supported IoT system has been proposed in to manage all those data.

A. Machine Learning: Wind Energy Forecasting

Wind power is one of the fastest growing renewable energy sources in the world. About 12 percentage of the world's electricity will be supplied by wind generation by 2020. Integration of wind power sources with the grid provides several technical, economic, and environmental benefits. But due to the intermittent and stochastic nature of wind power, it provides some obstacles during power generation and distribution. Variation in wind speed causes fluctuation



Reference	Institute	Year	Application
Zhou et al. [84]	Hefei University of Technology, China	2016	Determining residential energy consumption
Zhou et al. [85]	Hefei University of Technology, China	2015	Demand side management
Zhou et al. [86]	Hefei University of Technology, China	2016	Demand side management
He et al. [90]	Shanghai Jiaotong University, China (with external collaboration)	2017	High-dimension smart grid modeling
Ryu et al. [91]	Sogang University, Korea (with external collaboration)	2016	Short time load side prediction
Coelho et al. [92]	State University of Rio de Janeiro, Brazil (with external collaboration)	2017	Load forecasting
Bessa et al. [93]	INESC Technology and Science, Portugal (with external collaboration)	2015	Very short-term power forecast

Analyzing big data is stated as a key functionality for energy management systems (EMS) for smart grids, control algorithms, and future energy market models. Although big data means a massive amount of data, technically it covers the predictive and behavioral analysis using those data. This huge amount of data is available at every aspect of our lives, and demands critical analysis. Scientists, businessmen, social welfare organizations, economists, and many others need to process through this large volume of information that is available online.

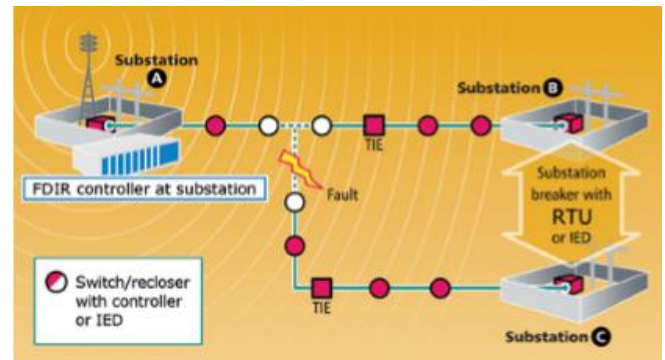


1. BIG DATA: FAULT DETECTION

The carbon emission reduction and sustainability of environment are the driving force and construction purpose of smart grid, which is designed in a decentralized structure. The employment of distributed generator units in modern power distribution system now provides an effective means for the utilization of wide spread renewable energy such as wind and solar energy.

These emerging micro grids are vital for the expectation of a low carbon society. Moreover, the close distance between the generator and loads in micro grid improves the reliability of power delivery and reduces the power transmission loss. The ability to operate in an island model so protects the load from damages caused by power system including voltage fluctuation, frequency deviation

While the two general schemes discussed here may remain the first order choice for implementing feeder automation, there are evolutions of each of these basic architectures that can provide utilities with a combination of the advantages provided by both.



A semi-distributed system is a model-driven scheme in which the FDIR algorithm is hosted at the substation level instead of at the control center. In this configuration, an intelligent substation controller serves as the field host for FDIR, utilizing a local network connectivity model updated with real-time topology for the area of automation. All feeder devices that are part of the automation scheme communicate back to the substation level only, and specialized field hardware is not required.

The FDIR controller at the substation can also act as a data concentrator, communicating back to a primary SCADA or DMS system for enhanced system visualization at the control center level. Expansion to multiple substations and feeders within the automation island is accomplished through the appropriate updates to the network model. The model can be updated offline when network updates or additions are made, and then downloaded to the controller remotely or loaded locally at the substation.

CONCLUSION

The electricity grid is transitioning towards an IoT-based, connected smart grid, and with the benefits of such a system, concerns are also emerging that were unprecedented until now. The big data generated in the smart grid is requiring no analysis techniques such as machine learning methods for proper handling and data extraction. The connected devices, and the data they generate are also bringing forth the dire necessities of proper protection, as they are being targeted to attacks of varying magnitudes which highlighted the lack of proper counter-measures in place. In an attempt to present an overall picture of these issues, this paper had presented a brief timeline of the grids journey to the smart grid, and how internet of things (IoT) had become a part and parcel of the electricity grid. Challenges associated with IoT-generated big data, namely their analysis and protection, as well as other security concerns in the smart grid had also been discussed.

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conference papers

Social Exclusion Faced by Elderly Women

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Abstract: Modern society has overburden feeling of ageing. Our society blessed with long life expectancy for female which becomes a curse due to the inability to incorporate this into modern atmosphere. Kerala is not an exception to this. Objective of this study is the major factors lead elderly to social exclusion. In this context descriptive method was undertaken. Analysis was based on primary and secondary data. Primary data is collected through structured interview schedule. Samples were selected with random sampling method from Thiruvananthapuram district. 100 samples selected from Thiruvananthapuram district, 50 are from home and 50 from old age home. To identify the factors which lead them to social exclusion, researcher asked questions in connection with it. According to their answer they are categorised. Based on the ranks given by the respondents to each factor a ranking analysis was carried out. Through this study researcher understood that the severity of the factors are different among elderly residing in home and old age home. Any one problem alone can acts as a leading factor for elderly to social exclusion. Several factors are together work hard to make an easy entrance to social exclusion. As age increases, the severity of the economic factor decreases among members residing in home and old age home.

Keywords: Elderly, Ageing, Social exclusion.

INTRODUCTION

The multidimensional word 'social exclusion', indicates the existing inequalities in society. Social exclusion is the by-product of poverty, unemployment etc. It relates not simply to a lack of material resources, but also to matters like inadequate social participation, lack of cultural and educational capital, inadequate access to services and lack of power. Social exclusion relates to the complexity of powerlessness in modern society. It is the failure of society to provide certain individuals and groups with those rights and benefits normally available to its members, such as employment, adequate housing, health care, education and training etc. In the social world, whether one is heartily welcomed or not is the outcome of collection of social practices. So we can say that social exclusion is the creation of society whether it is appreciable or not. Social exclusion is social disadvantage and relegation to the fringe of society. Whenever our attention focused on elderly population, it throws some light on their alienation in society.

In this computerised era, demographic structure leads to kaleidoscopic changes in society. One of the major issues recognised by demographers is ageing of population. Ageing has become increasingly recognised as an important issue facing individuals, families, communities and nations. Increasing age is

related to long-term health conditions, higher rates of disability and poorer reported health status. As Indian society is based on patriarchal theories, it favours men. In this modern era several initiatives have been taken to bring social inclusion in the society, still women are facing social exclusion in different walks of life, and be it social, political, economic etc. 'Greying population' and 'demographic feminization in ageing' are the two major challenges faced by the twenty first century. Our Society concentrated on the negative impact of these factors. Society's major concentration on negative impact of greying population made elderly population in utter confusion and alienation. In this context descriptive method was undertaken to explore the factors of social exclusion of elderly women. Analysis was based on primary data collected through structured interview schedule. Samples were selected with random sampling method from Thiruvananthapuram ditrict.

Social exclusion in old age is one of the most common issues that are affecting older women constantly. In this industrialised era, social exclusion faced by elderly women is mainly because of the complexity of powerlessness in modern society. Older women, who are still living with their sons/daughters and grand-children are also suffering from emotional exclusion. Due to fast changing socio-economic scenario of the country, fast paced modern life style and

rapid urbanization across the country younger generations hardly interact with their elderly family members. Popularity of nuclear family system has virtually crushed strong traditional bond between grandchildren and grandmothers. Longitudinal explosion of knowledge and transfer of economic authority made this alienation more severely and pathetically.

REVIEW OF LITERATURE

A literature review is a text of a scholarly paper, which includes the current knowledge including substantive findings, as well as theoretical and methodological contributions to a particular topic. Literature reviews are a staple for research in nearly every academic field. Literature reviews are used as secondary sources. In the article, "On being old and female: some issues in quality of life of elderly women in India" by Indira Jai Prakash [1] analyses the socio-economic effect of ageing. Though ageing is a universal phenomenon, all aged persons are not alike. Ageing process is different for different persons. This is confirmed in this article. Some of the factors which affect the quality of life are race, gender, social status and marital status. In these, gender is most powerful factor. Due to low social status, poor reproductive health care, economic dependence, malnutrition and domestic violence women's wellbeing is adversely affected. 'Gender ageing' increases the intensity of poverty. In countries like India, with a predominantly patriarchal ethos, older women face triple jeopardy—that of being female, of being old and of being poor. The factors which affect the quality of life of ageing women are marital status, living condition, and health status, socio-economic and political status. Chronic illness increases with age. Older women have more factors with activities of daily living. Probable widowhood is one of the after effects of prolonged life. Widowhood much lowers the socio-economic status of the women. This brings not only loneliness and depression but also economic dependence. Social and political power is achieved by active involvement in public and community life. In general older women do not participate in community activities. Rural elderly engage in agricultural work which has no retirement age as such. In the west 'grey power' has become visible and viable. Older people go themselves organized to fight for their rights. They could achieve increased participation of women in labour force, policies of reservation for women in the political process and in decision making bodies. "Increased awareness regarding the demographic changes, improvements in the medical field that help control age related disabilities and more awareness on the part of the older people themselves could create a better society for older women of the next millennium".

H.S. Srivastava [2] analyzes the socio-economic effect of ageing along with health factors in his book, 'Managing Age'. There are three independent facts of age-physical age, mental age and moral age.

They have remote relationship. A carefree or care-shackled attitude of mind bears a direct relationship with ageing. Individual could be considered as old, when he is unable to perform his normal duties. Ageing is undoubtedly a normal biological process and there is no way of avoiding it, though there are many viable ways for slowing the process. Many changes that occur in old age are mainly due to disease and physical distress and the social and economic consequences of growing old. The loss of power and authority is a great disconcerting thing to happen and the individual suddenly finds himself at a loss to understand the phenomenon. The individuals in old age find it very hard to accept this situation when they are no more in power or authority. They feel as if adversity has caught them completely the characteristics which imbibe in young age tend to become more acute and compulsive in old age. A religious person can turn into a fanatic, a liar into a damn liar, a fastidious person into a cynic and so on. Life has become firefighting operation punctuated all the way by unanticipated emergencies. To the individual in old-age condition the long cherished values seem overturned. The things which old generations find as avoidable extravagance, the younger generations considered it as an unavoidable necessity.

In the book 'The ageing world' which is written by Anil Bagchi [3], the socio-economic status of elderly examined. According to the author, elderly become out of step with the economic environment and the changing technology. The old get cast off from the mainstream of life. Social interaction with younger people becomes infrequent. Thus society makes the person old. The conventional definition of old age definition is not realistic. It leads to excessive depressing forecasts. In this changing social circumstances, even centenarians, show mental acuity comparable to those who are decades younger. According to the author, mental senility is a creation of society. Thus ageing cannot be considered as a physiological process wholly. It has some social factors also. Some people live their old age excellently and to some purpose. Fast living people are likely to age faster and die earlier'. It is not a disease. It is the consequence of normal course of living. It is not the mischief of any foreign body. It is not due to any aberrant cell. The wealth difference existing between the nations is due to the difference in knowledge of sociology, science and technology. The increased wealth leads to the beginning of the formation of greater proportion of old age people—the greying of the developed countries. Thus there is a strong correlation between knowledge, wealth and greying. Wealth and culture among nations and communities are the important factors of grey dynamics. The less modern countries are now young. The traditional dependence of the elderly index is the number of the people above 65 divided by the number of people in the age group 18 to 64. Responsibility of elderly is considered as a national burden. In future, as the younger generation keeps growing wealthier than

their parents and grandparents, inheritance will have less than the all-important role that it plays today. This will have an effect on the inter-generational dependence. This leads to the independence of different generation. Some constraints associated with greying like political and security issues, ethical considerations are human creations and are therefore amenable to some extent. Within the boundary conditions we must look for solutions to the factors of our future. This book reveals the importance of sociological study in ageing.

Vijay Prakash Sharma [4], in his paper, 'Tribal Aging in Jharkhand Health Perspective' analyzed elderly in traditional region. The old have traditionally been honoured and respected. Those who neglected their old parents earned social disrespect and were ridiculed. Government of Jharkhand in its new health policy-2004 has announced that provisions for care of aged will be made. In 2002-03 Govt. of Jharkhand reported construction of two old age homes for elderly. This gave an idea about the involvement of State for the wellbeing of old.

In the paper, 'Status and Role of Elderly Persons in Tribal Communities of Chotanagpur (With Special Reference To Chik Baraik Of Jharkhand) by Karma Oraon and Pravin Kumar Jha [5] analyzed the social role performed by elderly. Changing pattern of family life brought repercussions on elderly folk. Elderly lead a happy life since time immemorial. One of the values of our society is the respect for elderly. They create a strong bond of union among the family members. Now the tribal family structure undergoes changes. This may be due to the impact of urbanization, industrialization, education, globalization and modernization. This paper gives the indication of factors which affect the elderly. According to the authors both generations have to make compromises and the failure to compromise leads to breakage of the family. Migration of children prompted older generation to migrate as well. But they don't get any engagements and are friendless. Thus they left for their village in despair and frustration. Their guardianship vanished. Educated younger generations are reluctant to respect them. Now a days, modernization leads to various attitudinal clashes. Elderly have to compromise to their fate. If this trend continues. India will lose her cultural glory.

However, an ongoing criticism of the social scientific study of ageing is that it lacks "theoretical rigor" and tend towards the descriptive. Thus research on ageing being primarily factor-driven rather than theory-driven. Kerala's elderly female folk are heterogeneous group. Factors of social exclusion of elderly women are different. We have to find out those factors which lead them to social exclusion.

METHODOLOGY

In Kerala as per 2011 census, the percentage of 60+ was 11.7 per cent and is projected to be 15.6 per cent in 2021. The elderly women represent the fastest growing age group in the population of Kerala. The threat of population ageing is more severe in Kerala than the rest of the country. Gender dimension of ageing is very significant in Kerala and female population predominates at all the stages of older ages. Population ageing could have profound implication for the economies as well as the societies. Thus the dependency ratio is greater.

A large number of elderly females are in the status of widowhood, illiterates, and non-working and belong to lower and or no income brackets. All these finding leads to the conclusion that the aged females are the vulnerable within vulnerable. Their miserable status makes them to appear more aged than actually what they are.'World Health Organisation Report 'states that the percentage of the aged women who are 60+is going to be doubled within two decades. But so far no specific study has been done to elevate their status. There will be lesser and lesser people taking care of the elderly as the decades roll by. Traditional life guards of family care are dwindling due to industrialization, our migration, dual career, female job participation and growing consumerism. All these make the well-being of the elderly, a growing challenge of the 21st century. A significant aspect of challenge comprises the depressed elderly along with society who are unwilling to accept them.

An overview of available studies revealed the fact that the majority of researches concentrated on the factors faced by the elderly women. A study based on the Social Exclusion Faced by Elderly Women has not been done. So the present study is undertaken with a view to explore information to fill the existing research gap. It is hoped that such a study would be helpful to the policy makers and society.

The scope of study is limited to the elderly women (60 years and above) residing in Thiruvananthapuram district, Kerala. The study on factors which lead them to social exclusion was being primarily problem-driven. Kerala elderly womankind is a heterogeneous group. They have to face a lot of factors of social exclusion during their existence. So this analysis is based on these factors. A single theory cannot explain all these factors. Various factors deeply intertwined to each of it. Descriptive research design has been adopted for this study. The purpose of this research design is to explore the factors which lead elderly women to social exclusion and elicit new information about the elderly women residing in old age homes in Kerala.

The objective of this study is to find out major factors lead elderly to social exclusion. The design uses

primary and secondary data. The primary data about the elderly for the study have been collected through structured interview schedule among elderly women in Thiruvananthapuram district. Two questionnaires are used for it. One is for members residing in home and the other is for members belonging in old age home. The secondary data are derived from books, journals, reports, newspapers and online media on the subject. 100 subjects from Thiruvananthapuram district is selected on simple random method. In the 100 elements, 50 residing in home and the remaining 50 from old age home. Data collected through structured interview schedule were analysed with SPSS.

OBJECTIVE

To explore the factors of social exclusion of elderly women.

DISCUSSIONS AND ANALYSIS

In this study 100 samples selected from Thiruvananthapuram district are considered as samples with the help of simple random sampling. Based on earlier studies the factors lead elderly to social exclusion are as: economic, familial, social, health, psychological and cultural. To identify the factors which lead them to social exclusion, researcher asked question in connection with it. According to their answer they are categorised. Based on the ranks given by the respondents to each factor a ranking analysis was carried out. Through this study researcher understood that the severity of the factors are different among elderly residing in home and old age home. Any one problem alone can acts as a leading factor for elderly to social exclusion. Several factors are together work hard to make an easy entrance to social exclusion.

Table-1: Rank Given by Elderly Women to the Factors of Social Exclusion

Major factors of elderly			
Rank	Home	Rank	Old Age Home
1	Health factors	1	Social factors
2	Economic factors	2	Economic factors
3	Family factors	3	Family factors
4	Social factors	4	Cultural factors
5	Psychological factors	5	Health factors
6	Cultural factors	6	Psychological factors

Old age is one of the stages in lifecycle. It is natural. In this stage they have to face life's most stressful experience [6]. In the above table (No.1) rank of the major factors of social exclusion of elderly residing in home and old age home are analysed. Major factors of social exclusion of elderly women are social, economic, familial, cultural, health and psychological. All factors are more severe in old age home. All these factors are faced by elderly residing in home, but not in a severe form. From this researcher found out that ranking of factors of elderly women residing in home and old age home are different. Elderly women residing in home give first rank to health factors while elderly residing in old age home give fifth rank to it. For elderly women residing in old age home, social factors are considered to occupy in the first rank. For both of them, economic factors have second rank and familial factors have third rank. Social factors have fourth place in ranking analysis for elderly in home. Psychological

factors have fifth rank and cultural factors have sixth rank for elderly residing in home. Cultural factors have fourth place in ranking analysis for elderly in old age home. Health factors have fifth rank and psychological factors have sixth rank for elderly residing in old age home. Elderly residing in old age home are in a deteriorated position due to the high intensity of factors like, economic, familial, social, health and psychological. From this researcher found out that elderly residing in old age home are in a deteriorated position due to the high intensity of factors like, economic, familial, social, health and psychological. They are vulnerable within the vulnerable. Elderly residing in home have factors but their percent is very minute and the order of intensity is different. Number of elderly in home have high level factors are very meagre. Then the social, economic and familial factors analysed separately based on the independent variable.

Table-2: Age and Social Factor

Age	Social Factor								Total
	Home				Old Age Home				
	Low	Medium	High	Total	Low	Medium	High	Total	
60-69	73 ²⁹ 85	50 ⁴ 12	50 ¹ 3	68 ³⁴ 100	---	---	39 ¹⁹ 100	38 ¹⁹ 100	53 ⁵³ 100
70-79	20 ⁸ 67	50 ⁴ 33	---	24 ¹² 100	---	---	45 ²² 100	44 ²² 100	34 ³⁴ 100
>80	7 ³ 75	---	50 ¹ 25	8 ⁴ 100	---	100 ¹ 11	16 ⁸ 89	18 ⁹ 100	13 ¹³ 100
Total	100 ⁴⁰ 80	100 ⁸ 16	100 ² 4	100 ⁵⁰ 100	---	100 ¹ 2	100 ⁴⁹ 98	100 ⁵⁰ 100	100 ¹⁰⁰ 100

The table no.2 analyses age with social factor. Out of 100 elderly 53 percent belong to young old, 34 percent to medium old and 13 percent to old old. Out of 50 elderly residing in home, 80 percent (40) have low social factor, 16 percent (8) medium factor and 4 percent (2) high factor. Out of 50 elderly residing in

old age home, 2 percent (1) have medium factor and 98 percent (49) high factor. Based on the above table (No.2) researcher found out that as age increases, the social exclusion also increases in home but in old age home as age increases, the significance of social factor in social exclusion decreases.

Table-3: Education and Social Factor

Education	Social Factor								Total
	Home				Old Age Home				
	Low	Medium	High	Total	Low	Medium	High	Total	
Illiterate	8 3 ¹⁰⁰	---	---	6 3 ¹⁰⁰	---	---	33 16 ¹⁰⁰	32 16 ¹⁰⁰	19 19 ¹⁰⁰
Primary	57 20 ⁷¹	74 8 ²⁷	100 2 ²	60 30 ¹⁰⁰	---	100 1 ¹	59 29 ⁹⁹	60 30 ¹⁰⁰	60 60 ¹⁰⁰
Secondary	29 13 ¹⁰⁰	---	---	26 13 ¹⁰⁰	---	---	6 3 ¹⁰⁰	6 3 ¹⁰⁰	16 16 ¹⁰⁰
Degree	4 3 ¹⁰⁰	---	---	6 3 ¹⁰⁰	---	---	2 1 ¹⁰⁰	2 1 ¹⁰⁰	4 4 ¹⁰⁰
>Degree	2 1 ¹⁰⁰	---	---	2 1 ¹⁰⁰	---	---	---	---	1 1 ¹⁰⁰
Total	100 40 ⁸⁰	100 8 ¹⁶	100 2 ⁴	100 50 ¹⁰⁰	---	100 1 ²	100 49 ⁹⁸	100 50 ¹⁰⁰	100 100 ¹⁰⁰

Table no.3 analyses education and social factor. Out of 50 elderly residing in home, 80 percent (40) belong to low factor category, 16 percent (8) to medium and 4 percent (2) to high. Out of 50 elderly residing in old age home, 2 percent (1) belong to medium and 98 percent (49) to high. From the above

table (No.3) researcher found out that major share of elderly residing in home have low level factors irrespective of their educational qualification. But the major share of elderly residing in old age home have high level social factors which lead to social exclusion irrespective of their educational qualification.

Table-4: Marital Status and Social Factor

Marital status	Social Factor								Total
	Home				Old Age Home				
	Low	Medium	High	Total	Low	Medium	High	Total	
Married	68 27 ⁹⁶	12 1 ⁴	---	56 28 ¹⁰⁰	---	---	2 1 ¹⁰⁰	2 1 ¹⁰⁰	29 29 ¹⁰⁰
Widow	30 12 ⁶⁰	88 7 ³⁵	50 1 ⁵	40 20 ¹⁰⁰	---	---	76 37 ¹⁰⁰	74 37 ¹⁰⁰	57 57 ¹⁰⁰
Separated	---	---	50 1 ¹⁰⁰	2 1 ¹⁰⁰	---	---	4 2 ¹⁰⁰	4 2 ¹⁰⁰	3 3 ¹⁰⁰
Unmarried	2 1 ³²	---	---	2 1 ¹⁰⁰	---	100 1 ⁵	18 9 ⁹⁵	20 10 ¹⁰⁰	11 11 ¹⁰⁰
Total	100 40 ⁸⁰	100 8 ¹⁶	100 2 ⁴	100 50 ¹⁰⁰	---	100 1 ²	100 49 ⁹⁸	100 50 ¹⁰⁰	100 100 ¹⁰⁰

Table no.4 analyses marital status with social factor. Out of 100 elderly 29 percent (29) belong to married, 57 percent (57) to widows, 3 percent (3) to separated and 11 percent (11) to unmarried. From this researcher found out that there is relationship existed between marital status and social factor. There is very meagre percent have high level social factor residing in

home. In the high level category widows and separated are included. This indicates the importance of marital status. In old age home the situation is different. Marital status has no significance in old age home. Majority of them belong to very high social factor. The atmosphere is horrible there.

Table-5: Region and Social Factor

Region	Social Factor								Total
	Home				Old Age Home				
	Low	Medium	High	Total	Low	Medium	High	Total	
Rural	88 35 ⁷⁶	75 6 ²²	100 2 ²	86 43 ¹⁰⁰	---	100 1 ¹	95 47 ⁹⁹	96 48 ¹⁰⁰	91 91 ¹⁰⁰
Urban	12 5 ⁷⁴	25 2 ²⁶	---	14 7 ¹⁰⁰	---	---	5 2 ¹⁰⁰	4 2 ¹⁰⁰	9 9 ¹⁰⁰
Total	100 40 ⁸⁰	100 8 ¹⁶	100 2 ⁴	100 50 ¹⁰⁰	---	100 1 ²	100 49 ⁹⁸	100 50 ¹⁰⁰	100 100 ¹⁰⁰

Table no.5 analyses region and social factor. Out of 43 rural elderly residing in home 76 percent (35) belong to low social factor, 22 percent (6) to medium and 2 percent (2) to high. Out of 48 rural elderly residing in old age home 1 percent (1) belong to medium and 99 percent (47) to high. Village is considered as the basic unit of social policy. The

inhabitants of the village had intimate social and economic relationship regulated by age old traditions and institutions [7]. From this researcher found out that there is more deteriorated position observed among rural elderly residing in home. But in old age home the urban elderly is more deteriorated.

Table-6: Income and Social Factor

Income	Social Factor								Total
	Home				Old Age Home				
	Low	Medium	High	Total	Low	Medium	High	Total	
Nil	72 29 ⁹⁴	25 2 ⁶	---	62 31 ¹⁰⁰	---	---	97 46 ¹⁰⁰	92 46 ¹⁰⁰	77 77 ¹⁰⁰
<500	3 1 ⁵⁰	---	50 1 ⁵⁰	4 2 ¹⁰⁰	---	---	1 1 ¹⁰⁰	2 1 ¹⁰⁰	3 3 ¹⁰⁰
500-1000	5 2 ¹⁰⁰	---	---	4 2 ¹⁰⁰	---	---	1 1 ¹⁰⁰	2 1 ¹⁰⁰	3 3 ¹⁰⁰
1000-2000	---	---	---	---	---	---	---	---	---
>2000	20 8 ⁵³	75 6 ⁴⁰	50 1 ⁷	30 15 ¹⁰⁰	---	100 1 ⁵⁰	1 1 ⁵⁰	4 2 ¹⁰⁰	17 17 ¹⁰⁰
Total	100 40 ⁸⁰	100 8 ¹⁶	100 2 ⁴	100 50 ¹⁰⁰	---	100 1 ²	100 49 ⁹⁸	100 50 ¹⁰⁰	100 100 ¹⁰⁰

Out of 100 elderly, 77 percent (77) belong to non-income class, 3 percent (3) to less than 500 rupees category 3 percent (3) to 500-1000 rupees category and 17 percent (17) to above 2000 rupees category. From this researcher found out that income has not much influence in social factor. Among high level factor

holders equal number of elderly have less than 500 rupees category along with above 2000 rupees category. But the situation in old age home is entirely different. There major share has high level factors irrespective of their income. Their situation is very poor. They are vulnerable within the vulnerable.

Table-7: Age and Economic Factor

Age	Economic factor								Total
	Home				Old Age Home				
	Low	Medium	High	Total	Low	Medium	High	Total	
60-69	72 13 ³⁸	66 19 ⁵⁶	67 2 ⁶	68 34 ¹⁰⁰	---	---	40 19 ¹⁰⁰	38 19 ¹⁰⁰	53 53 ¹⁰⁰
70-79	22 4 ³⁴	24 7 ⁵⁸	33 1 ⁸	24 12 ¹⁰⁰	---	100 1 ⁵	44 21 ⁹⁵	44 22 ¹⁰⁰	34 34 ¹⁰⁰
>80	6 1 ²⁵	10 3 ⁷⁵	---	8 4 ¹⁰⁰	100 1 ¹¹	---	16 8 ⁸⁹	18 9 ¹⁰⁰	13 13 ¹⁰⁰
Total	100 18 ³⁶	100 29 ⁵⁸	100 3 ⁶	100 50 ¹⁰⁰	100 1 ²	100 1 ²	100 48 ⁹⁶	100 50 ¹⁰⁰	100 100 ¹⁰⁰

The table no.7 analyses age and economic factor of elderly. Out of 50 elderly residing in home 68 percent (34) belong to young old, 24 percent (12) to medium old and 8 percent (4) to old old. Out of 50 elderly residing in old age home 38 percent (19) belong to young old, 44 percent (22) to medium old and 18

percent (9) to old old. From this researcher found out that members residing in old age home have severe economic factor than the members in home. By analysing the above (Table No. 7) researcher found out that as age increases the severity of the factor decreases among members residing in home and old age home.

Table-8: Education and Economic factor

Education	Economic Factor								Total
	Home				Old Age Home				
	Low	Medium	High	Total	Low	Medium	High	Total	
Illiterate	---	---	100 3 ¹⁰⁰	6 3 ¹⁰⁰	---	---	33 16 ¹⁰⁰	32 16 ¹⁰⁰	19 19 ¹⁰⁰
Primary	30 6 ²⁰	83 24 ⁸⁰	---	60 30 ¹⁰⁰	---	100 1 ³	61 29 ⁹⁷	60 30 ¹⁰⁰	60 60 ¹⁰⁰
Secondary	50 8 ⁶²	17 5 ³⁸	---	26 13 ¹⁰⁰	---	---	6 3 ¹⁰⁰	6 3 ¹⁰⁰	16 16 ¹⁰⁰
Degree	15 3 ¹⁰⁰	---	---	6 3 ¹⁰⁰	100 1 ¹⁰⁰	---	---	2 1 ¹⁰⁰	4 4 ¹⁰⁰
>Degree	5 1 ¹⁰⁰	---	---	2 1 ¹⁰⁰	---	---	---	---	1 1 ¹⁰⁰
Total	100 18 ³⁶	100 29 ⁵⁸	100 3 ⁶	100 50 ¹⁰⁰	100 1 ²	100 1 ²	100 48 ⁹⁶	100 50 ¹⁰⁰	100 100 ¹⁰⁰

The table no.8 analyses education and economic factor of elderly. Out of 100 elderly 19 percent (19) belong to illiterate, 60 percent (60) to primary, 16 percent (16) to secondary, 4 percent (4) to degree and 1 percent (1) to above degree. From the above table (No.8) researcher found out that as education increases the severity of economic factor decreases in home, but this kind of relationship is absent in old age home. Among low factor holders residing in home, a gradual increase is observed as

education increases. This gives an indication about the importance of education in economic factor. Among elderly residing in old age home, majority of them have high economic factor without any exception of any educational levels. Knowledge explosion and industrialization made a gigantic change to society. This upset socio-economic set up of society. Transfer of economic authority from father to son made a social conflict.

Table-9: Marital Status and Economic Factor

	Economic Factor								Total
	Home				Old Age Home				
Marital status	Low	Medium	High	Total	Low	Medium	High	Total	
Married	33 6 ²¹	76 22 ⁷⁹	---	56 28 ¹⁰⁰	---	---	2 1 ¹⁰⁰	2 1 ¹⁰⁰	29 29 ¹⁰⁰
Widow	61 11 ⁵⁵	24 7 ³⁵	67 2 ¹⁰	40 20 ¹⁰⁰	---	100 1 ³	75 36 ⁹⁷	74 37 ¹⁰⁰	57 57 ¹⁰⁰
Separated	6 1 ¹⁰⁰	---	---	2 1 ¹⁰⁰	---	---	4 2 ¹⁰⁰	4 2 ¹⁰⁰	3 3 ¹⁰⁰
Unmarried	---	---	33 1 ¹⁰⁰	2 1 ¹⁰⁰	100 1 ¹⁰	---	19 9 ⁹⁰	20 10 ¹⁰⁰	11 11 ¹⁰⁰
Total	100 18 ³⁶	100 29 ⁵⁸	100 3 ⁶	100 50 ¹⁰⁰	100 1 ²	100 1 ²	100 48 ⁹⁶	100 50 ¹⁰⁰	100 100 ¹⁰⁰

Table number 9 is analysed marital status with economic factor of elderly. Among high factor category, 67 percent (2) belong to widows and 33 percent (1) to unmarried. From the above table (No.9), researcher found out that marital status has significance in homely atmosphere and not in old age home.

Absence of married members residing in home in high factor category may be considered as the importance of marital status. The deteriorated position of elderly women residing in old age home is also confirmed through this table.

Table-10: Region and Economic Factor

	Economic Factor								Total
	Home				Old Age Home				
Region	Low	Medium	High	Total	Low	Medium	High	Total	
Rural	78 14 ³³	97 28 ⁶⁵	33 1 ²	86 43 ¹⁰⁰	100 1 ²	---	95 47 ⁹⁸	96 48 ¹⁰⁰	91 91 ¹⁰⁰
Urban	22 4 ⁵⁷	3 1 ¹⁴	67 2 ²⁹	14 7 ¹⁰⁰	---	100 1 ⁵⁰	5 1 ⁵⁰	4 2 ¹⁰⁰	9 9 ¹⁰⁰
Total	100 18 ³⁶	100 29 ⁵⁸	100 3 ⁶	100 50 ¹⁰⁰	100 1 ²	100 1 ²	100 48 ⁹⁶	100 50 ¹⁰⁰	100 100 ¹⁰⁰

Table no.10 analyses region and economic factor. Among high factor category, 33 percent (1) belong to rural and 67 percent (2) to urban. Among high factor category, 95 percent (47) belong to rural and 5 percent (1) to urban. From this researcher found out that

rural elderly residing in home have less complicated economic factors than urban elderly. But the situation is entirely reversed among elderly residing in old age home. There rural elderly have more complicated economic factor for their social exclusion.

Table-11: Income and Economic Factor

	Economic Factor								Total
	Home				Old Age Home				
Income	Low	Medium	High	Total	Low	Medium	High	Total	
Nil	6 1 ³	93 27 ⁸⁷	100 3 ¹⁰	62 31 ¹⁰⁰	---	---	98 46 ¹⁰⁰	92 46 ¹⁰⁰	77 77 ¹⁰⁰
<500	6 1 ⁵⁰	6 1 ⁵⁰	--	4 2 ¹⁰⁰	---	---	1.4 1 ¹⁰⁰	2 1 ¹⁰⁰	3 3 ¹⁰⁰
500-1000	6 1 ⁵⁰	3 1 ⁵⁰	--	4 2 ¹⁰⁰	---	---	0.6 1 ¹⁰⁰	2 1 ¹⁰⁰	3 3 ¹⁰⁰
1000-2000	---	---	--	--	---	---	--	---	---
>2000	82 15 ¹⁰⁰	--	--	30 15 ¹⁰⁰	100 1 ⁵⁰	100 1 ⁵⁰	--	4 2 ¹⁰⁰	17 17 ¹⁰⁰
Total	100 18 ³⁶	100 29 ⁵⁸	100 3 ⁶	100 50 ¹⁰⁰	100 1 ²	100 1 ²	100 48 ⁹⁶	100 50 ¹⁰⁰	100 100 ¹⁰⁰

The table no.11 analyses income and economic factor. Out of 100 elderly 77 percent (77) to non-income class, 3 percent (3) to less than 500 rupees category, 3 percent (3) 500-1000 rupees category and 17 percent (17) to above 2000 rupees category. From this researcher found out that economic factor highly influenced by income among elderly residing in old age home but the influence is very much limited among elderly residing in home. As income increases, the severity of factor decreases.

CONCLUSION

The dawn of twenty first century presents a new demographic structure to society. 'Ageing population' and 'Feminization among elderly' are the major ingredients of this presentation. More awareness about the negative consequences of these makes the

elderly female folk in utter confusion and misery which lead them to social exclusion. They struggle hard to acquire adequate spaces in society and majority of them fail to achieve. Objective of this study is major factors lead elderly to social exclusion. The design uses primary and secondary data. Primary data collected through structured interview schedule. Secondary data collected from books, journals, reports, newspapers and online media on the subject. Out of 100 samples from Thiruvananthapuram, 50 are from home and 50 from old age home. Collected data were analysed with SPSS.

Major findings of the present study are

- The rank order of factors of social exclusion of elderly women residing in home and old age home are different. Elderly women residing in home give first rank to health factor while elderly residing in

old age home give fifth rank to it. For elderly women residing in old age home, social factors are considered to occupy in the first rank.

- From this researcher found out that elderly residing in old age home are in a deteriorated position due to the high intensity of factors like, economic, familial, social, health and psychological.
- As age increases, the social exclusion also increases in home but in old age home as age increases, the significance of social factor in social exclusion decreases.
- Marital status has significance in social exclusion only for elderly residing in home but not in old age home.
- Researcher found out that there is more deteriorated position observed among rural elderly residing in home. But in old age home the urban elderly is more troubled.
- As age increases the severity of the economic factor in social exclusion decreases among members residing in home and old age home.
- As education increases the severity of economic factor decreases in home, but this kind of relationship is absent in old age home.
- When consider economic factor, researcher found out that marital status has significance in homely atmosphere and not in old age home.
- Rural elderly residing in home have less complicated economic factors than urban elderly.
- From this researcher found out that economic factor highly influenced by income among elderly residing in old age home but the influence is very much limited among elderly residing in home.

SUGGESTIONS

- Take necessary steps to increase awareness among elderly and society about their significant role have to play in old age.
- Make adequate action plans to increase their power and economic status.
- Steps should be taken to strengthen our familial and social bonds.
- Take necessary steps to increase the educational skills which help them an easy living in new advanced era and transferring this to increase income
- Help them to develop necessary precautions for managing their ageing process
- Should modify their communicative skills to prevent social exclusion
- Take necessary steps to increase their income.
- Make awareness among society members and elderly themselves about the importance of elderly.
- In this consumer world elderly must have contribute something to society.

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Transgender: A Marginalized and Alienated Community

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Introduction

Gender is a multifaceted, construct, a complex phenomenon viewed differently in different societies. The most important impact that gender created in the society is the assigning or segregating the work load among the two dominant group the male and female. The relatively smaller group in population, the transgender is facing inequality and condemnation by this patriarchal society. Living as a transgender someone who identifies with a gender different than one assigned at birth is an experience filled with stress, strain and tensions. Transgender persons who are largely marginalized from the mainstream society because of the social stigma related to the gender identity. It negatively affects their mental wellbeing. The social exclusion results the different types of discriminations towards this minority group.

The God's own country, Kerala is the first state to introduce a transgender policy in 2015. The State has passed the Transgender Bill in an attempt to bring them to the mainstream of social life. However, discrimination, exclusion, suppression and oppression against transgender persons still continue from all walks of life. Transgender suffer from the lack of continuity in their identity, lack of self esteem, over emphasized and unwanted distinctiveness and injustice at every turn. This study intended to expose sufferings, discrimination and marginalization of transgender and try to explain every day issues of transgender through the sociology of third gender.

Gender equality refers to people receiving equal opportunities to realize their full human potential according to their wish, irrespective of gender. This includes equality in opportunities to take part in social, economic, cultural and political developments and benefiting equally from the results. It can also refer to the equality in protection of human rights. People are not aware about the gender issues especially transgender problems in the present society. Our constitution is guaranteeing fundamental rights for all human beings. But we are creating variety of boundaries for the transgender.

Methodology

The objective of the study is to identify the major problems confronted by the transgender. Research design of the study is descriptive in nature. Transgender people who are living in Kerala formed the Universe of the study. Fifty Samples are taken from the Thrissur district in Kerala. Snowball sampling method was used to collect the data. For this study, both primary and secondary sources of data are used. Primary data collected through interview schedule. Secondary data were collected from books, journals and internet.

Discussion and Results

In the modern complex society transgender confronted a lot of problems. Discrimination, disrespect, inequality, rejection, unwanted attention are the major difficulties of their life. They have restricted access to education, health services, and public spaces. They are denied from the political, religious and recreational involvements with the public. The Constitution provides for the fundamental right to equality, and not allowed any discrimination on the grounds of sex, caste, creed or religion. The Constitution also guarantees political rights and other benefits to every citizen. But the third community continues to be oppressed. The analysis reveals the present conditions of the transgender in our society.

The study shows that 94% of the respondents are not satisfied with their present condition. Transgender faces avoidance in all spheres of life. People living together in a community make up a society, and anything connected to that group can be described as societal. Societal pressures are expectations that influence the entire community, especially the existing social stigmas effect negatively to the transgender. So they are not gratifying by the present condition. The analysis indicates nobody is happy with the attitude of society towards them. All of them are opined that the societal attitude is not favorable to them. It means society is not giving any consideration to the transgender. The study shows in Kerala people are more conservative in nature. Society have very negative attitude to these persons. It creates the adjustment problems in the life of transgender The study clearly reveals that a great majority of the respondents openly said that people are more conservative and they have a negative attitude towards them. This situation creates discrimination and a lot of adjustment problems in the everyday life of Transgender.

In Kerala the transgender faces extreme type of avoidance from their fellow beings. This is mainly due to the conventional culture of gender binaries. A well proportion (90%) of the

respondents in this study feel that the society is not considering them and always avoiding them.. This avoidance and negligence always pull them back from public spaces. Actually transgender are very talkative, enthusiastic and friendly in nature. But the people are not ready to communicate with them. The exclusion from the social interactions leads transgender people into several distresses, tribulation, deprivation which further limits their opportunities. It also denies their visibility in all major domains of society.

The study reveals that a little more than half (54%) of the respondents often face negative experiences from the society. The society considered the transgender as a social deviant who have certain psychological problems. There no acceptance from the family and their community. At present our society is not successful in providing the facilities for the transgender to get their livelihood requirements. Not only providing the opportunities but also blaming for their mistakes.

Equality is a fundamental human right. It guarantees in our constitution. The right of equality before law and equal protection of law is guaranteed under Article 14 and 21 of the Constitution. The right to chose one's gender identity is an essential part to lead a life with dignity which again falls under the ambit of Article 21. The Court has given the people of India the right to gender identity. Further, they cannot be discriminated against on the ground of gender as it is violation of Articles 14, 15, 16 and 21. But transgender people are discriminated in our society in all walks of life. In public places like bus stands, railway stations, theatres, temples, educational institutions, offices, malls, beaches, playgrounds, even within the public toilets they are offended and insulted. The society considers transgender are not normal as the other members of the society. One of the largest reasons that transgender face inequality and feel inferior is due to the lack of public understanding of transgender people. This cause low self respect, self esteem self confidence and self acceptance within them.

Table-1: Feelings of Respondents

Feelings of respondents	Number of respondents		Total
	Yes	No	
Self respect	12(24%)	38(76%)	50(100%)
Self esteem	10(20%)	40(80%)	50(100%)
Self confidence	18(36%)	32(64%)	50(100%)
Self acceptance	13(26%)	37(74 %)	50(100%)

On respondents feelings about themselves shows that only one fourth (24%) have self respect, while about three fourths do not have any self respect. About one fifth only have self esteem, while a great majority does not have any self esteem. A little more than one third feels self confidence. While others (64%) do not have self confidence. A little more than one fifth only accepted themselves. Self respect helps to fulfill our potential, develop healthy relationships. If we truly respect ourselves, then we can accept ourselves as well as others. The present study shows they have low level of self respect, self confidence and self esteem. Healthy self esteem originates in the environment found in the family, school, peer group, work place, and community. For healthy self esteem individuals need to receive nurturing from the people in their environment. Self control is the ability to regulate one's emotions, thoughts, and behavior. The ability to control ourselves helps to boost our feeling of self esteem. Here the transgender persons are very poor in the self respect, self esteem, self confidence, self acceptance, and self control. Our society has a vital role in these personality traits. They feels the society is under valuating and under estimated them. This attitude of transgender itself acts as a barrier to uplift their life.

Table-2: Types of Difficulties

Types of difficulties	Number of respondents		Total
	Yes	No	
Economic difficulties	46(92%)	4(8%)	50 (100%)
Lack of family support	39(78%)	11(22%)	50 (100%)
Difficulty with identity	38(76%)	12(24%)	50 (100%)
Avoidance based on transgender	45(90%)	5(10 %)	50 (100%)
Difficulties in social participation	48(96%)	2(4%)	50 (100%)
Difficulties in political participation	49(98%)	1(2%)	50 (100%)
Difficulties in religious functions	46(92%)	4(8%)	50 (100%)
Difficulties while using public facilities	48(96%)	2(4%)	50 (100%)
Difficulties in Education	47(94%)	3(6%)	50 (100%)

The table 2 on distribution of Respondents by their difficulties in various life situations shows that Except a few almost all suffer from various difficulties such as economic difficulties (92%), participation in social activities (96%), political participation (98%), religious participation

(92%) and feel avoidance (90%). A more than three fourths (78%) are not getting any support from family and feel homelessness. Another three fourths (76%) feel identity crisis

We have to experience all kinds of difficulties throughout our lives. Everyone has problems in life. For the most part, we are able to quickly solve them without much trouble. Problems become more difficult it is impossible to lead a happy life. Here the table shows different types of difficulties faced by the transgender. The major difficulties faced by the transgender are the economic problems, absence of family support, identity crisis, different types of avoidance, and difficulties in social, political and religious participation. The mentality of the society is not strong enough to support the transgender as to accept them in the mainstream of the society.

Transgender experience discrimination in their everyday life. The major one is they have very limited employment opportunities. This study shows that 96 % respondents are say that government is not giving opportunities to them. 4 percentage of the minority respondents are says that the government giving opportunities to them. In real life situations in any of the areas government is not taking any actions to support them. But The Transgender Persons (Protection of Rights) Bill 2016 was introduced in Lok Sabha on August 2, 2016 highlights a transgender person must obtain a certificate of identity as proof of recognition of identity as a transgender person and to invoke rights under the bill. The bill prohibits discrimination against a transgender person in areas such as education, employment, and healthcare. It directs the central and state governments to provide welfare schemes in these areas.

The study shows that 92% of respondents are believe that the new generation accepts the third identity. Teens are more broadminded persons and they accepting all changes in the society. They oppose the entire conservative and traditional outlook and believe. The study also reveals the other problems that are being faced by the transgender community are unemployment, lack of educational facilities, homelessness, and lack of medical facilities, depression, social exclusion and problems related to marriage.

The rule of law is supreme and everyone is equal in the eyes of law in India. Yet, the transgender community is in a constant battle as they have to fight oppression, abuse and discrimination from every part of the society, whether it's their own family and friends or society at large. The life of transgender people is a daily battle as there is no acceptance anywhere and they are ostracized from the society and also ridiculed.

Implications of the study

Transgender are constantly targeted for abuse. They suffer cruel, inhuman and degrading treatment, including a constant threat of violence that amounts to torture, forced disappearances and sexual violence. The International Protection for the Human Rights of Transgender guarantees all people are entitled to enjoy the protection afforded by international human rights law. Transgender are no exception. The non-discrimination principle, recognized in the UN Charter, the Universal Declaration of Human Rights, and other basic human rights treaties, including the International Covenant on Civil and Political Rights, mandates that the rights recognized in these treaties are ensured to all individuals, without any distinctions based on race, color, sex, national origin, religion or political opinion or other status. The “other status” clause invites the recognition of new grounds upon which discrimination is prohibited, such as sexual orientation and gender identity. It is now well-recognized that discrimination based on sexual orientation and gender identity violates the non-discrimination principle. The obligation to “respect” the right to equality prohibits any discrimination to “ensure” that right requires states parties to protect individuals from discrimination. This study recognized, affecting basic aspects of ordinary life such as work or housing, individuals are to be protected from discrimination within the article of right to equality. The right to personal security also obliges States parties to take appropriate measures in response to death threats against persons in the public sphere, and more generally to protect individuals from foreseeable threats to life. Unfortunately, Kerala has failed in this obligation. The high number of murders and other violent attacks against transgender individuals is stark evidence of the very hostile and violent environment for the transgender population that persists in Kerala. By failing to take adequate measures to protect transgender individuals from such attacks, Kerala is violating its positive obligations with respect to the rights to life and personal security under different Articles.

Conclusion

In Kerala Transgender face discrimination within their own family units and schools, in employment and housing, within government settings, and under the justice and legal systems. The main problem in the society is that there is no proper awareness and understanding of the transgender community and many of them are not accepting even they are human beings. Support from family and society is very essential for their upliftment. The transgender are averse against the society when the basic respect is refused by the society and when they receive ill-treatment

from the society they expose their arrogant activities to safeguard themselves. Marginalization deprives the transgender from their maximum potential for prosperity and denies even in gender related opportunities. It is wrong to judge and discriminate the persons who are different from the stereotype, which is created by human beings. A radical change in the life of transgender people is possible only through powerful legislation. The transgender policy bill introduced by Kerala government shows light on transgender issues and further steps for the upliftment of transgender people. The urgency of the era is the inclusion strategies for overcoming discrimination, inequality and stigmatization.

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PROBLEMS AND POSSIBILITIES OF TRANSGENDER ENTREPRENEURSHIP IN KERALA

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ABSTRACT

Entrepreneurship was a male dominated phenomenon in the world. But in the modern era we are witnessing the gender equity between in all spheres of life. Today a transgender entrepreneur enjoys high status and positions in our society. But transgender entrepreneurs face multiple types of problems and challenges. It negatively affects their efficiency. The major objective of the study is to find out the major constraints confronted by the transgender entrepreneurs. Another aim is to provide the effective suggestions for the development of transgender entrepreneurship. In this study primary data collected through interview schedule and observation. Secondary data were collected from books, journals and internet. Samples are taken from the Thrissur district in Kerala. Snowball sampling method was used to collect the data. The study was concentrating 50 samples from the universe. The study shows both the internal and external factors affected the development of their entrepreneurship.

Keywords: Problems, Possibilities, Transgender, Entrepreneur and Entrepreneurship

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Introduction

The emergence of the entrepreneurs in a society mainly depends upon the economic, social, cultural, religious and psychological factors. An entrepreneur is essentially a person who through his foresight and ability directs the application of human energy for organizing the enterprise. Entrepreneurship has been a male dominated phenomenon from the very early age, but time has changed the situation. The transgender also emerging as today's most memorable and inspirational entrepreneurs in the different parts of the world. Transgender entrepreneurship plays a vital role in creating jobs, innovation, growth as well as development in their life. It will help to enhancing the gender equality, empowerment and social inclusion of the transgender community.

In the words of Sharma "entrepreneurship demonstrates the inner quality, a creative and innovative response of the entrepreneur to changing environment." It is a perennial and perpetual process of development and reformation in every field of socio-economic endeavour. It connotes the philosophy of enterprise promotion, creation, proliferation, modernization and rehabilitation in the field of commerce, trade and industry. Actually small scale industrial units act as outlets for entrepreneurial talents and initiative. In the changed scenario awareness has motivated to transgender. Entrepreneurship opens up a new field for them and transgender can achieve their cherished profession which has independence and self support. Max Weber the classical sociologist says the spirit of entrepreneurship and its effectiveness is to a large degree affected by the prevailing climate of the region and culture. Culture through its values has a strong effect on entrepreneurial growth.

Today a transgender entrepreneur enjoys high status and positions in our society. But transgender entrepreneurs face multiple types of problems and challenges. It negatively affects their efficiency. The major objective of the study is to find out the major constraints confronted by the transgender entrepreneurs. Another aim is to provide the effective suggestions for the development of transgender entrepreneurship. In this study primary data collected through interview schedule and observation. Secondary data were collected from books, journals and internet. Samples are taken from the Thrissur district in Kerala. Snowball sampling method was used to collect the data. The study was concentrating 50 samples from

the universe. The study shows both the internal and external factors affected the development of transgender entrepreneurship.

Small Tempo of Transgender Entrepreneurship.

Transgender face different types of discriminations in all areas of life, especially in employment. The unstable careers and economic insufficiency is a major challenge for the transgender.

The socially constructed ideas are mainly unflavored for these people. Due to their gender identity and sexual nonconformity society considered them as a curse. The assigned gender role also creates a contradictory effect for their all initiatives. The cross gender characteristics and behavior pattern not accepted in the larger society. It is very difficult to come forward to the mainstream. They are struggling for a space in the community.

Discrimination, lack of social support, social stigma results the internal conflict and mental depression. The social hierarchy assigned to the transgender group is based on the nature of their professional engagement for their livelihood. In Kerala the people never give the mythical supernatural status to the transgender persons. They receive the supernatural status in other states of the country. They are considered as the sex workers and treated as the most vulnerable section of the society. The widespread nature of discrimination related with their gender expression also resulted they feel unsafe and ashamed in our social settings. The lower status of the minority group creating a separate category will lead to the stagnant lower position in the different spheres of life. In light of recent legislation the rise in successful legal action and a greater awareness of the rights of transsexual people in the workplace, it is clear that failure by employers and employees to eradicate such discrimination will have serious legal and economic implications. Transgender face several unique problems for their free movements in the highly gendered society. The unsupportive and rejection from family and society deletes their self confidence and self esteem, it is essential for a successful happy life. The talented transgender in different fields fear the discouraging societal attitude .They are unwilling to take the responsibility of the entrepreneurship.

Exclusion from the main stream of society

The existing patriarchal structure and social norms in our country have always suppressed the identity, dignity and even eligibility of those who belong to the 'transgender' category. They are the most marginalized and vulnerable communities with very pathetic and miserable living conditions and life situations. In Kerala context transgender subjugated to tortured and unvalued in the society. The inhuman treatment compelling them to migrate in other states of the India. The study reveals they are not significant persons in their family and fear of rejection from the society which caused their invisibility.

Transgender people who have always treated as inferiors in the mainstream .the unequal treatment and hesitation transgender forced to develop a unique life style. These differences are mainly in beliefs, habits, dress code, hair style, ornaments, cosmetics, food wear, entertainment, toilet practices, clapping and travelling nature. They confronted a series of issues from the public. The exclusion includes they cannot participate in social functions like engagement, marriage, housewarming, cultural and religious ceremonies. They are afraid the societies' unfavorable attitude, avoidance and humiliation. In some times they hide their transgender identity to their own protection. They are extremely excluded in the Kerala culture. It limits their freedom and living opportunities. They are highly invisible in the entire major domains of society. Not only discrimination but also exploitation in every parts of life is a serious problem. The society not accept and tolerant to this marginalized community. Harassment, abuses and reckons threaten their peaceful mind and normal life.

The social exclusion mainly reflected in all social institutions. The unfavorable attitude of staff and students caused the increasing dropouts among transgender people. It also limits their employment opportunities. It is a hurdle to get a better job. The enforced marriage and sexual exploitation is the major issues of the transgender. The lack of social integration leads to the increasing rate of suicide among transgender people in our state. The denial of basic necessities, rejection from the family and society are the important reasons for their suicide attempt. In Kerala has a lot of misconceptions related with gender identity. A radical change will happen through only with the powerful legislation. The transgender policy bill introduced by the Kerala government is a revolutionary step towards the upliftment of the transgender people in Kerala. The direct outcome of the policy bill is the better living condition and visibility of the transgender in our society. The transgender persons as the entrepreneurs are the remarkable achievement of the implementation of transgender

policy bill. The government provides more opportunities and financial help to this minority for new innovative strategies. The powerful legal support is very powerful and useful in the existing situation.

Factors Affecting Development of Transgender Entrepreneurship

Entrepreneurship is the outcome of certain traits which is found in the individuals that make them the successful entrepreneurs. The economic theory explains entrepreneurship emerges with the presence of certain economic conditions favorable to entrepreneurial activities. The socio-cultural theorists emphasize the entrepreneurship develop if a particular socio-cultural environment is Psychological theory proposes some psychological motives are responsible for the development entrepreneurship. Ironically the integrated theory proposes a set of factors responsible for generating entrepreneurship. On the basis of integrated approach several factors are responsible for the emergence of entrepreneurship. These are mainly internal and external factors. This different factors which affecting the development of transgender entrepreneurship are as following.

(A) Internal Factors

Internal factors arise or act from within or inside the transgender entrepreneurs. It is mainly the inner motives of the individual. The entrepreneurs here the transgender wish to work independently. This is the major reason for the development of entrepreneurship. The study shows 96% of the respondents are became the entrepreneurs, because of this reason. Transgender are the socially neglected category but they have the human desires and needs. Abraham Maslow's Hierarchy of Needs reveals the actual motivating factors of the entrepreneurship of the transgender. Here Maslow explains about the needs of self actualization and self realization through the fulfillment of the other needs. They are the human beings and they have their own person and social needs which motives them independently to achieve their needs.

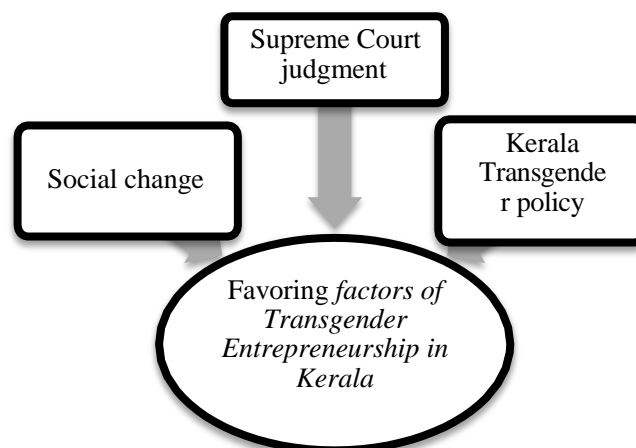
In the post modern era knowledge as well as money hold the power. It is essential for attaining the high social status and position in the society. The prestige issue is the real motivating factor behind their ambition to become the entrepreneur. 92% of the transgender agreed this reason. The situational reasons is a compelling or forcing reason for the entrepreneurship of the transgender. 90% of them opined this is the another factor for their entrepreneurship. They are pushed by their situation and the facilitating environment is the

supportive reason. Their work experience and self confidence which helps to start the new ventures. These internal factors or the personality traits of the individuals encourage them to select the entrepreneurship as their career. It is an opportunity and real challenge for these marginal people.

(B) External Factors

It is the opportunities and conditions which is favorable for entrepreneurship. The external environment has a vital role in the development of entrepreneurship. The major external factors are the financial factor. The availability of the financial assistance from banks and other financial institutions is an important external factor that promotes the entrepreneurship. The government and non government agencies supported the transgender entrepreneurs in their attempt to start a new attempt. The financial encouragement fostered the rate of transgender entrepreneurship. The training and guidance is available in the part of government and other concerned agencies, promoted their entrepreneurship. The post modern society is very open and meritocratic. It is the suitable condition for the transgender entrepreneurship. The members of the society are very generous in their outlook. Here ability and talents are valuable qualities. The open mind, positive attitude and mentality of the people also contributed the favorable condition. Beyond the traditional attitude on a day's society is more or less accepted the transgender as they are. These support systems and society are very external factor of entrepreneurship. The demand of the customer is the best scope for their entrepreneurship. The people are ready to accept the quality related goods and services. The availability of quality items and competitions also trained the transgender for better production and service. This increase their demand and necessity. The open market and free will also contributes the entrepreneurship in our society.

Figure: 1 Favoring Factors of Transgender Entrepreneurship in Kerala



Problems and Barriers of Transgender Entrepreneurs.

Transgender people in India face different types of problems. They are totally neglected community and excluded from effective involvement and denied the active participation of socio-cultural, economic and political participation. The study shows depth as well as intensity of the problems.

Lack of acceptance

Society is very doubtful about the abilities of the transgender. There is no history of successful transgender entrepreneurs in the country. Kerala people consider they are only sex workers. Nobody is willing to accept their abilities and talents.

Financial problems

Economically they are poor people. Their financial condition is very pathetic. The capital for the entrepreneurship is a difficult issue. Generally they have no any fixed income. So the transgender investment capacity is low. People are not ready to give any financial assistance to them.

Lack of technical knowledge

The higher education of the transgender is a difficult task. Only very limited persons attain high qualification. The technical knowledge is found at low level compared to others. They needed the technical education to become a successful entrepreneur.

Lack of decision making capacity

Their decision making capacity is very low. Transgender people never participate in any decision making process in their family. They do not have any courage to take risk in life. Entrepreneurship needs their greater involvement in entrepreneurial activities.

Lack of motivation

The aims and goals of the transgender people are very limited. Motivation .if we have a goal, we will boldly overcome any crisis..Lack of purpose is a major drawback of the transgender entrepreneurship

Lack of awareness

Nowadays government and other private lenders are willing to finance them. But they are not aware of it. Moreover, transgender people are not aware of training programs and awareness classes that are held for entrepreneurs.

Different types of discriminations.

Transgender entrepreneurs experience social, cultural, religious political and gender discriminations. How well they perform, no one accepts or encourages them. That undermines their self confidence. This adversely affects their performance.

Gender bias

Gender bias affects them very much. Society not valued their existence and presence. It is also an issue of society's attitude. Others in the society regard transgender as inefficient and useless. This prevents the entrepreneurs doing well.

Accommodation problem

This is one of the biggest problems. They are always viewed with the eye of a doubt. Transgender do not always have the necessary facilities to do their work. Because of this, many of their ventures have to quit. All these problems always hinder their activities.

Entrepreneurship demand high level of sociability and mingling capacity. Lack of self acceptance negatively affects the relationship. It reflects in all activities. A transgender entrepreneur has various obstacles in their life. It is so large that we cannot be numbered. The main barriers illustrated in the following table.

Table: 1 Barrier of Transgender Entrepreneurs.

Barriers	Number of respondents		Total
	Yes	No	
Avoidances	44(88%)	6(12%)	50(100%)
Conservative outlook of the people	36(72 %)	14(28%)	50(100%)
Denial of access to public accommodations	42(84%)	8(16%)	50(100%)
Economic constraints	44(88%)	6(12%)	50(100%)
Exploitation	40(80%)	10(20%)	50(100%)
Fear of taking risk	38(76 %)	12(24%)	50(100%)
Feeling of depression	32(64%)	18(36%)	50(100%)
Gender discrimination	48(96 %)	2(4%)	50(100%)
Gender dysphoria	42(84%)	8(16%)	50(100%)
Inadequate managerial skills	26(52%)	24(48 %)	50(100%)
Lack of education	30(60 %)	20(40%)	50(100%)
Lack of encouragement	40(80 %)	10(20 %)	50(100%)
Lack of family support	36(72%)	14(28%)	50(100%)
Lack of self confidence	26(52 %)	24(48%)	50(100%)
Lack of self esteem	38(76%)	12(24 %)	50(100%)
Maltreatment	38(76%)	12(24 %)	50(100%)
Rejection and prejudices	44(88 %)	6(12%)	50(100%)
Social exclusion	44(88 %)	6(12 %)	50(100%)
Social stigma	46(92 %)	4(8 %)	50(100%)
Tough competition	30(60%)	20(40 %)	50(100%)
Unfavorable attitude of society	46(92%)	4(8%)	50(100%)
Violence at workplace	32(64 %)	18(36 %)	50(100%)

Supportive Measures and Strategies for Transgender Entrepreneurship

In the male dominated world all the weaker sections of the society struggling to establish their identity in the social system. It is essential to take right actions for the development of transgender entrepreneurship. They need special attention and support, trainings and meritorial awards etc. Vocational training is essential for the transgender entrepreneurs. The supportive measures include the different types of financial assistance, accommodation facilities,

Transgender friendly policies will encourage them to participate effectively in the development process.

For the greater participation in the entrepreneurial activities need the grossness to introduce certain strategies for the effective development of transgender entrepreneurs. Firstly we must consider they are a special target group. Provide the better educational facilities and ensure their utility of the opportunity. Conduct the training programs to improve their managerial skills. Give support their imitativeness. Organize vocational and soft skill training programs. Help to enhance their professional competence and leadership qualities. Adequate training and continuous monitoring system discarded one. Start counseling facilities for the needy persons. Take actions for bestowing more capital assistance by the government and other finance corporations. The table gives a clear idea about the strategies.

Figure: 2 Strategies for Transgender Entrepreneurship



Suggestions

Ensure equality: According to the Indian constitution, all citizens are equal. Article 15 guarantees the fundamental right to equality. This equality must also be ensured in the comprehensive areas of life. As a citizen of India, transgender people need to ensure this equality. They should have the opportunity to engage in any kind of decent work they like.

Protection from violence and exploitation: Violence and exploitation should be eliminated, which is the critical problems of transgender entrepreneurs. We need to protect them from all kinds of exploitation. It is the duty of each of us.

Schemes and Programs for empowerment: Transgender people are deprived of even the basic amenities in life. We have to give them all the help they need to increase their knowledge and work skill. This will help their financial well being. Then only transgender make a profit by engaging in new jobs with confidence. The government has to come up with many schemes that provide financial assistance to the transgender entrepreneurs.

Empowerment through Education: We can raise the social position of the transgender people only by giving them a good education. They also need special learning facilities. They should be able to talk and share their problems. Their status can only be enhanced by providing good education .That way we can lift them up.

Accept the society: Any change begins with the acceptance of society. For the transgender people to have a good place in our society, we must embrace them with our minds. All the necessary programs have to be organized at the government level and all humanitarian considerations have to be given to them by civil rights.

Soft skill and Vocational training: We should be able to enable them to earn enough for their livelihood. Soft skills training and other vocational training are ways to help them become self sufficient. They must work, earn their own income and live well. This is empowerment. The way to do this is entrepreneurship.

Confidence building workshops: It is very essential to give the confidence building training to the transgender entrepreneurs. A person can use his skills properly only when he has confidence. Those who face ridicule and neglect from society will never have self esteem. Everyone can do well if they have faith in their own abilities. Therefore, we should organize workshops for transgender people to build self confidence.

Technology based knowledge classes: Technology based knowledge classes can be a great help to entrepreneurs if they get before starting a business.

Thus more and potential transgender candidates should be motivated to join entrepreneurial activities. Today government and voluntary organization had taken different developmental programs for the upliftment of transgender.

Hope the Colorful Future

The recognition of transgender is one of the most important events of the modern age and our society is ready to accept them. Despite its limitations, transgender people have a place in our society. One of the main reasons is the change in attitude of the people. The society is ready to accept their limitations. Society values these people and tries to give them equality in everything. Transgender people are being accepted everywhere in all walks of life. Those who were once deemed despicable are now being given a place of honors in society. The recognition of the people makes it clear that they have a place in the general mind. This is a very positive thing. It is very important to take the oppressed and neglected into the main stream. This shows the infinite possibilities for development ahead of them.

In the past the condition of transgender is worse in Kerala than any other states. This is related with our traditional viewpoint of gender binaries. It is very sad for transgender people to be excluded from social relationships. That limits the development possibilities of their lives. They do not come into the mainstream in Kerala society. The government of Kerala has made many changes in order to reverse the situation and improve their condition. Kerala government enacted legislative measures for the transgender. To protect constitutional rights and privileges, the government of Kerala has implemented a transgender policy in the state after Supreme Court Judgment. This gave them the right to legal protection to exercise their rights. Transgender people have a situation where they can live just as any other citizen. The state gives them the opportunity to engage in work suited with their talents. This demonstrates the great potential they have in their careers. They can perform tasks based on abilities. Yes, the horizon opens up a huge scope for transgender to work according to their skills. As an entrepreneur, there is a situation in Kerala today where transgender are allowed to work. The existing condition is that enables them to work on their feet freely and happily. A bright future awaits the transgender community.

Conclusion

Entrepreneurship was a male dominated phenomenon in the world. But in the modern era we are witnessing the gender equity between in all spheres of life. Today a transgender entrepreneur enjoys high status and positions in our society. But transgender entrepreneurs face a various types of problems and challenges. This study has assessed the problems and

possibilities of transgender entrepreneurship. The income generating business activities is a feasible solution for the better status and empowerment of transgender in our society. Their own income will help them stay on their feet. Financial self-reliance is something that boosts our confidence. So it is the best time we can focus our genuine actions for the upliftment of the transgender people by increasing their work participation and entrepreneurship.

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‘In-migration; aspirations and career enhancement of transgender Persons’

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ABSTRACT

Transgender people are the most oppressed and marginalized sections of India. Due to the hostile attitude of society, they are not able to succeed in life. But social change and development opportunities provide everyone with golden chances to show their individual skills. Transport facilities, push and pull factors leading to internal, national and international migrations. Each country provides individuals with opportunities to move to places where their abilities are recognized and freedom of action is ensured. A person's abilities, talents and skills greatly help one to excel in the profession. There are a lot of transgender people in India who have been very talented in their careers. In Kerala, several prominent transgender people have reached the top of their lives through systematic planning and ingenuity. This is a research paper on transgender who are in-migrants within the state of Kerala, who strive to excel in their careers by overcoming life's difficulties with great confidence.

Key words: ‘Migration, Ambition, Profession, Transgender.

INTRODUCTION

Migration is a global phenomenon. This can happen between countries, within and outside the country. People move to other places for various reasons. They do this to improve their lives. It is motivated by good jobs, economic profit and social acceptance. Transgender people are a neglected and outspoken minority in our society. Even though Kerala is culturally

high, transgender people are still unacceptable. Traditionalist thinking and antagonistic attitudes in the society are creating obstacles to their inclusion. Structural and social stigmas lead to many forms of discrimination. Transgender persons are totally unacceptable in the areas of education, employment and health care. Due to changes in the socio-cultural level and the progressive mindset, there are some differences in favor of transgender people.

They are quickly attracted to a place where they can work. They work there and live well. Thus transgender migrating to urban areas of Kerala and making their mark in the work place. In their own homes transgender are not recognized by their parents, siblings or other relatives. Even their friends keep them away from them because of their unusual behavior. They don't like places where people are just mocking and ignoring them. They move to a place where nobody cares about them and teases them. In addition, the good living conditions of urban areas attract transgender people.

A person's abilities, talents and skills greatly help one to excel in the profession. There are a lot of transgender people in India who have been very talented in their careers. In Kerala, several prominent transgender people have reached the top of their lives through systematic planning and ingenuity. They are able to work freely and earn money in their new place. Many studies show that the process of migration is a result of socio-cultural and economic factors. Women, men, children and people from different groups have different reasons for this. Just as there are many reasons to move from one location to another, there are certain factors that influence the choice of the right places. Transgender people tend to choose careers according to their tastes. They have good self-confidence and self-esteem. These people work hard to make the best of their jobs.

METHODOLOGY

The present study designed to find out the in-migration; aspirations and career enhancement of transgender persons. In this work researcher try to analyses the internal migration of transgender from rural to urban settings in Kerala, especially in Ernakulum district. Here transgender means that individuals who live with a different gender identity, gender expression and behavior pattern which is mismatched from their assigned sex at birth. Descriptive research design and snowball sampling method were used for the study. The tool of data collection was Interview schedule. The study was conducted among 50 transgender people who come to Ernakulum from different parts

of Kerala to find a job and now live here. Respondents belonged to the age group of 20 to 40 and were members of the 'Mudra' the CommunityBased Organization in Ernakulam.

RESULTS

This is a study of 50 transgender people who come from different parts of Kerala and live in Ernakulam city. It was conducted among 50 transgender people aged 20 to 40 years. From the total participants, 60% were Hindus, 10% were Christians, 26% were Muslims, and the remaining 4% were atheists. In terms of their living arrangements, 30% of the respondents live with their partners, 70% live with transgender friends. According to Stanislaus (1999) education leads to self reliance and involves self respect and self assurance which are helpful for the total upliftment of an individual. Among the total respondents 10% of them have only lower primary education 50% of them have upper primary education and 40% of them have high school and above. Transgender people are working and earning a good income. About 26% of transgender people have a monthly income of between 10000 to 15000. 44% of the transgender earning a monthly income is between 15000 to 20000. For 20% the monthly income is 20,000 to 25000. 10% of transgender people earn more than 25000 in a month. The following table outlines the major types of jobs that transgender people are engaged in their life.

Table1: Occupational status of the respondents

Occupation	Frequency	Percentage
Cochin metro workers	3	6%
Transgender shelter home employees	2	4%
Running beauty parlor	2	4%
Makeup artists	9	18%
Community Based Organization Staff	3	6%
Dance Teachers	7	14%
Shop Keepers	3	6%
Food Delivery Service	1	2%
Stitching and Tailoring Works	5	10%
Designers	4	8%
Modeling	3	6%

Stage programmers	5	10%
Jewelry makers	3	6%
Total	50	100%

DISCUSSION

James M Henslin (1997) states that the in-migrants always searching for a better life condition. Immigrants from rural areas to the city are liberated from many things. When they come here, they are completely freed from the family, religion, educational institutions and social institutions that are always trying to control their life and behavior. DehanjGhose and V N P Sinha (2005) argues all migrants from rural areas to urban areas are free from old traditional agencies. Internal displacement refers to the forced movement of the people within a country. Coffee Annan former UN Secretary General opined "internal displacement is the great tragedy of our time .The internally displaced people are among the most vulnerable of the human family."

The push and pull factors prompted transgender people who migrated to the region to find work and make a living. Push factors have mainly forced them to leave their places of birth. These include financial insecurity, unemployment, limited opportunities, intolerance, poverty, ridicule and lack of recognition. Security feeling, career choices, different Jobs, better employment opportunities, better wages, better living conditions, tolerance and individual freedom are some of the important pull factors that have attracted them to the city and helped them to live here.

All transgender people in this study live a good life with a variety of occupations. Unlike the traditional occupations of transgender people such as begging and prostitution, they are doing decent work. Getting higher education and good jobs is a natural desire of all human beings. But this is wrong for transgender people. The reason is that they are not getting the higher education, good job, or the opportunities they need. Here we see transgender people who work very well and earn income. Although they have experienced discrimination and violence in the workplace, they have adapted to the most conducive environment and are living well. It is with this in mind that they moved to the city, and the career chosen for them. These are all

positive changes. In this study, we can see that transgender people's vocation concerns and attitudes.

The research work shows 6% transgender are working in Cochin metro. 34% want to do their own business in the future. The biggest obstacle is the economic deficit. They strive to rise further in the profession and achieve many. 62% of them have utilized the benefits received from the Government of Kerala and the Social Welfare Department. 88% of respondents said they feel great satisfaction when they work and earn a good income. 24 percent said they use their income to support their families. They try to participate in the training and complete the courses to gain expertise in their areas of interest. They realize that all this has a profound effect on their career. Although many are not well-educated, they have found suitable employment and succeeded. 18% of them are makeup artists. They even work in the film industry. There are 6% of transgender people who work in a very flattering way in the modeling. In addition, they train and prepare for a variety of events, including school festivals, university-level competitions, and other stage events.

Mustafa Bilgehan Ozturk and Ahu Tatli (2016) says that transgender people face a lot of obstacles in their careers. Difficulties starting from the time of recruitment and selection persist throughout the careers of gender identity minorities and they have to endure much. 76% of respondents had a bitter experience with their work. 65% said they were proud and accepted by the community. 92% of respondents say they want to rise from their current social status. 96% of respondents said that they are constantly striving to reach their intended goal, regardless of any negative experiences. 76% have their own savings. 78% of respondents said that being able to work has eliminated the anxiety and uncertainty about life. They also shared that self-satisfaction gave them the sense that they were important people. 96% of respondents are confident that their transgender friends will always be there to assist in any of their needs. More than 90% of respondents feel that they need to be financially well off in order to have a good status in society. 70% of transgender people are capable of taking care of themselves. They are confident that they will be able to work and earn whatever they need. 88% of the respondents said that it is the society's duty to ensure that the fundamental rights guaranteed by the Constitution of India and the rights of justice, equality, liberty and equality as per Supreme Court judgments. 94% of

respondents said they needed good support from the community if they were to grow to the level they wanted.

CONCLUSION

Transgender people are one of the most neglected groups in Kerala. Nowadays transgender people have a habit of migrating to other parts of the country in search of jobs to secure their future. Their departure from Kerala to other states for looking a safer place has also decreased. Today, transgender people in urban areas of Kerala are getting decent and high-paying jobs. As a result of the new transgender policies of the Government of Kerala; they have seen some positive progress. They strive to make a decent living apart from the traditional forms of begging, sex work and dancing. They are striving to achieve self-sufficiency by participating in projects being implemented by the Social Welfare Department and Transgender Cell with the help of the Government of Kerala. They can live here only if we bring a radical change in the current way of our society. Transgender people need the support and encouragement of our Kerala community to find suitable employment, career advancement and socio-economic well being.

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Editorial

Good teaching emanates from Research. The teachers' love for research and their experience in research are vital for the growth of the institution. Any institution is judged by the level and extent of the research work it accomplishes. This sets in a regenerative cycle of excellence. Experience of research leads to quality teaching and quality teaching imparted to the young in turn enriches the research. The campus dynamics needs such type of research teaching research environment.

Technology is the non-linear tool available to humanity, which can affect fundamental changes in the ground rules of economic competitiveness. Science is linked to technology through applications. Technology is linked to economy and environment through manufacture of knowledge products. Economy and environment are linked to technology, which promotes prosperity to the society. We have to use innovation to generate high value added products for becoming a global player. The foundation for academic excellence is the research.

Let us take would like to give, how you young friends can become a great inventors or discoverers. What is the unique nature of thinking minds of discoverers and inventors of the world. "Inventions and discoveries have emanated from creative minds that have been constantly working and imaging the outcome in the mind. With imaging and constant effort, all the forces of the universe work for that inspired mind, thereby leading to inventions or discoveries". Now there are three unique friends to make you great; they are great books, great human beings and great teachers. Teachers should have the capacities to nurture the "creative minds" and "imagining minds".

So this conference has been designed to stimulate the young minds including Research Scholars, Academicians, and Practitioners to contribute their ideas, thoughts and nobility in these disciplines of engineering. It is a pleasure to welcome all the participants, delegates and organizers to this International Conference on behalf of IRAJ Research Forum and ITR family members. This conference has received a great response from all parts of the country and abroad for the presentation and publication in the proceedings. I sincerely thank all the authors for their valuable contribution to this conference. I am indebted towards the Reviewers and Board of Editors for their generous gifts of time, energy and effort for the Conference.

Editor-In Chief

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PROSPECTS AND IMPACT OF 'COLONIAL HYDROLOGY' IN MALABAR

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Abstract -

This paper analyses how was the concept of hydrology used as an imperial tool in the west coast of Malabar in Madras presidency. It conjoins the north and south regions of Malabar through the inland water way and it configure the market system of interior parts by interconnecting with principle ports near to it. However, as an impact of the integration of the natural inlets like rivers, backwaters and estuaries it brings out an uninterrupted line of inland waterway. The canal policy of British was a prime motive of imperial power that took up the natural water bodies especially rivers, backwaters and estuaries to join with artificial ways.

Keywords - Canal, Hydrology, Malabar, Inland waterways.

The canal system in the south western coast of Malabar was introduced by the Madras presidency. According to GeographicusIndicus, Malabar bounded from Mangalore to Cape Comorin, considerably lower and either muddy or sandy having shallow inlets termed as backwaters. The inlets pass through the inland area and very close to the coast of Malabar, more or less navigable and receiving the drainage from the streams coming from Western Ghats.¹This geophysical position of Malabar made an exposure in the imperial plan of making of canal that principally interlink the maritime exchange centers from north to south. So, the construction of canal in Malabar mainly through the hydraulic as well as mercantile policies were used parallel and created some transitions in the economic sphere of Malabar.

The history of Conolly canal underlies not the artificial creation but the imperial design of a coastal canal, passing through numerous backwaters, rivers and near to low sea board of the south western portion of the Indian subcontinent. It was primarily a colonial strategy that endowed through hydrological elements. Here, the concept '*Colonial Hydrology*' that explores the colonial experience with floods, drainage, wetlands, lakes and inland river navigations which encapsulated the British interventions in the geographical areas which were naturally favourable for the hydrological configuration of the region. As in the process, British tried to transform the floodplains which was watered by seasonal or inundation canals to the site for perennial irrigation works that involved the permanent head works across river beds with barrages and weirs. These canal engineering is not only acted as the channel from the river flow but also reorient the ecological relation between land and water. According to the concept of 'colonial hydrology' the canal policy represented not as a commercial and revenue motives of colonialism but

were intervention of social and physical colonial contexts.²

The locale of the canal depends up on two main factors; one is geophysical position of Malabar and other with the imperial design and discussions of the canal. There was several discussions occurred between British officials the experts from Malabar district which would be seen in the official letters to Madras presidency. The East India Company was very much conscious about the necessity of accurate geographical knowledge for the administration purpose and they executed series of survey in the newly acquired territories. In the case of Malabar, Francis Buchanan, a traveler who conducted agricultural survey and B.S. Ward and Conner made the geographical surveys which shaped strategic policy over the region. Evidently, Buchanan describes the navigable channels of Ponnani river broadest bed that was very shallow but during rains it was navigable within 15 miles of palakkad.³

According to the survey report of B.S. Ward and Conner, the narrow navigable channel from the right bank of Beypoor which had numerous serpentine windings of north west to Kakyebidge, south of Calicut and 1 mile of bridge communicates with sea. The bar was opened only during south west monsoon and a direct distance from the Beypoorriver to the Calicut bridge was only 4 miles and its actual distance was 8 miles.⁴Moreover, in the administration report of Madras, the Malabar described as singularly but diversified in its configuration. Beyond the boundary limits, the region near to the sea board the

²RohanD'souza, '*Water in British India; Making of a Colonial Hydrology*', *History Compass*, Vol.4, no.10, UK: Blackwell, 2006, pp.621-28.

³ Francis Buchanan, *A Journey from Madras through the Countries of Mysore, Canara and Malabar, Vol.2*, Delhi: Asian Educational Services, 1988, p.423.

⁴Ward and Conner, *A Descriptive Memoirs of Malabar*, Thiruvanthapuram: Kerala Gazetteers Department, 1995, pp.1-2.

¹ Index GeographicusIndicus, J. FresrickBaness, W. Newman and co., 3, Dalhousie square, 1881.p.129.

low laterite table lands helve into rice plains and backwaters fringed with coconut palms. Numerous rivers have hollowed out for themselves long valleys to the coast for 145 miles; its breadth varies from 25 miles on the north to 70 on the south. The coast runs in a south easterly direction, and forms a few headlands and small bays, with a natural harbor in the south at Cochin.⁵

Along with natural advantages of Malabar which possess a connected inland water communication, the above imperial survey reports and official letters emphasized the feasibility of canal consideration. So the completion of first 6 mile length of canal can be provided an uninterrupted water communication of 134 miles.⁶ By this integration of such a line, the company calculated the value of water with money valuation of two main purposes; irrigation and navigation. In this, the irrigation which gets first priority that comprised with three ways of irrigation which include complete irrigation of crops, seasonally irrigated and longtime irrigation. Through this, the cultivation and supply of food were sufficient to the whole population that sometimes extended to the surplus production of food crops itself. So, one of the most extraordinary ideas on the subject of irrigation was too much food will be grown and it made some ruinous situation more food that can be consumed on the spot, unless there is communications to provide for its being taken to other markets'.⁷ Moreover, it was the object of the company, who wanted to extend the communication of grains which more than the consumption. And the problem that comes across the irrigation system was 'what is the use of growing system when it proposed. Hitherto, British made a justification about the communication system itself. The canal policy in Malabar was also justified navigation of men and material.

Configuring of Regional and Market Networks in Malabar

The mapping and designing of canal was occurred during the early half of twentieth century. The utilization process of canal and accessing the channel started at its early foundation. The canals networks in Malabar were not a wholly connected one but a linkage between the backwaters of the coast and estuaries of rivers. The channel consists with three major cuttings which was not a linear progression whereas it links about the six hundred to eight hundred miles that connects inland water

communication with navigable rivers. The navigability of canal can be discussed through the evidences of the official correspondence of the deputy chief engineer of DPW, F.C.Cotton and Captain Francis, civil engineer of seventh division who made a detailed examination about the wide range of navigation accessibilities on the western portion of Malabar region by navigating through the channel from the southern end of Tanoor canal to Ponnani.⁸ According to Cotton the waterways in Malabar was marvel, intermingled the canals with lakes and rivers and reiterated that the stretch which would be useful for commercial transportation between north and south of Calicut.

The imperial discussion between the officials evidently shows the integration of inland network for the commercial purposes. As through the configuration of regional networks of Malabar prominently connected with the navigation system by which, it conjoins the inland parts of the Malabar.

Moreover, in the case of south Malabar, line of water communication through the Ponnani – Chavakkad section, conjoins the Malabar and British Cochin. The line of this stretch was prominently used by the merchants, travelers and common people for the navigation purposes because of the accessibility of road transport was rare in this part of the district. The southern portion of Malabar includes two navigable rivers Ponnani and Chetuvai which was distance of 20 miles between them. There was no communication between those rivers since the canal connection opened on those rivers. It was found the distance between Tirur to Cochin was 92 miles out of this only 26 miles was artificial channel and this made the southern portion as a practically sole means of communication between the southern part particularly Cochin.

According to their observation, the accessibility of road transport was rare in this part of the district and the inland network had been inevitable to this region. The accessibility of the direct navigation through inland waterways strategically paved the way for depreciating the importance of the subordinate ports. For instance, the Chetuvai port, a subordinate declined because of the systematic plan of the company was to create a direct navigation via northern to southern end. Here, we can see that the prominence given to the Cochin port was simply an imperial policy, that which explicitly seen in the communication between canal engineer, H.V.Conolly and the secretary of board of revenue.

⁵Manual of the Administration of the Madras Presidency in the Illustration of the Records of Government and the Administration Reports, vol.2, Madras: government press, 1885, p.115.

⁶Correspondence relating west coast canal project from July 1845 to December 1856, 2nd volume, Madras record office 7175, Calicut regional archives.

⁷Arthur Cotton, *Public Works In India Their Importance; With Suggestions for Their Extension and Improvements*, 2nd Edition, London: Richardson Brothers 23, Cornhill, 1854, Pp.176-177.

⁸Letter from F.C.Cotton, deputy chief engineer DPW, fort st. George to Colonel E.C. Faber, chief engineer of DPW, dt.5th October 1855. Madras record office si.no.7175, correspondence relating west coast canal project, 1845-1856, 2nd volume, Calicut regional archives.

The port is rising gradually in an importance and it was much frequented with British and foreign vessels, as well as steamers and country craft looking at the tonnage account, the average number of vessels of the description which are hereafter contribute to the customs, amount to more than 500 and then tonnage to 4500 a year, the traffic with free Indian ports is also considerable.⁹ Moreover, the impact of locale of the Conolly canal diverted the importance of the port cities of Malabar which was widely seen in these ports. The canal construction in Malabar creates a new paradigm to market system which was majorly linked with the port cities. It tried to convert the major ports of Malabar since 19th century in to the category of minor or subordinate ports where British intended to achieve the looping trade system that is port to port trade within the madras presidency through the Act VI of 1848. As per the act, the trade from port to port should be left free and unrestricted and take this opportunity as a modifying or abolishing the duties on articles used for the purpose of manufacture.¹⁰

In the case of Malabar, the company targeted to the Cochin port as a port to port trading system, which was affluent with sea trade activities within the madras presidency. The advancements of Cochin port paved the way for the diminishing the necessity of other ports in the west coast. So, as a mercantile policy the company planned to maximum utilizing the accessibility of the Cochin port by connecting it with the inland areas, linked with the of artificial channel of conolly canal with the natural watercourse of the region brings out the southward relation. The geographical accessibility of the western coast with rivers, backwaters enriched the navigation possibilities through the coast. So forth, the bridging regional networks by connecting these natural waterways was possible through the artificial channel of canal. Here, British maximum utilized the hydrological elements of the region itself. The construction of the canal occurred as in systematic way, the proposal after the systematic survey, organized authority and accuracy in the canal cutting at considerable extent. By, this structuring of canal was mainly done in the 4 parts; Pyolee, Ellathur to Beypoor, Tanur to Calicut, Ponnani to Chetuvai, the unconnected parts of western coast division.

The British policy of hydrological as well as mercantile interventions was done primarily through understanding of the landscape specialties which was done by the detailed survey of the region, by adapting

the landscape peculiarities, the canal which was constructed along with the natural inundations; it solely connected the linkages of north and south direction, evidently parallel towards the sea coasts. It evidently reflects the role of landscape peculiarities in orienting new level of mercantile tactics which penetrate the colonial capital resource to the micro regions of the Malabar. Here, at first through the construction of artificial channel allocated the colonial fund for the construction of it, later the emergence of new local marts which brought out the native capital to the British state. By this, the transfusion of the capital at the initial level as an investment to the development of the mercantile activities which was further reconstituted the capital resource of the native to the colonial country through emergence of new local based marts. So that, the making of canal and its construction policies was played a pivotal role in the transition in the system of market hierarchy as well as the configuration of regional networks. So that, the local markets become one of the major factor for the configuring the regional networks which was a controlling or intervention factor for the micro regions of Malabar. It was the strategic political idea combined with economy that the British who tried to penetrate in to the micro level economy from the gradual movement from the macro level. Not only had that, these shifts from the macro to micro which reconstituted to locating the original production centers, directly linked to the core region or grass root level of economy itself.

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¹⁰Letter from W.E. Underwood, Collector of Madras Sea Customs to H.V. Conolly, Collector of Malabar, dt. 6th April, 1848. Proceedings of Board of Revenue (Sea Custom) Vol. 106. Madras Archives.

DESIGN AND MANUFACTURING OF FORMING DIE FOR REINFORCEMENT C & E COLUMN BOTTOM INNER

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Abstract - In this paper we have proposed design for die for producing part namely reinforcement C & E column bottom inner. For producing part various sheet metal processes were which were blanking, forming, blanking etc. But our part only required forming operation. So we designed forming die for that. Firstly tonnage calculations were made for die and according to its press load press was used. After that as per design company manufactured die by using their standard processes. Then final component obtained from die was inspected on inspection panel for dimension constraints and required surface finish.

Keywords - Form Die, Inspection Panel, Die Design.

I. INTRODUCTION

Forming processes are particular manufacturing processes which make use of suitable stresses (like compression, tension, shear or combined stresses) to cause plastic deformation of the materials to produce required shapes. For that metal stamping die is ideal tool that can be used for better accuracy and quality. It may be defined as chip less manufacturing process by which various components are made from sheet metal. Sheet metal operations are classified in two categories cutting operation and forming operation. In cutting operation work piece is stressed beyond ultimate strength which includes blanking, punching, notching, perforating, trimming, shaving etc. In forming operation stresses are below ultimate strength. There is no actual cutting of metal just contour of work piece is changed to get desired product which includes bending, drawing, redrawing, squeezing. Dies are classified according to press operation used or according to method of operation. Some of them are as follows.

A. Simple Dies:

Simple dies or single action dies perform single operation for each stroke of the press slide. The operation may be one of the operations listed under cutting or forming dies.

B. Compound Dies:

In these dies, two or more operations may be performed at one station. Such dies are considered as cutting tools since, only cutting operations are carried out. Figure shows a simple compound die in which a washer is made by one stroke of the press. The washer is produced by simulation blanking and piercing operations. Compound dies are more accurate and economical in production as compared to single operation dies.

C: Combination Dies:

In this die also, more than one operation may be performed at one station. It is difficult from compound die in that in this die, a cutting operation is combined with a bending or drawing operation, due to that it is called combination die.

D: Progressive Dies:

A progressive or follow on die has a series of operations. At each station, an operation is performed on a work piece during a stroke of the press. Between strokes the piece in the metal strip is transferred to the next station. A finished work piece is made at each stroke of the press.

II. COMPONENT DESIGN

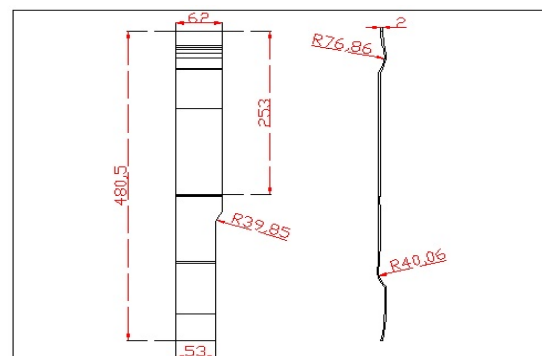


Fig 1 Component design

III. LOCATION OF COMPONENT



Fig.2 Location of part

Above figure shows location of part used in FORCE TRUMP

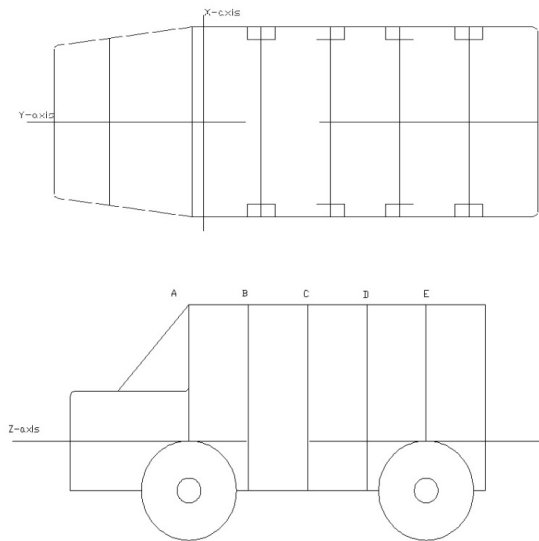


Fig.3 Division of vehicle by axes and column

Above figure is for better understanding of how vehicle is divided into axes and column name.

IV. FORMING DIE DESIGN.

Force required to deform the stock material with the upper form punch is form load.

Force Calculations:

A) Bending Force = $2 \times 0.33 \times UTS \times \text{Forming Length} \times (\text{Thickness})^2$

C

C = Punch Radius + Die Radius + Thickness

Bending Force = $(0.66 \times 60 \times 282 \times 4) / 8$
 = 5.583 Tons (c=8 mm)

B) Pad Force = 50 % of Bending Force

Pad Force = 0.5×5.583
 = 2.791

C) Total Load = Bending Force + Pad Force

Total Force = 5.583 + 2.791
 = 8.374

Die set consist of bottom plate that forms base of tool and top plate which supports guide pillar. The die insert is housed above housing plate. Component is extrapolated and similar surface is generated which is further extruded to obtain shape of die insert. Similarly upper punch is designed by taking inner contour of component. Distance between two surfaces is equal to thickness of metal. Selection of spring was done according to force motors manuals.

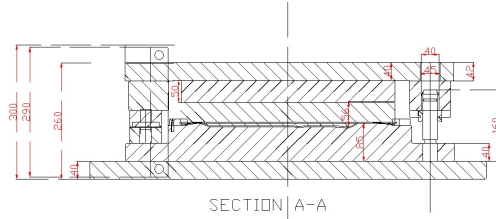


Fig. 4 Assembly of die

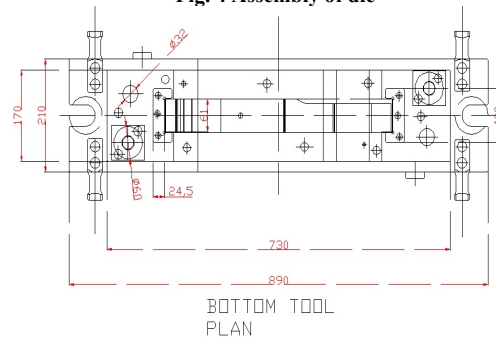


Fig.5 Bottom tool plan

NO.	DESCRIPTION	Mat.	SIZE			Qty.	
			DIA.	L(mm)	W		T
1	Bottom Plate	MS		890	210	40	1
2	Bottom Insert	C55		730	170	86	1
3	Soc. HD Screw	HW	M10	60			8
4	Dowel	STD	D10	60			2
5	Guide Pillar	STD	D30	160			2
6	Setting Block	MS		70	65	36	2
7	Soc. HD Screw	HW	M10	30			4
8	Stacker Pin	STD	SL. NO. 01				2
9	Lifter	MS	SR. NO. 01				4
10	Soc. HD Screw	HW	M12	40			8
12	Soc. HD Screw	HW	M12	40			4
13	Gauge Plate	16MnCr5		100	40	15	2
14	C' Sunk Screw	HW	M8		85		6

Table1: List of components for bottom tool

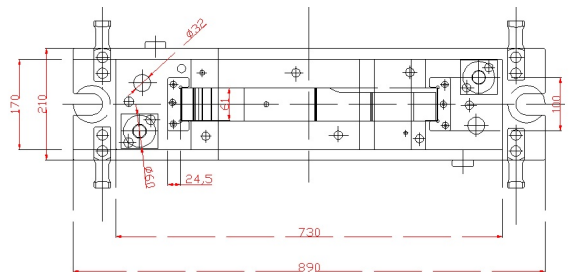


Fig. 6 Top tool plan

DESCRIPTION	Mat.	SIZE			Qty.	
		DIA	L(mm)	W		T
Top Plate	MS		730	210	42	1
Top Insert	C55		479	75	59	1
Soc. HD Screw	HW	M10	40			5
Dowel	STD	D10	40			2
Packing Plate	MS		479	75	50	1
Soc. HD Screw	HW	M10	40			5
Dowel	STD	D10	40			2
Bush Bearing	MS		170	90	65	2
Setting Block	MS		70	65	56	2
Soc. HD Screw	HW	M10	30			4
Guide Bush	STD	SR. NO. 01/02				2
Bush Retainer	STD					4
Soc. HD Screw	HW	M8	25			4

Table 2 : List of components for top tool

V. MANUFACTURING

Following manufacturing process is followed during manufacturing

GENERAL PROCESS FLOW

1. Bottom tool

- Plate of M.S. is taken as raw material
- Edges were grinded in surface grinder
- Marking and punching id done to get coordinates
- Holes were drilled in vertical drilling machine
- Clamp slots were cut by gas cut
- Top and Bottom surface were grinded
- Chamfering of $2 \times 45^\circ$ done on all corners

2. Bearing block

- Gas cutting is done to get require shape
- Milling is done to get required profile
- Surface grinding is done on both sides
- Marking is done to align block with other parts
- Holes are drilled on block

3. Top plate

- Gas cutting is done to get to get required dimension
- Edges were grinded
- Top and Bottom milling
- Milling only ate two corners
- Holes are drilling in vertical milling machine
- Layout marking is done on plate
- Drilling and tapping is done

4. Inserts

- Gas cutting is done to get required shape
- Milling is done to get required profile
- Surface grinding is done on both sides
- Marking is done to align one block with other
- Holes are drilled on the block

5. Stripper plate

- The raw material of dimension of plate is taken
- Edges were grinded in surface grinder
- Marking is done to get coordinates
- Holes were drilling in vertical milling machine
- Tapping was done

6. Bush bearing

- Gas cutting is done to get require shape
- Milling is done to get required profile
- Surface grinding is done for better surface finish
- Marking for alignment

- Proper positioning to the bush

VI. OPERATION DESCRIPTION

Work Order no : 85890		Machine : Light CNC			
Item Name/Number : Bottom Tool		Machine Name : Deckle 50CC			
Tool Name : Form Die		Total Estimated Time : 16 hours			
Part Name : Reinforcement C&E Column Bottom Inner LHRH					
SR. NO.	OPERATION DESCRIPTION	RPM	FEED (mm/min)	EST. Time(min)	Act. Time(min)
1	Loading & Setting			45	45
2	Gauge 2D Marking			15	15
3	Drill for Gauge Block			20	20
4	Gauge 2D	1000	1000	15	20
	Fine			15	20
5	Gauge 2D	2000	800	15	15
	cor Fine			15	15
6	Check			10	10
7	Remove Gauge Block			20	20
8	Height Milling up to Z=9.0 (Rough)			40	40
9	Step Milling at Edge Z=37.900			80	80
10	Step Milling for Gauge Setting Area up to Z=2.00	1000	1000	30	30
11	Pro Rough	800	1200	70	70
12	Pro Rest Rough	3000	1000	10	10
13	Pro SM GN	3000	1200	110	110
14	Pro cor SM Fine	3000	800	10	10
15	Pro Fine	3000	1200	250	250
16	Pro cor GN	3000	800	10	10
17	Pillar Bore			120	120
18	Check			15	15
			Total	915	925

Table 4: Operation description for bottom tool

Work Order no : 85890		Machine : Light CNC			
Item Name/Number : Top Tool		Machine Name : Deckle 50CC			
Tool Name : Form Die		Total Estimated Time : 16 hours			
Part Name : Reinforcement B Column Bottom Inner LHRH					
SR. NO.	OPERATION DESCRIPTION	RPM	FEED (mm/min)	EST. Time.	ACT. TIME(min)
1	Loading & Setting			45	50
2	Outer 2D Marking for Material			10	10
3	Height Milling upon Z=4.50 (Rough)			25	25
4	Tooling Hole			30	30
5	Pro Rough	800	1200	40	40
6	Pro Rest Rough	3000	1000	10	10
7	Pro SM Fine	3000	1200	55	55
8	Pro cor SM Fine	3000	800	10	10
9	Pro cor SM Fine	3000	600	10	10
10	Pro Fine	3000	1200	120	120
11	Pro cor Fine	3000	800	10	10
12	Pro cor Fine	3000	600	10	10
13	Gauge Relive Machining	2000	800	85	85
14	Pillar Guide Bush Bore			120	120
15	Check			20	20
			Total	600	605

Table 5: Operation description for top tool

VII. CONCLUSION

The component Reinforcement C & E Column Bottom Inner was successfully manufactured with the help of forming die and inspected on inspection panel. Thus die is used for mass production of part used in FORCE TRUMP.

ACKNOWLEDGEMENT

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STATIC FINITE ELEMENT ANALYSIS OF N1 TYPE CHASSIS FOR BENDING PERFORMANCE UNDER CONSIDERATION OF DIFFERENT CHASSIS MATERIAL PROPERTIES

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Abstract - The Automotive chassis is considered as the backbone of the vehicle. On chassis different members are provided to strengthen it and an important consideration in chassis design is also to have adequate bending stiffness for better handling characteristics. Thus, strength and stiffness are two important criteria for the design of the chassis. This paper is related with work performed towards the static structural analysis of the N1 type chassis and study of variation of bending stiffness of Chassis with different material properties as a part of final year graduate project at Automobile Research Association of India (ARAI). Structural systems like the chassis can be analyzed using the finite element techniques. Hence, a proper finite element model of the chassis is to be developed. The chassis in this project is modeled in CATIA V5. Analysis is done using the FEA software ANSYS.

Keywords - Chassis, Catia, Ansys, Bending, Stiffness.

I. INTRODUCTION

A Vehicle without body is known as chassis frame. The frame serves as carcass to which the engine, the units of transmission, control system, and the body of automobile are fastened. It should exhibit sufficient stiffness so that the relative displacements of the mechanisms installed on it remains unchanged and the deformation of body is minimum under action of inertia and reaction loads.

Chassis are made up of steel sections so that they are strong enough to withstand the loads and at the same time light enough to reduce the dead weight of the vehicle. The long sections which are at left and right positions are known as long members and the transverse sections connecting the long members are called as cross members. The total number of cross members is usually around 6-7. Cross members are joined to the long members using rivets or bolts and nuts to make the chassis robust and resistant to bending [1]

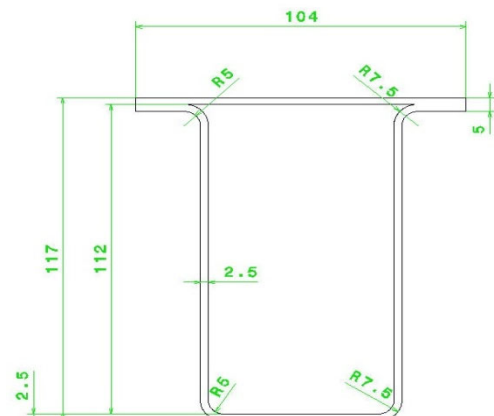


Fig.1: Cross section of long member

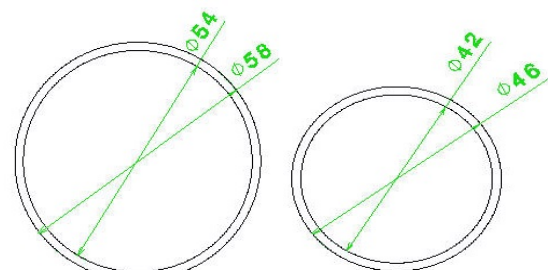


Fig.2: Cross sections of cross members

II. FINITE ELEMENT MODEL VALIDATION

2.1 FEA model specifications [2]

PARAMETER	DIMENSIONS(in mm)
Length	3800
Width	1500
Height	1845
Wheelbase	2100
Trackwidth- Front	1300
Trackwidth- Rear	1320
Cargo-Box Dimensions	2140*1430*300
Maximum Length	3800
Maximum Width	1104

Table 1: Modeling parameters of chassis

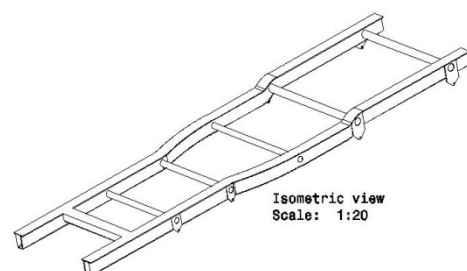


Fig.3: Final draft of chassis model (Isometric view)

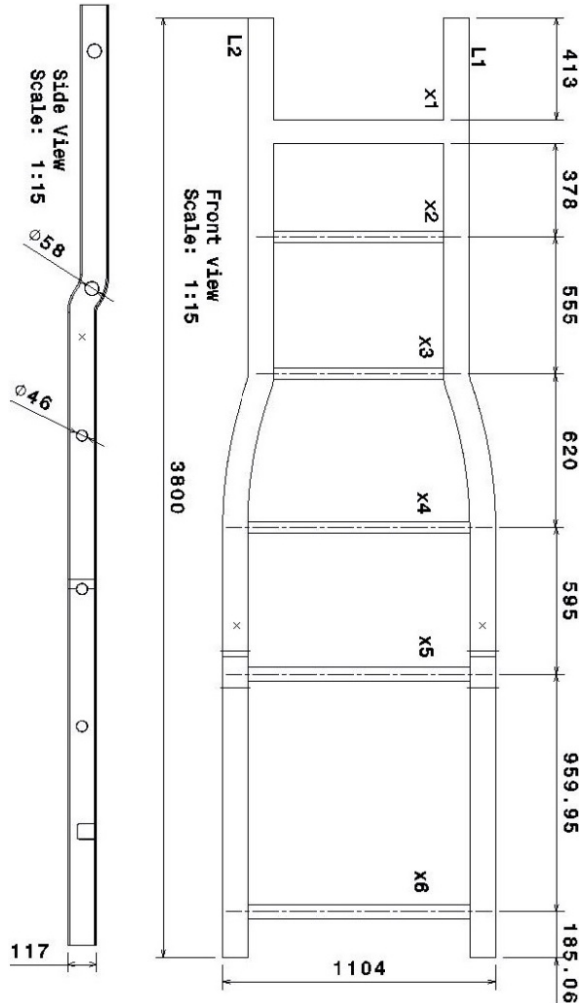


Fig.4: Final draft of chassis model with dimensions

2.2 Load determination

The load cases for this study are standardized cases and most of the calculations are carried out with the help of design data and other loading conditions. The main load acting on the chassis frame consists of engine, transmission, fuel tank, steering gearbox and cargo. These are the loads that will be acting at a particular point throughout the chassis. The various systems mentioned above are mounted on various cross members, these members are then analyzed for the load acting at a certain point. [3][4]

Particulars	Weight (in kg)
Chassis Self weight	61.75
Engine Transmission Assembly	105
Propeller shaft	5
Fuel tank(Completely filled)	35
Steering assembly	28.5
Cabin weight (with driver)	205
Battery	6
Exhaust assembly	7
Tool box	4
Radiator	12

Table.2: Weights of components

After examining the mounting of the above components and their weight distribution across the mounting points, final load acting on cross members and long members were calculated. [5][6]

III. CALCULATION OF BENDING STIFFNESS FOR VARIOUS CHASSIS MATERIAL

3.1 Materials used

Sr. No.	Material	Density (kg/m ³)	Poisson's Ratio	Syt (MPa)	Sut (MPa)	E (GPa)
1	Structural Steel	7850	0.3	250	460	200
2	AISI 9255	7850	0.29	930	580	200
3	AISI 5120	7850	0.29	635	460	205
4	AISI 2330	7750	0.29	689	841	209
5	AISI 1006	7872	0.29	689	841	209
6	AISI 1020	7870	0.29	346	445	186

Table 3: Material properties
Syt: Yield Strength
Sut: Ultimate tensile strength
E: Modulus of elasticity

3.2 Bending Stiffness Formula

The **bending stiffness** is the resistance of a member against bending deformation. It is a function of elastic modulus, the area moment of inertia of the beam cross-section about the axis of interest, length of the beam and beam boundary condition. Bending stiffness of a beam can analytically be derived from the equation of beam deflection when it is applied by a force.

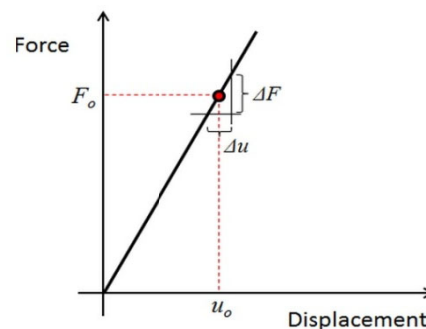
$$K = \frac{P}{W}$$

Where P is the applied force and W is the deflection. According to elementary beam theory, the relationship between the applied bending moment (M) and the resulting curvature of the beam is:

$$M = EI\kappa = EI \frac{d^2w}{dx^2}$$

$$F(u) = F_0 + k(F_0, u_0)(u - u_0)$$

$$k(F_0, u_0) = \lim_{\Delta u \rightarrow 0} \frac{\Delta F}{\Delta u} = \left. \frac{\partial F}{\partial u} \right|_{F=F_0, u=u_0}$$



A typical force vs. displacement curve for a linear elastic structure.

3.3. Meshing of chassis [8]

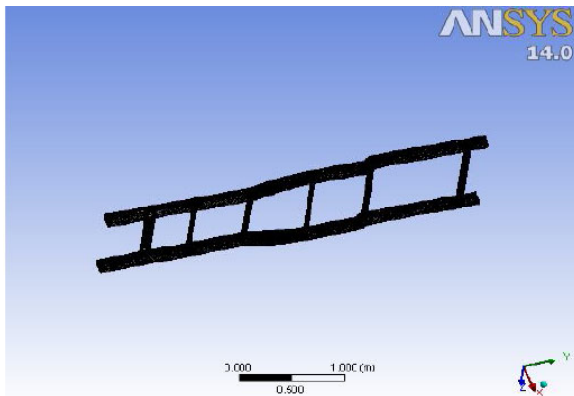


Fig.5: Mesh of Chassis

Mesh type	Tetra
Relevance Centre	Fine
Transition	Slow
Node count	138761
Smoothing	High
Element size	5
Element count	69939

Table 4: Mesh specifications

3.4 Defining loads and boundary conditions [8]

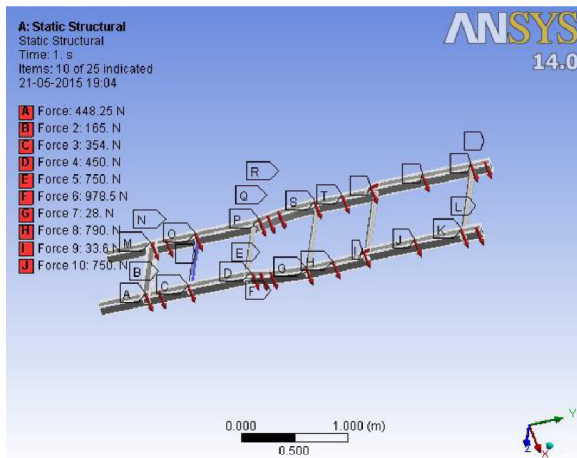


Fig.6: Bending analysis deck with loads

No	Forces (N)	es (mm)	no.	Forces (N)	s (mm)
A	448.25	460	M	634.25	448.25
B	165	595	N	165	165
C	354	885	O	354	354
D	450	1520	P	450	450
E	750	1600	Q	750	750
F	978.5	1705	R	978.5	978.5
G	28	2060	S	42	28
H	790	2330	T	810	790
I	33.6	2655	U	62.6	33.6
J	750	3145	V	750	750
K	126.9	3615	W	126.9	126.9
L	750	3760	X	750	750

Table 5: Loads on chassis for bending

3.5 Calculation of bending stiffness [7]

For, Structural Steel:

The maximum displacement value achieved is **0.054649m**

The force acting at the maximum Displacement point is point I with a force of 750 N

Therefore,

$$\text{The bending Stiffness} = (\text{Force}/\text{Deflection}) = (750 / 0.054649)$$

$$\text{Bending stiffness} = 13724 \text{ N/m}$$

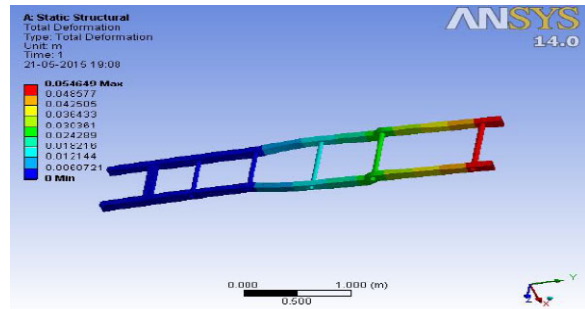


Fig.7: Analysis results (Vector Displacement) for structural steel

Similar process was carried out for other materials

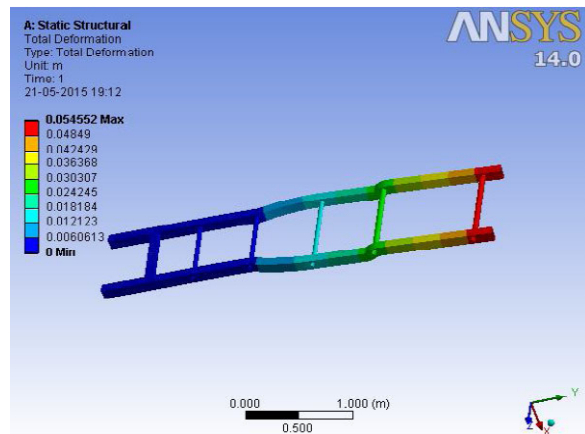


Fig.8: Vector Displacement plot for AISI 9255

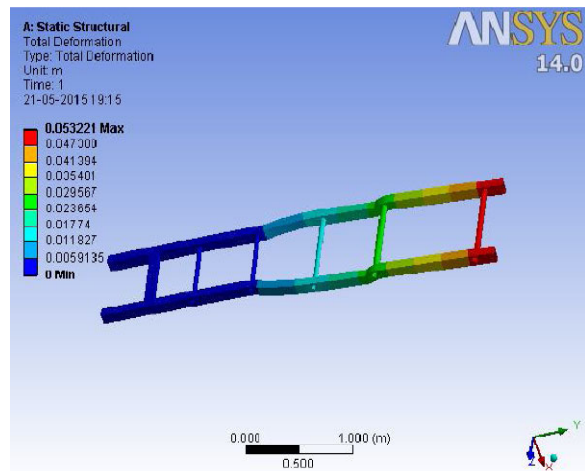


Fig.9: Vector Displacement plot for AISI 5120

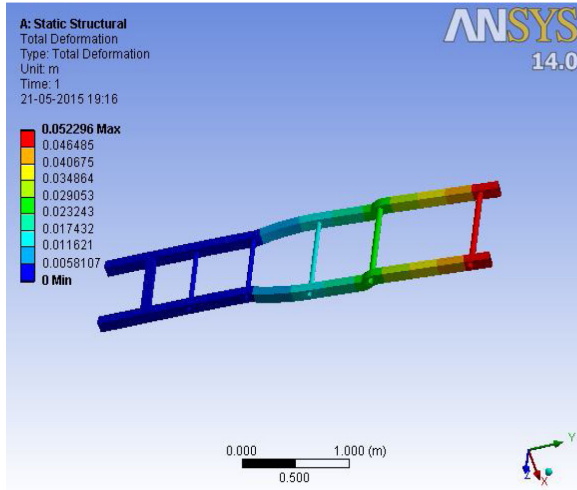


Fig.10: Vector Displacement plot for AISI 2330

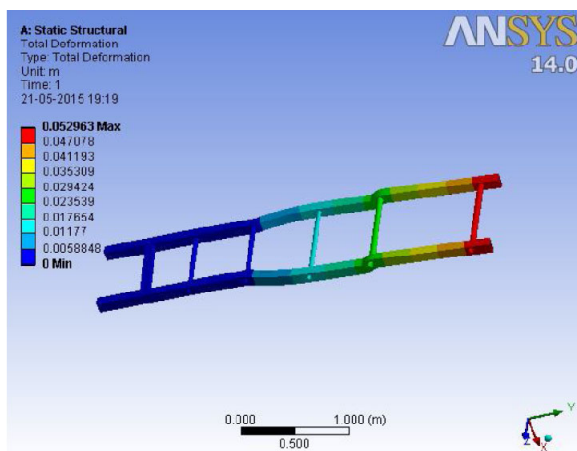


Fig.11: Vector Displacement plot for AISI 1006

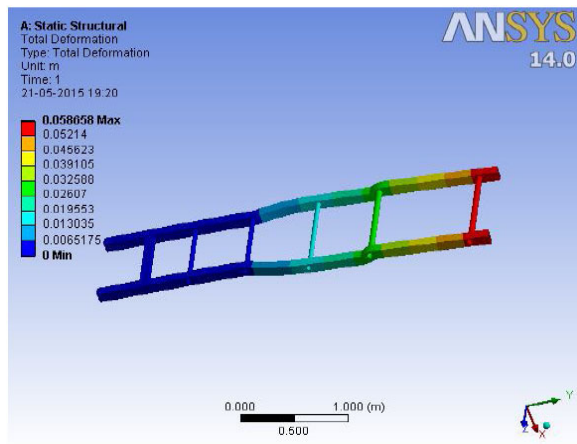


Fig.12: Vector Displacement plot for AISI 1020

IV. RESULTS

Sr.No.	Material	Bending Stiffness (N/m)
1	Structural Steel	13724
2	AISI 9255	13748.36
3	AISI 5120	14092.18
4	AISI 2330	14341.34
5	AISI 1006	14160.83
6	AISI 1020	13724

Table 6: Bending stiffness values

CONCLUSION

Thus it was observed that the bending stiffness value changes by changing the percentage of alloying elements, the values of bending stiffness of all alloys of Steel are in the range of N1 type Vehicles that is within 22000N/m.

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STUDY OF DRAG FORCE ON METRO RAIL USING CFD ANALYSIS

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Abstract - Reducing aerodynamics drag in fast running metro trains is necessary now days. Due to increase in the aerodynamic drag in the commuter trains, an increase in the power consumption by the metro train is observed. However the aerodynamic analysis is the most difficult part of design process, since it requires the evaluation of air flow at different speeds and is evaluated using CAE, as CFD. This approach has been applied in the past with the aim of improving the high speed train aerodynamic, Baker (2010). Wood and Beauer (2003) and KambizSalari et al. (2006) studied the aerodynamics of heavy road vehicles, aiming to create designs that could diminish the fuel consumption by reducing the aerodynamic drag. In this paper, the aerodynamic behavior of metro train had been evaluated with the help of CFD. The main goal was to compute the main aerodynamic drag force on metro train. The paper aimed to study the flow structure and its effect on metro train using CFD technology. Study led to simulation and analyzing the source structure and study of the velocity and pressure patterns of air across the body. It was an analysis on 2-D structure of the moving train. Present study had been done to understand the concept of fluid dynamics and its applications and to study the air flow over the body and its behavior at different locations and aerodynamic concept involved. Study resulted in obtaining various plots of variation of velocity and pressure due to its motion.

Keywords - CFD, Simulation, CAE, Aerodynamic Drag.

I. INTRODUCTION

CFD is a sophisticated computationally-based design and analysis technique. CFD software gives you the power to simulate flows of gases and liquids, heat and mass transfer, moving bodies, multiphase physics, chemical reaction, fluid-structure interaction and acoustics through computer modeling [3]. This software can also build a virtual prototype of the system or device before can be apply to real-world physics and chemistry to the model, and the software will provide with images and data, which predict the performance of that design. Computational fluid dynamics (CFD) is useful in a wide variety of applications and use in industry [1]. CFD is one of the branches of fluid mechanics that uses numerical methods and algorithm can be used to solve and analyze problems that involve fluid flows and also simulate the flow over a piping, vehicle or machinery. Computers are used to perform the millions of calculations required to simulate the interaction of fluids and gases with the complex surfaces used in engineering. More accurate codes that can accurately and quickly simulate even complex scenarios such as supersonic and turbulent flows are ongoing research. Onwards the aerospace industry has integrated CFD techniques into the design, R &D and manufacture of aircraft and jet engines. More recently the methods have been applied to the design of internal combustion engine, combustion chambers of gas turbine and furnaces also fluid flows and heat transfer in heat exchanger (Figure 1). Furthermore, motor vehicle manufactures now routinely predict drag forces, under bonnet air flows and surrounding car environment with CFD. Increasingly CFD is becoming a vital component in the design of industrial products and processes. The obtained data from the analysis can be utilized in reducing the aerodynamic drag on the metro

train running across the cities. This reduction of aerodynamic drag can be brought up by modifications in the design process or it may be the operating condition like velocity which can affect the performance of the metro train up to great extent. The data can be used to further improve the results by changing the input variables and observing the new data along with the old data and compare them to find out how much sensitivity each operating variables acquires. After this we can move on to those most sensitive operating variables.

II. NUMERICAL SETUP

A. Modeling

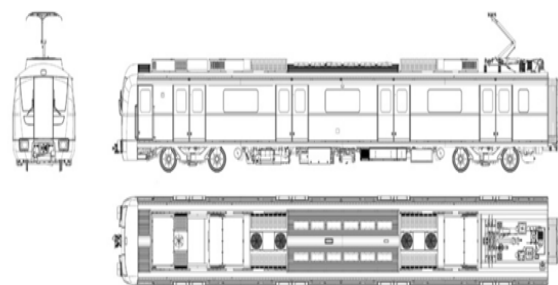


Fig.1: Geometric description of Metro Train

A thorough survey was done regarding the overall dimensions of the metro train. We have taken the dimensions from the paper provided by the bombardier company on the internet. The basic dimensions are as follows: Length: 22600 mm, Car width: 3200 mm, Car height: 4048 mm, Floor height: 1130 mm, Wheel base: 2500 mm [2].

The above dimensions are of the driver car and not the entire train. As per our convenience we have scaled down the dimensions by a factor of 200.

After the survey, we moved to solid works software for generating the model. The generated model is transferred into the ansys software which is shown in fig.2.

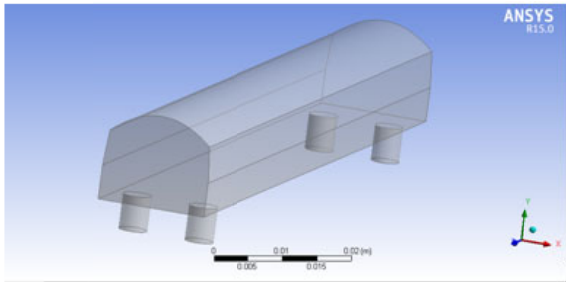


Fig. 2: Geometric Modeling in Ansys

It is necessary to generate an enclosure around the model so that the material enclosing the bodies can be assigned to something such as a gas or fluid in the ANSYS Mechanical application. The feature takes either all the bodies or selected bodies of the model as input, creates a frozen enclosure body around those bodies, and then cuts the bodies out of the enclosure. The frozen enclosure body will have a Fluid/Solid Property (as seen in the Details View when this body is selected) set to Fluid. This operation will not delete any bodies currently in the model. All types of bodies will be enclosed but only Solid bodies will be cut out of the enclosure.

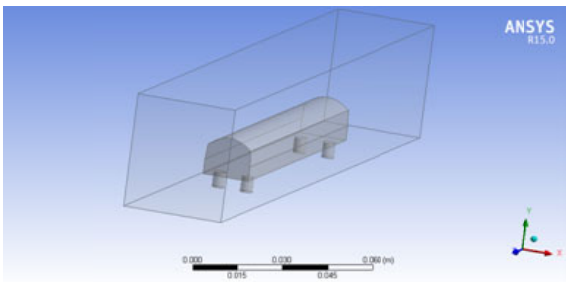


Fig.3:

See Fluid/Solid Property for more information about editing the property.

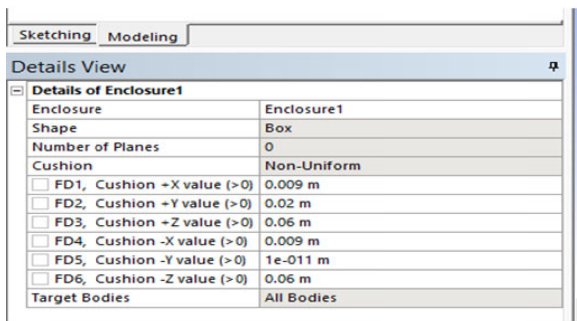


Fig.4: Parameters Selection in Enclosure Generation

Further Boolean Operators were used to connect and define the relationship between certain terms [4]. In the Boolean operation, the body of the metro train is subtracted from the air column.

B. Meshing

The process of obtaining an appropriate mesh (or grid) is termed mesh generation (or grid generation), and has long been considered a bottleneck in the analysis process due to the lack of a fully automatic mesh generation procedure. The partial differential equations that govern fluid flow and heat transfer are not usually amenable to analytical solutions, except for very simple cases. Therefore, in order to analyze fluid flows, flow domains are split into smaller sub domains (made up of geometric primitives like hexahedra and tetrahedral in 3D and quadrilaterals and triangles in 2D). The governing equations are then discretized and solved inside each of these sub domains [6]. Typically, one of three methods is used to solve the approximate version of the system of equations: finite volumes, finite elements, or finite differences. Care must be taken to ensure proper continuity of solution across the common interfaces between two sub domains, so that the approximate solutions inside various portions can be put together to give a complete picture of fluid flow in the entire domain. The sub domains are often called elements or cells, and the collection of all elements or cells is called a mesh or grid. The origin of the term mesh (or grid) goes back to early days of CFD when most analyses were 2D in nature. For 2D analyses, a domain split into elements resembles a wire mesh [7].

After Boolean operation, the geometry is entered into meshing. In meshing, face sizing of the body was done after which various parameters were selected. Among these parameters, sizing, inflation, patch conforming options, advanced options were included. In meshing, three types of meshing were done.

First coarse meshing was done in which relevance center chosen was coarse and analysis was done on the basis of those parameters.

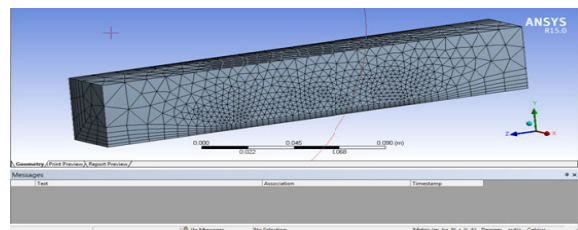


Fig.4: Coarse Meshing

After this, more refinement was necessary for obtaining the more accurate results. Then the medium and fine relevance center had been chosen and further analysis was done.

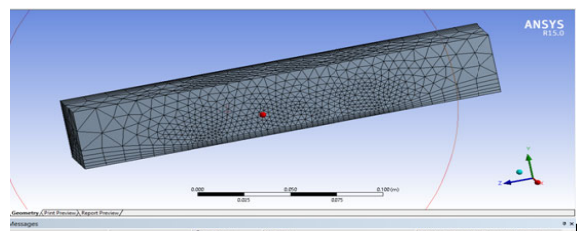


Fig.5: Medium Meshing

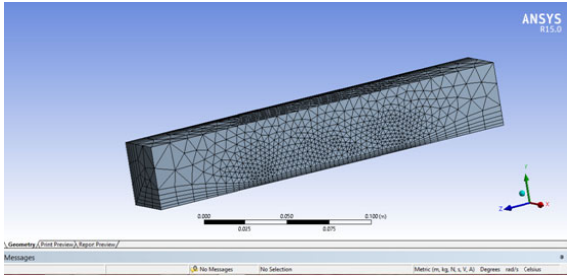


Fig.6: Fine Meshing

C. Sizing

Under mesh parameters selection, the sizing is done. In this sizing, the various parameters were selected.

Use Advanced Size Function	On: Proximity and Curvature
Relevance Center	Fine
Initial Size Seed	Active Assembly
Smoothing	High
Transition	Slow
Span Angle Center	Fine
<input type="checkbox"/> Curvature Normal Angle	Default (18.0 °)
<input type="checkbox"/> Num Cells Across Gap	Default (3)
<input type="checkbox"/> Min Size	2.e-003 m
<input type="checkbox"/> Proximity Min Size	Default (3.4835e-005 m)
<input type="checkbox"/> Max Face Size	0.250 m
<input type="checkbox"/> Max Size	0.250 m
<input type="checkbox"/> Growth Rate	Default (1.20)
Minimum Edge Length	5.e-003 m

Fig.6: Sizing Parameters

In this, advanced size function was chosen as Proximity and curvature and then relevance center was chosen according to the problem’s requirement. Then initial size seed was selected as active assembly. Transition in this project problem had been taken as slow because when the elements tended to change the surface from one to another, it requires slow transition.

D. Inflation

Under inflation also, various parameters had been selected.

Inflation	
Use Automatic Inflation	Program Controlled
Inflation Option	First Aspect Ratio
<input type="checkbox"/> First Aspect Ratio	5.
<input type="checkbox"/> Maximum Layers	5
<input type="checkbox"/> Growth Rate	1.2
View Advanced Options	No

Fig.7: Inflation parameters

Automatic inflation was selected as program controlled and the inflation option as first aspect ratio. First aspect ratio was chosen as 5 and growth rate as 1.2 taken from Best practice guidelines for handling automatic external aerodynamics with fluent research paper [8].

E. Statistics

Statistics shows number of nodes and elements in the generated mesh. The number of elements in the coarse mesh was 131464 and number of nodes was 33972.

In medium mesh, number of elements was 131030 and nodes were 33907 [8]-[9]. While in fine mesh, the number of elements and nodes are 131297 and 33955 respectively.

F. Mesh Refining

Meshing refining was an important step during improvement in project problem results. During mesh refining, the analysis was done in different mesh size conditions and the results were calculated and analyzed.

G. Name Selection

Name selection was an important part of the meshing. Different surfaces were given different names according to the incoming of air and outgoing of air. The surface names were velocity inlet, pressure outlet, symmetry top, symmetry side, and floor [10]. The body was also given name as body. For the name selection, the cursor was moved to the surface which had to be given name and right click at that surface. Then chose the “create” named selection option and gave the name to that surface.

III. SOLUTION SETUP

After meshing, project moved on to the solution setup in which various parameters such as velocity, surface area of the body, boundary conditions, turbulent viscosity were entered and calculations were done accordingly.

Purpose of solution setup is that by modifying the solver settings you can improve both: The rate of convergence of the simulation and the accuracy of the computed result.

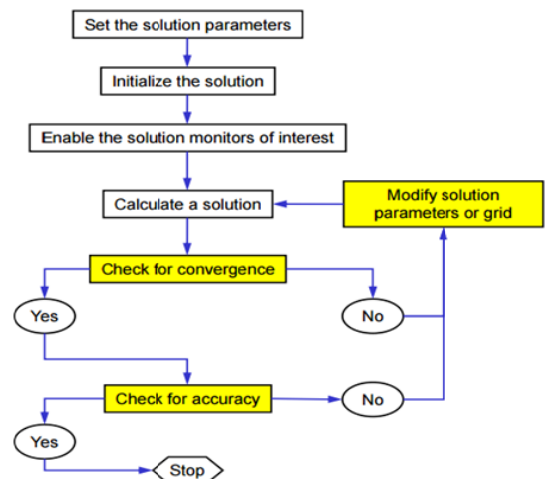


Fig.8: procedure for solution setup

A. General Setup

Simulation was carried out in ANSYS® FLUENT® v15. In the Fluent solver Pressure Based type was selected, absolute velocity formation and steady time was selected for the simulation. In the model option energy calculation was on and the viscous was set as

standard k- ϵ , standard wall function (k-epsilon 2 equation).

There are two kinds of solvers available in FLUENT:

1. Pressure based
2. Density Based

This Project utilized the Pressure Based solver because the **Pressure-based** solvers take momentum and pressure (or pressure correction) as the primary variables. The **Pressure-based solver** is applicable for a wide range of flow regimes from low speed incompressible flow to high-speed compressible flow.

1. Requires less memory (storage).
2. Allows flexibility in the solution procedure.

The **Density-based coupled solver** (DBCS) is applicable when there is a strong Coupling, or interdependence, between density, energy, momentum, and/or species.

1. Examples: High speed compressible flow with combustion, hypersonic flows, shock interactions.
2. In cell Zone Conditions Air was selected for simulation. Boundary condition was selected for Inlet and Outlet. Velocity at inlet was set to be 80Km/h and at pressure outlet was set as atmospheric pressure i.e. 101325 Pascal.
3. In reference values area was 9.496 m^2 , Density of 1.125 kg/m^3 , Temperature 288.16 K, Velocity 80 Km/h, were chosen. Air was selected as reference zone [13].

B. Solution Method

In this project, Coupled Pressure –velocity scheme had been selected. Spatial discretization gradient entered was least squares method and pressure was second order. Momentum, Turbulent kinetic energy and turbulent dissipation rate selected were second order upwind.

C. Solution Controls

In solution controls, Flow courant number entered was 50. Momentum and Pressure explicit relaxation factors entered were 0.20 and 0.25 respectively. Turbulent Kinetic energy, turbulent dissipation rate and turbulent viscosity entered were 0.6, 0.8 and 0.95 respectively.

D. Solution Monitors

In surface monitors, there were two types of monitors.

1. Residual, Statistic and Force monitor
2. Surface monitor

In Residual, Statistic and Force monitor, C^d , C^l and C^m monitors were created and the options of write, plot and print were selected. In surface monitors, Report type was selected as vertex average and field variable selected was static pressure.

E. Solution Initialization

In the solution initialization, Hybrid Initialization was done. This provides a quick approximation of the flow field, by a collection of methods. It solves Laplace's

equation to determine the velocity and pressure fields [11].

F. Run Calculation

The solver should be given sufficient iterations such that the problem is converged. At convergence, the following should be satisfied:

1. The solution no longer changes with subsequent iterations.
2. Overall mass, momentum, energy, and scalar balances are achieved.
3. All equations (momentum, energy, etc.) are obeyed in all cells to a specified tolerance.

Monitoring convergence using residual history:

1. Generally, a decrease in residuals by three orders of magnitude indicates at least qualitative convergence. At this point, the major flow features should be established.
2. Scaled energy residual should decrease to 10^{-6} (for the pressure-based solver) [11]-[12].
3. Scaled species residual may need to decrease to 10^{-5} to achieve species balance.

If solution monitors indicate that the solution is converged, but the solution is still changing or has a large mass/heat imbalance, this clearly indicates the solution is not yet converged. In this case, you need to:

1. Reduce values of Convergence Criterion or disable Check Convergence in the Residual Monitors panel.
2. Continue iterations until the solution converges.

IV. RESULTS

A. C_d Convergence history

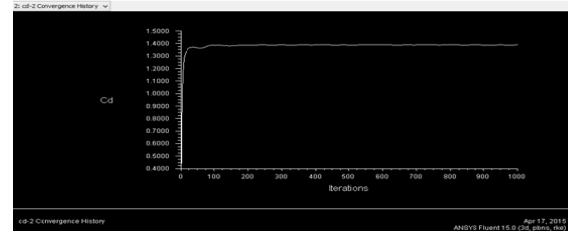


Fig.9: Coarse C_d Convergence history

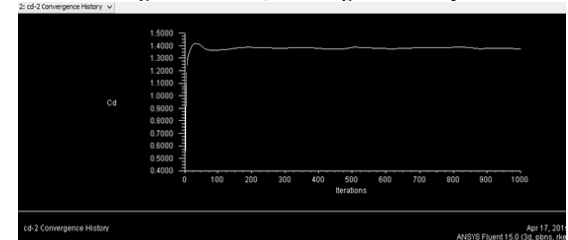


Fig.10: Medium C_d Convergence history

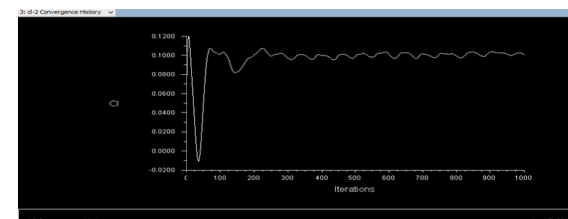


Fig.11: C_l Coarse convergence history

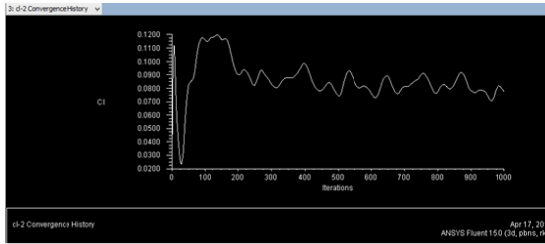


Fig.12: C_l Medium Convergence history

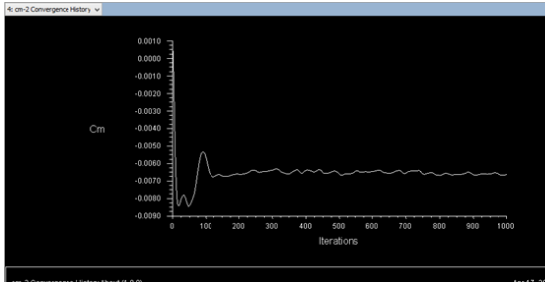


Fig.13: Coarse C_m Convergence history

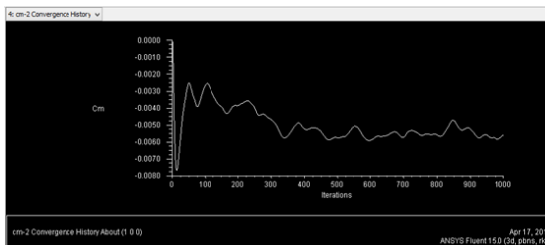


Fig.14: Medium C_m Convergence history

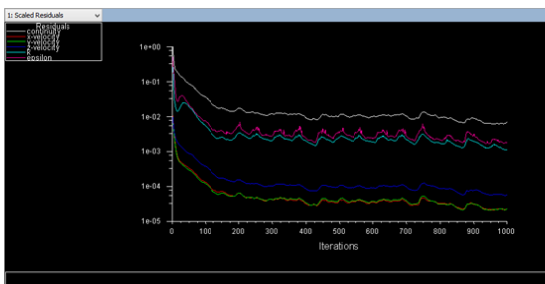


Fig.15: Scaled residuals in Coarse

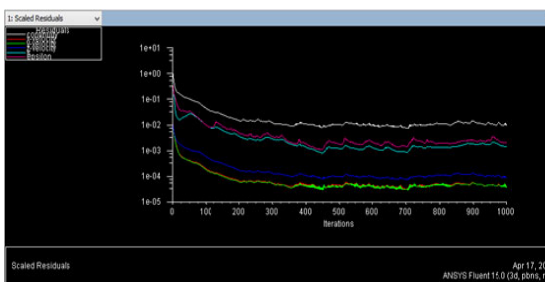


Fig.16: Scaled Residuals in Medium

V. CONCLUSION

The project is done to analyze and simulate the drag force on metro train through simulation using Ansys

software. Drag force has been analyzed on metro train in elevated operating conditions in terms of energy per unit load. Boolean operation is applied and then geometry is entered into meshing. In meshing, face sizing of the body was done after which various parameters were selected. Among these parameters, sizing, inflation, patch conforming options, advanced options were included. With suitable assumptions in the calculations, results show that with no of iterations the convergence is almost achieved. Hence applying CFD(grid formation) ,solid works, Ansys techniques equations are made and converged Still the study is limited and has a wide scope ahead as only elevated position is simulated and converged.

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ONLINE SOCIAL NETWORK WALL FILTERING USING ML AND HUMAN SENSING

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Abstract - With the large amount of growth in the data and use of social networking sites users share free text, image, audio and video data daily. Today's OSNs (Online Social Network System) not provide much support to the users to avoid unwanted messages displayed on their own their wall. In existing system, if unwanted words are found, system directly blocks the message. But the problem is important articles which include unwanted words but having positive or good topics, gets blocked. So, to overcome the above problem, we proposed a system in which data will be divided into three categories: Normal, Low risk and High risk. Then filtering rules are applied to block corresponding data using human intervention.

Keywords - Machine Learning Techniques (MLT), Filtering Rules, SVM, Online Social Network.

I. INTRODUCTION

Today modern life is totally depending on Internet. Now a day's people cannot visualize life without Internet. Also, OSNs is also part of modern life. Now a day's people share their views, ideas, information with each other using social networking sites. Such communications may include different types of contents like text, image, audio and video data [1]. Whereas huge amount of data such as web links, news stories, blog posts, notes, photo albums, etc. are shared daily. But, in today's social network, there is a very high chance of posting unwanted content on particular public/private areas, called in general walls. Therefore Information filtering can be used to give users the ability to automatically control the content of messages written on their social walls, by filtering unwanted messages. Today OSNs offer very small to avoid unwanted messages on user walls. For example. In Facebook users are only permitted to state who is allowed to put messages in their walls i.e. direct friends and indirect friends. Content-based preferences are not supported. The online social networking wall messages are representing by short text for which traditional classification methods have some limitations. Therefore the goal of the present work is to propose and demonstration evaluates an automated system, called Filtered Wall, able to filter unwanted messages from OSN. It assigns the message automatically to each short text message, a set of categories based on its content we utilize Machine Learning text categorization methods [6].

In proposed system we classify the data in three types 1) Normal Risk 2) Low Risk 3) High Risk. In Normal risk it consists of regular words which can be post from GUI directly. Low risk in which data is first processed as a black list from where it is identified whether the data is of low risk or higher risk if data is of low risk we select randomly three users from entire friend list among which if the given data is accepted

by any of two users which has been taken into consideration randomly then the given data is published otherwise it would be blocked. In higher risk if the given data is accepted all of the three users then it would be published or it would be blocked. The system provides a powerful rule layer a flexible language to specify Filtering Rules, by which users can state which contents shouldn't be displayed on their walls. FRs can support a variety of different filtering criteria that can be combined. The rules of filtering exploit user profiles, user relationships as well as the output of the ML categorization [6] process to state the criteria of filtering to be performed. In addition, the system will gives the support for user-defined Blacklists, the lists of users that are temporarily prevented to post any kind of messages on a user wall.

To the best of our information this is the first proposal of a system to automatically filter bad messages from OSN user walls on the basis of both messages content and the messages creator relationships and characteristics.

II. LITERATURE SURVEY

N.J.Belkin et al. [2] designed information filtering systems to classify a stream for generating information is dynamically to dispatched asynchronously by an information producer to satisfy according to user considerations. Nicholas J. Belkin has been talk about the relationship between information filtering and retrieval and they come to the conclude that both are two sides of the same coin the previous recommended systems use social filtering methods.

P.J.Hayes et al. [3] modelled filtering activity to perform binary classification to partitioning incoming documents into relevant and non-relevant categories. But that was difficult to include multi-label text categorization automatically labelling messages into

partial thematic categories. By this system describe that a content-based book recommended system that utilizes information extraction method and a ML algorithm for text categorization. This way they improve access to relevant information and products. M. J. Pazzani et al. [4] adopted feature extraction methods and collection of samples. This procedure maps text into a compact representation of generalization this phases. In this system real-time classification accuracy, and classification speed and they conclude that Linear Support Vector Machines are most unique classifier, fastest to train, and quick to evaluate.

D.D. Lewis et al. [5] had performed some experiments which proved that Bag of Words (BoW) approaches had good performance and prevail in general over more revealing text presentation that have superior semantics but lower statistical quality.

F. Sebastiani et al. [6] had given comparative analysis of Boosting-based classifiers, Neural Networks and Support Vector Machines over other popular methods, such as Rocchio and Naïve Bayesian. The application of content-based filtering on messages posted on OSN user walls poses additional task or situation that given the short length of these messages other than the wide range of topics that can be discussed. A different approach is proposed by Bobicev and Sokolova that circumvent the problem of error-prone feature construction by adopting a machine learning method that can perform reasonably well without feature engineering.

B. Shriram et al. [7] proposed a classification method to categorize short text messages in order to avoid overwhelming users of micro blogging services by raw data. They focus on Twitter 2 and associate a set of categories with each argument describing its content. The user can then view only certain types of tweets based on his/her interests.

S. E. Robertson and K. S. Jones,[8]proposed “Relevance weighting of search terms,” Journal of the American Society for Information Science, In this paper they examine the statistical techniques for exploiting relevance information to weight search term. These methods are presented as a neural extension of weighting method using information about the distribution of index term in documents in general .A series of relevance weighting functions is derived and is justified by theoretically.

S. Zelikovitz and H. Hirsh,[9] proposed “Improving short text classification using unlabelled background knowledge,” We describe a method for improving the classic- fiction of short text strings using a combination of labelled training data plus a secondary corpus of unlabelled but related longer documents. We show that such unlabelled background knowledge can greatly decrease error

rates, particularly if the number of examples or the size of the strings in the training set is small. This is particularly useful when labelling text is a labour-intensive job and when there is a large amount of information available about a particular problem on the World Wide Web. Our approach views the task as one of information integration using WHIRL, a tool that combines database functionalities with techniques from the information-retrieval literature.

Y. Zhang and J. Callan, [11] proposed “Maximum likelihood estimation for filtering thresholds, “filtering systems based on statistical retrieval models compute a numeric score indicating how well each document matches every profile. The one optimal dissemination threshold is maximizes a given utility function based on the distributions of the scores of non-relevant and relevant documents. The parameters of the distribution can be estimated using relevance information, but relevance information obtained while filtering is biased. This paper presents a new method of adjusting dissemination thresholds that explicitly models for this bias. The new algorithm, which is based on the Maximum Likelihood principle, the parameters is jointly estimates to the density distributions for relevant and non- relevant documents and the ratio of the applicable document in the collection. Experiments with TREC-8 and TREC-9 Filtering Track data demonstrate the effectiveness of the algorithm.

C. Apte, F. Damerau, S. M. Weiss, D. Sholom, and M. Weiss, [12] proposed“ Automated learning of decision rules for text categorization,” Online social network media in these days is most powerful way to share the Information, thought, event and many more. In the Definition of technology we usually follow the Industry of Information Technology where, we describe the high-level contributions of this paper and discuss potential future research directions. The massive popularity of online social media, surprisingly little is known about how people are using them to connect and share. To understand the structure of networks, we conducted a large-scale measurement study that collected data on the social networks of four popular sites, covering over 12 million users and 400 million links. In this paper in order to remove the unwanted messages.

III. PROPOSED SYSTEM

In this we are using three layers such as follows, Social Network Manager, Social Network Applications, and Graphical User Interfaces.

A. Social Network Manager (SNM):- The first layer is a Social Network Manager (SNM), which provides the basic OSN functionalities i.e., profile and relationship management. All user profile data is maintains in this layer. After maintaining all user data

will provide for second layer for applying Black Lists (BL) and Filtering Rules (FR).

B. Social Network Applications (SNA):- On the other hand the second layer provides the support for external Social Network Applications (SNAs). In this layer Content Base Message Filtering (CBMF) and Short Text Classifier is used. In this layer the message categorization is down according to its CBMF filters rules it is very important part in this layer. In SNA we also provide three types of classification Normal, Low and High Risk. The supported SNAs need an additional layer for their desired Graphical User Interfaces (GUIs).

C. Graphical User Interfaces (GUI):- Third layer provides Graphical User Interface to the user who wants to post his message as an input. In this layer to filter the unwanted messages we is filtering rules (FR) and provide black list (BL) for the user who publish message on user's wall.

The main operation of proposed system is down in the second and third layers, as shown in the architecture. By means of GUI users interact with the system to set up and manage their rules. The GUI provides filtered wall with a user's, where only messages that are authorized according to their filtering rules and black list are published or post. The main components of the proposed system are the Content-Based Messages Filtering (CBMF) and the Short Text Classifier (STC) modules. STC classifies messages according to a set of categories. In content-based message filtering we are dividing a post or message into three different forms for storage the message shown in the Fig.1. In Normal Risk regular words are stored; they are directly posted on the user wall. Second is Low Risk in this abused word like violence and etc. words will be stored. Third is High Risk in these abused words like vulgarity, sexually explicit and etc. words will stored.

IV. SYSTEM ARCHITECTURE

As shown in Figure 1, the path followed message, from its writing to the possible final publication can be given as follows:

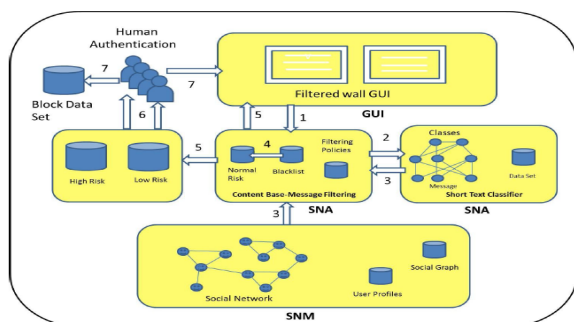


Fig.1. Filtered Wall Conceptual Architecture

- 1) The user tries to post a message after entering the private Wall of his/her contacts which is interrupted by FW.
- 2) From the message content a ML based text classifier extracts Metadata.
- 3) A meta-data together with data extracted from the users' Profiles and social graph provided by the classifier is used by FW, to impose the filtering and BL rules.
- 4) The category of message will be decided. Normal Risk, Low Risk and High Risk.
- 5) Suppose message should be Low risk or High Risk then Human authentication will be check
- 6) The message will be published or filtered by FW depending on the result of the previous step.

V. SHORT TEXT CLASSIFIER

For datasets of large documents, existing techniques work well for text classification but gives problem when the documents in the corpus available are short in size. Here we defining a hierarchical model with two level strategies by assuming that it is better to identify and reduce "neutral" sentences, and then classify "non- neutral" sentences. In the first level work is a difficult classification where small size texts are labelled with crisp Neutral and Non-Neutral labels. In the second level soft classifier produces estimated accurateness or "gradual membership" for each and every of the conceived classes, without taking one of the "hard" decision of them. This list of grades will become successive phases of the filtering process.

A. Text Representation

The underlying model for text representation is the Vector Space Model (VSM) according to which a text document d_j is represented as a vector of binary or real weights $d_j = w_{1j}, \dots, w_{Tj}$, where T is the set of terms (sometimes also called features) that occur at least once in at least one document of the collection T , and $w_{kj} \in [0; 1]$ represents how much term t_k contributes to the semantics of document d_j . In the BoW representation, terms are identified with words. In the case of non-binary weighting, the weight w_{kj} of term t_k in document d_j is computed according to the standard term frequency - inverse document frequency (tf-idf) weighting function, defined as

$$tf - idf (t_k, d_j) = \#(t_k, d_j) \log \left(\frac{|T_r|}{\#T_r(t_k)} \right)$$

where $\#(t_k, d_j)$ denotes the number of times t_k occurs in d_j , and $\#T_r(t_k)$ denotes the document frequency of term t_k , i.e., the number of documents in T_r in which t_k occurs. Domain specific criteria are adopted in choosing an additional set of features, D_p , concerning orthography, known words and statistical properties of messages. D_p features are heuristically assessed; their definition stems from intuitive

considerations, domain specific criteria and in some cases required trial and error procedures.

VI. EXPECTED RESULT

We present OSN site with basic functionalities of OSNs. In this system, using Filtering rules we can filter wall for preventing unwanted messages. Initially, we focus on Violence, Vulgar, Offensive, Hate type of message, Sexual and filter these messages. We also, maintain Black list for the user who will send the prevented type of messages more times.

VII. CONCLUSION

Presented system in this paper filtering unwanted messages from OSN user walls. This system describes a ML soft classifier to enforce customizable content-dependent FRs. The flexibility of this system in terms of filtering options is enhanced through the management of BLs. Here the batch learning strategy which is based on the preliminary collection of the whole set of labeled data articles from authors allowed an accurate experimental evaluation but needs to be evolved to include new operational requirements. Our strategies and techniques limiting the inferences that a user can do on the enforced filtering rules with the goal of bypassing the filtering system, such as for instance randomly notifying a message that should be blocked, or detecting modifications to profile attributes that have been made for the only purpose of defeating the filtering system.

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THE WEIGHT ADJUSTMENT OF HAAR-LIKE FEATURES IN VOILA JONES CLASSIFIER USING PRINCIPAL COMPONENT ANALYSIS METHOD FOR HAND POSTURE RECOGNITION

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Abstract - Hand Posture detection and recognition are important steps in the Hand Gesture Recognition for Human Computer Interaction. This paper presents a novel approach for improving the most familiar Viola Jones classifier to detect and recognize Hand Postures. In the Viola Jones algorithm Haar like features are used for feature extraction and Adaptive Boosted Classifier is used for detection and classification. The proposed scheme includes Principal Component Analysis (PCA) method to adjust the weight of positive training feature samples for the improved performance in the cascaded adaptive boost learning algorithm. By using this method the complexity and time in training phase is reduced. The performance of the proposed scheme is investigated in terms of Recognition accuracy and computation time.

Keywords - Hand posture, Haar-Like Features, Boosting, Principal Component Analysis.

I. INTRODUCTION

The automatic visual recognition of hand gestures is a challenging task in the fields of Human Computer Interaction and Sign Language Recognition. Hand posture or pose is defined solely by the (static) hand configurations and hand locations and Hand gesture is a series of postures over a time span connected by motions with global hand motion and local finger motion (1). The automatic vision based hand posture classification has two approaches (i) Appearance based approach and (ii) 3D Hand model based approach. Appearance based approaches are based on direct registration of hand postures with 2D image features extracted from 2D images (6).

The frequently used image features for the detection of human hand postures are colors and shapes, local hand features, optical flow, etc. The feature extraction is followed by complex probabilistic model based machine learning algorithms to detect the hand postures with minimum number of degrees of freedom (DOFs). 3D hand model based approaches offer higher level of degrees of freedom for which employs comparison of input image with huge image data base describing the 2D appearance projected by 3D hand posture model to cover all the postures under different perspective.

Originally for the task of face detection the Viola Jones algorithm was proposed (2). In this algorithm the Haar like features are used for feature extraction and Cascaded AdaBoost classifier is used for hand posture detection and recognition. Chen et al have effectively implemented this algorithm for hand posture recognition (1). In this paper we use Principal Component Analysis method to improve the training phase and to improve the recognition rate by updating the weights of positive training instances.

In this paper, Section 2 details about the main contributions in the proposed scheme of Hand posture

detection and recognition. In Section 3 Haar like features that are used for feature extraction are reviewed. Section 4 explains about conventional Ada Boost learning algorithm. The steps involved in weight updation of positive training samples using Principal Component Analysis are detailed in Section 5. Section 6 discusses experimental results of the proposed method. Section 7 concludes this paper and presents future enhancements.

II. THE PROPOSED SCHEME

Hand Posture Detection and Recognition is an important step in Hand gesture Recognition which can be used as an effective tool for Human Computer Interaction and Sign Language Recognition, etc. In the proposed scheme extended Haar like features for feature extraction. A new image representation technique called as "Integral Image" is applied which allows the features used by the detector to compute the summation very quickly required for extended set of Haar-Like features calculation.

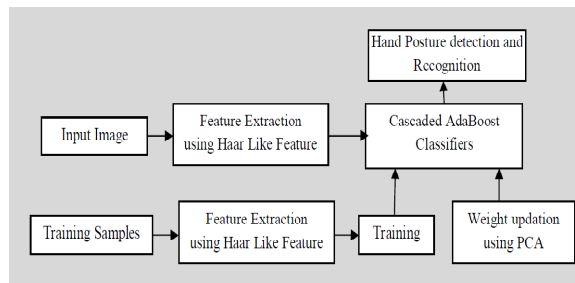


Fig.1. The proposed scheme for Hand Posture Recognition

The set of Extended Haar-Like feature includes Edge features, Line features, Center-surround features, Corner features and Diagonal line feature. Once the Integral Image is computed, any one of the Haar-like features can be computed at any scale or location in

constant time. Haar-like features are used to meet the real-time performance requirements.

A learning algorithm based on AdaBoost (Adaptive boost), which selects a small number of critical visual features and yields extremely efficient classifiers. In order to ensure fast classification, the learning process must exclude a large variety of available features, and focus on a small set of critical features. Feature selection is going to be achieved through a simple modification of the AdaBoost procedure. The weak learner is constrained so that each weak classifier returned can depend on only a single feature. As a result each stage of the boosting process, which selects a new weak classifier, can be viewed as a feature selection process.

The method for combining classifiers in a “cascade” allows background regions of the image to be quickly discarded while spending more computation on promising object-like regions. The purpose of the cascade of classifiers is to achieve both accuracy and speed. The principal component analysis method is applied in training phase to updated the weights of the positive training instances to converge quickly and to improve the recognition rate during testing.

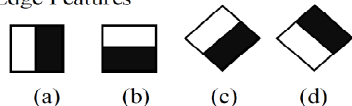
III. HAAR LIKE FEATURES

Haar-like features are rectangular features that can indicate specific characteristics in an image. The idea behind Haar-like features is to recognize objects or features based on the value of simple features, instead of pixel values directly. Hand detection procedure classifies images based on the value of simple features.

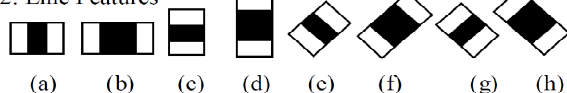
Each Haar-like feature consists of two or three connected “black” and “white” rectangles. Figure 1 shows the Extended Haar-like feature set. The value of Haar-like feature is the difference between the sums of the pixel values in the black and white rectangle is given in equation (1).

$$f(x) = \sum_{\text{black}} (\text{pixel value}) - \sum_{\text{white}} (\text{pixel value}) \quad (1)$$

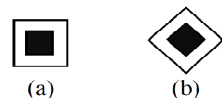
1. Edge Features



2. Line Features



3. Center-surround Features



4. Corner Features

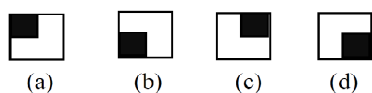


Fig.2. Extended set of Haar-like features.

The concept of “Integral Image” is used to compute the Haar-like features containing upright rectangles. The feature evaluation can be made fast by using the concept of “Integral Images”. The integral image, denoted $ii(x,y)$ and the value of the integral image at each point (x,y) is given in equation (2), at location (x, y) contains the sum of the pixel values above and to the left of (x,y) is shown in Figure 3(a) formally,

$$ii(x,y) = \sum_{x' \leq x, y' \leq y} i(x',y') \quad (2)$$

where $i(x, y)$ is the input image.

The integral image can be calculated using the recurrences given in equation (3.a) and equation (3.b):

$$s(x, y) = s(x, y - 1) + i(x, y) \quad (3.a)$$

$$ii(x, y) = ii(x - 1, y) + s(x, y) \quad (3.b)$$

where $s(x, y)$ is the cumulative row sum and $s(x,-1)=0$ and $ii(-1,y)=0$.

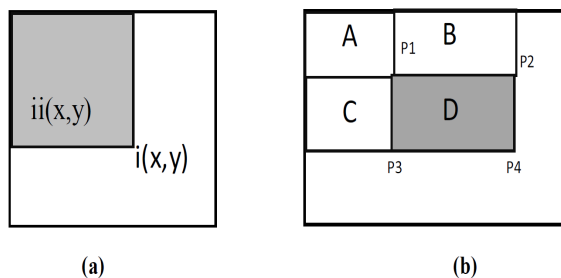


Fig.3. Concept of “Integral Image”

Using the integral image any rectangular sum can be calculated in four array references. P1, P2, P3 and P4 are reference points to calculate the value of the sum of gray level value within the area “D”. According to the definition of “Integral Image”, the sum of the grey level value within the area “D” in Figure 2 (b) can be computed using the equation (4).

$$P1 + P4 - P2 - P3 = \text{sum of the pixel values in area} \quad (4)$$

The integral image at a points P1 is A, P2 is A+B, P3 is A+C, and P4 is A+B+C+D. The difference between the two rectangular sums can be calculated in six array references, eight in the case of three-rectangular features, and ten in the case of four-rectangle features.

To detect the hand in an image, the image is scanned by a sub-window containing Haar-Like features. Resolution of the sub-window is 24x24. Haar-Like features within the sub-window is scaled by factor 1.25. Resolution of an image is 640x480. Rectangle features are very sensitive to presence of edges, bars and other simple image features. Totally there are 45,396 rectangle features associated with each image sub-window. It is far larger than the number of pixels. In our system, four hand postures are tested the

“little finger” posture, the “two fingers” posture, the “palm” posture, the “fist” posture.

IV. ADABOOST CLASSIFIER WITH CASCADED CLASSIFICATION

AdaBoost learning algorithm is used to select the features and to train the classifier. The number of features associated with each sub-window is far larger than the number of pixels. Even though each feature can be computed very efficiently, computing the complete set is prohibitively expensive. The AdaBoost learning algorithm steps are summarized as i.

- i. Given example images $(x_1, y_1), \dots, (x_n, y_n)$ where $y_i=0,1$ for negative and positive examples respectively.
- ii. Initialize weights $w_{1,i} = \frac{1}{2^m}, \frac{1}{2^l}$ for $y_i=0, 1$ respectively, where m and l are the number of negatives and positives respectively.
- iii. For $t=1, \dots, T$:
 1. Normalize the weights,

$$w_{t,i} \leftarrow \frac{w_{t,i}}{\sum_{j=1}^n w_{t,j}}$$

So that w_t is a probability distribution.

2. For each feature, j , train a classifier h_j which is restricted to using a single feature. The error is evaluated with respect to $w_t, \epsilon_j = \sum_i w_i |h_j(x_i) - y_i|$.
3. Choose the classifier, h_t , with the lowest error ϵ_t .
4. Update the weights:

$$w_{t+1,i} = w_{t,i} \beta_t^{1-e_i}$$

where $e_i=0$ if example x_i is classified correctly, $e_i=1$ otherwise, and $\beta_t = \frac{\epsilon_t}{1-\epsilon_t}$.

- iv. The final strong classifier is:

$$h(x) = \begin{cases} 1 & \sum_{t=1}^T \alpha_t h_t(x) \geq \frac{1}{2} \sum_{t=1}^T \alpha_t \\ 0 & \text{otherwise} \end{cases}$$

where $\alpha_t = \log \frac{1}{\beta_t}$.

AdaBoost learning is used to boost the classification performance of a simple learning algorithm. It does this by combining a collection of weak classification functions to form a stronger classifier. The simple learning algorithm is called a weak learner. The weak learners are boosted, to solve a sequence of learning problems. After the first round of learning, the examples are re-weighted which were incorrectly classified by the previous weak classifier. The final strong classifier is a weighted combination of weak classifiers.

Cascade of classifiers achieves increased detection performance while radically reducing the

computation time. More efficient boosted classifiers can be constructed which reject many of the negative sub-windows while detecting almost all positive instances. An intentional cascade is used to speed up the process. A positive result from the first classifier triggers the evaluation of a second classifier, which has also been adjusted to achieve very high detection rates. A positive result from the second classifier triggers a third classifier and so on. To be detected by a trained cascade, the positive sub-windows must pass each stage of the cascade. A negative outcome at any point leads to the immediate rejection of the sub-window. Figure 4 shows the detection of positive sub-windows using a trained cascade. To be detected by a trained cascade, the positive sub-windows must pass each stage of the cascade. A negative outcome at any point leads to the immediate rejection of the sub-window.

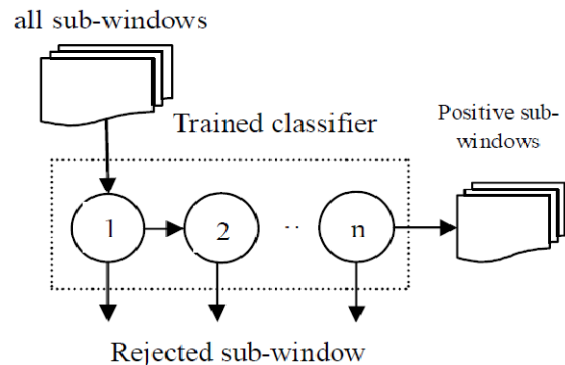


Fig.4. Detection of positive sub-windows using the trained cascade.

To hand posture database are collected. The hand posture database contains 512, 415, 412, 420 positive samples with different in-plane rotations, out-of-plane rotations and different lighting conditions and the sample's size is 640x480. 1339 hand samples in the database taken as the set of positive samples. 700 images that do not have hand are collected as negative samples for training process.

V. PRINCIPAL COMPONENT ANALYSIS

Principal component analysis (PCA) is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components.

This transformation is defined in such a way that the first principal component has the largest possible variance (that is, accounts for as much of the variability in the data as possible), and each succeeding component in turn has the highest variance possible under the constraint that it is orthogonal to the preceding components. The resulting vectors are an uncorrelated orthogonal basis set. The principal components are orthogonal because they are the eigenvectors of the covariance matrix,

which is symmetric. PCA is sensitive to the relative scaling of the original variables.

In this work, we use Principal Component Analysis (PCA) method to update the weights assigned in AdaBoost classifier during training and speed up the training process. The following steps are executed by Principal Component Analysis to update the weight values.

- i. Get the Weight vectors of positive samples (W_i)
- ii. Calculate the mean value(μ_i) Subtract the mean from each weight value.
- iii. Calculate the covariance matrix(CV)
- iv. Calculate the Eigen value \hat{E}_k s and Eigen vectors of covariance matrix
- v. Choosing the components and forming a feature vector
- vi. Deriving the new weight vectors V_i

The results are compared for conventional AdaBoost algorithm with the proposed scheme where in the weight values of positive instances updated using Principal Component Analysis.

VI. RESULTS AND DISCUSSION

The two data sets are collected from two different people. In each data set images with different DOF of each posture are taken for evaluation. The performance of recognition is evaluated in two different datasets from different person and the reports of evaluation are given as confusion matrix in figure5.

An our current implementation is in MATLAB, a more efficient implementation using programming languages like C++ would lead to further reduction in the process time. In the table 1 lists the recognition rate and processing time of are listed for various hand postures like palm, fist, two fingers, and little finger.

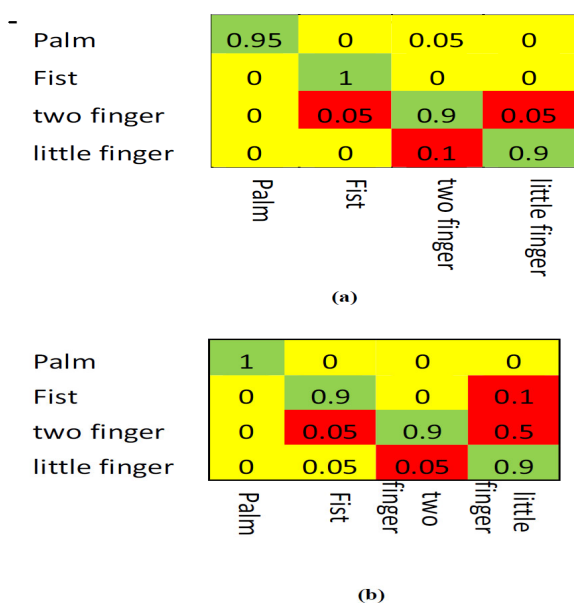


Fig.5.(a),(b) Confusion matrix for hand posture recognition of different data sets.

Hand gesture	Recognition Accuracy	Process Time(Seconds)
Palm	97.5%	1.864
Fist	95%	2.534
Two finger	90%	2.831
Little finger	95%	2.126

Table 1: Recognition time for the hand postures

VII. CONCLUSION AND FUTURE ENHANCEMENT

In this paper, a new weight adjustment method for Haar-like features in detecting hand postures was proposed. This method uses PCA over the positive training instances to assign new weights to the features in cascaded classification technique. The above presented experimental results demonstrate that the system correctly recognizes the hand postures and the performance is suitable for real time implementations. Future work is to create an algorithm to recognize hand gestures with a suitable probabilistic finite state machine from the recognized series of hand postures and implement complete algorithm in the suitable hardware to evaluate the real time performance.

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TIME SAVING STRATEGY FOR FINITE ELEMENT ANALYSIS OF TRANSFORMER TANK

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Abstract - The mechanical design validation of transformer is usually performed in the engineering industry by finite element analysis. Ideally the analysis should be nonlinear incorporating both geometric as well as material nonlinearities but due to time and computational constraints, often the analysts prefer to perform linear analysis while trying to keep the induced stresses well below the yield point at all locations other than regions of concentrated stress which will get relieved by yielding of the material. The design validation is required for both pressure as well as vacuum tests. The analysts usually perform the simulations for pressure and vacuum separately. In this paper, a time saving strategy that saves almost half of the analysis time is explained and demonstrated. The tremendous time saving along with the perfect accuracy is achieved by this method.

Keywords - Stress Analysis, Linear Analysis, Pressure Test, FEA

I. INTRODUCTION

The transformer tank is subjected to pressure and vacuum tests during its testing phase. It is required to be strong enough to withstand both pressure as well as vacuum loads as prescribed by the standards and the customer requirements [1]. The transformer tank is usually made of mild steel and the stresses induced in the tank are aimed to be limited to less than a fraction of the yield stress. But it must be noted that the stresses are calculated using semi empirical formulae for design purposes and do not give an actual value of stress in the structure. Generally, it is not possible to limit the stress values below the yield point since very high stress concentration factors at the geometric discontinuities like edges. Hence some amount of yielding is allowed even as per standards [2]. The procedure to perform such an analysis is available in the literature [3]. However, due to paucity of time and computational resources, the finite element analysts prefer the linear analysis for this application. While the concentrated stresses cannot be limited below the yield point, the stresses occurring in other regions can be designed to be less than the yield stress. This means that with the exception of a few small regions, the tank remains elastic and consequently, the permanent deformation is expected to be small and lesser than the limit. It has been seen that this approach works well for conventional transformer tanks. The high concentrations do not affect the strength of the tank since it is made of ductile material [4]. The design process flow for a transformer tank is as shown in fig.1. The finite element analysis for transformer tanks is demonstrated in the following sections. The design is carried out by analytical calculations which are semi-empirical in nature and do not give an accurate calculation for deflections and stresses. The tank designed on basis of these formulae may not be strong enough and its strength can be assessed more

reliably by Finite Element Analysis which is widely used in the industry. The designs that fail the FEA test are redesigned on basis of FEA alone. The analytical calculations are used for initial design only and cannot be used for design verification.

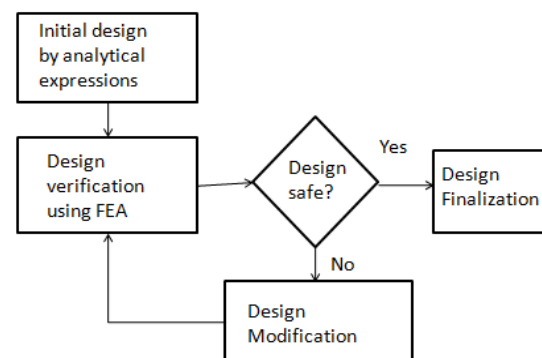


Figure 1

II. ANALYTICAL CALCULATION FOR THE TRANSFORMER TANK

The hand calculation for the transformer tank is carried out by using semi empirical formulae. The calculation is as follows.

The deflection of a plate clamped at the edges is [5]

Equation 1

$$\delta = \frac{\alpha \cdot P \cdot a^4}{Et^3} \quad \text{Where,}$$

α is a parameter dependent on the ratio of length of sides

P is the pressure

a is the length of the shorter side

E is the young's Modulus of steel

t is the thickness of the plate

Stress at the edge is [6]

Equation 2

$$\sigma = \frac{\beta \cdot P \cdot a^2}{t^2}$$

In this problem, $b = 900 \text{ mm}$, $t = 12 \text{ mm}$, $E = 200 \text{ GPa}$

In Vacuum test, $P = -0.1 \text{ MPa}$. Thus,

Deflection $\delta = 5.38 \text{ mm}$

Stress $\sigma = 281.22 \text{ MPa}$

In Pressure test, $P = 0.14 \text{ MPa}$. Thus,

Deflection $\delta = 7.54 \text{ mm}$

Stress $\sigma = 393.71 \text{ MPa}$

III. FINITE ELEMENT ANALYSIS OF A TRANSFORMER TANK

The finite element analysis of a transformer tank shown in the fig.2 is performed. The tank is made of mild steel having Young's modulus = 200 GPa, Poisson's ratio = 0.3 and yield stress = 250 MPa. The design was carried out with the intent to limiting the stress below 210 MPa for the transformer tank.

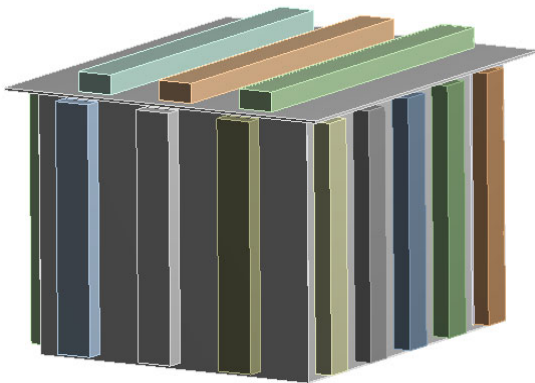


Figure 2

The tank is meshed with higher order tetrahedral elements which have one mid-side node on every element edge. These offer good convergence rate [7], [8], [9]. A higher order tetrahedral element with one mid side node per side is shown in fig.3.

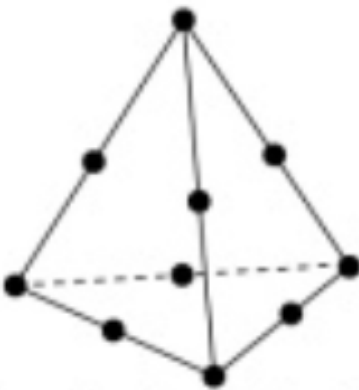


Figure 3

A. Vacuum Test

The vacuum test is performed by applying a pressure of - 0.1 MPa to the surface of the inner cavity of the tank. The bottom of the tank is fixed. The load and boundary conditions are shown in fig.4.

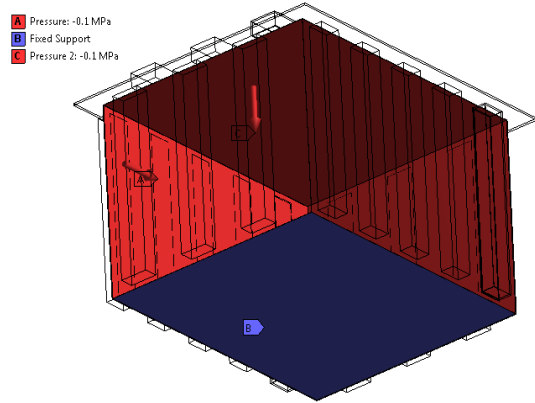


Figure 4

In the vacuum test, the tank experiences external pressure which tends to bend the tank inwards as shown in fig.5.

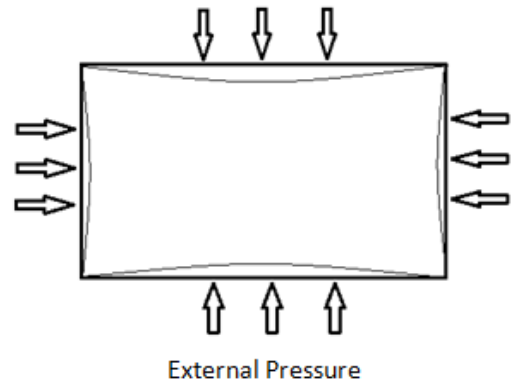


Figure 5

The solution convergence test was carried out and the convergence plot obtained is shown in fig.6. the converged mesh is shown in fig.7

The von Mises failure theory [10] was used. It may be seen that most portion of the tank has von Mises stress well below the yield stress of 250 MPa except for certain small regions where it is concentrated as shown in fig.10. Thus the tank is not expected to have appreciable permanent deformations and the tank design is considered safe.

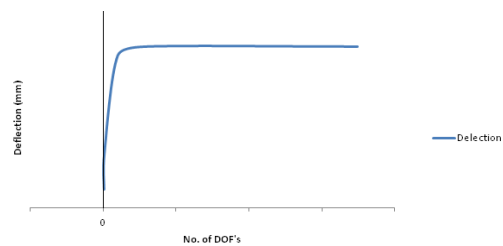


Figure 6

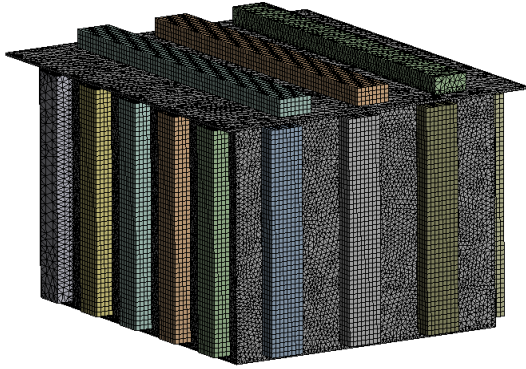


Figure 7

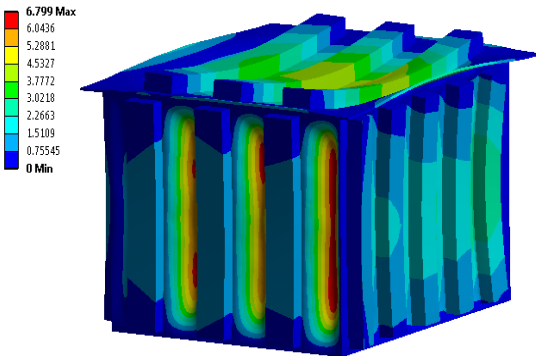


Figure 8

The displacement plot is shown in fig.3. The stress plot is shown in fig.8

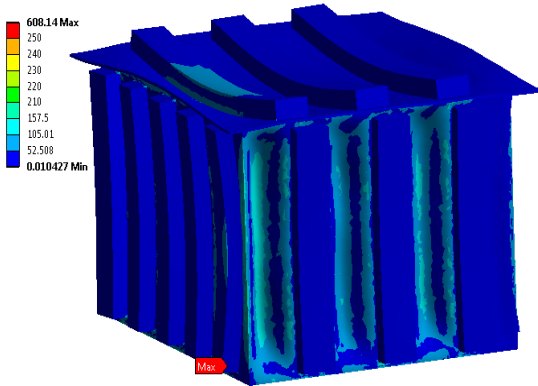


Figure 9

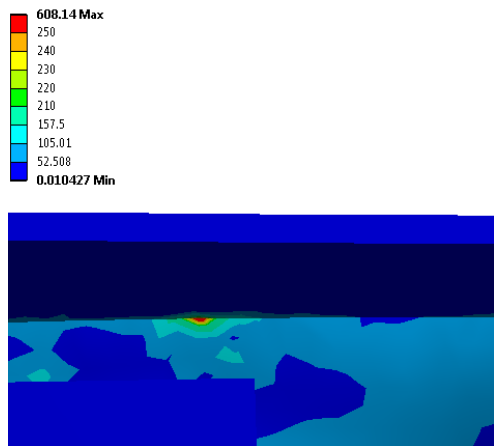


Figure 10

B. Pressure Test

While in the vacuum test, the response of the tank to external pressure was seen, in pressure test the response of the tank to internal pressure is validated. The pressure test analysis is performed by applying a pressure of 0.14 MPa to the insides of the tank cavity. The schematic is shown in fig.11.

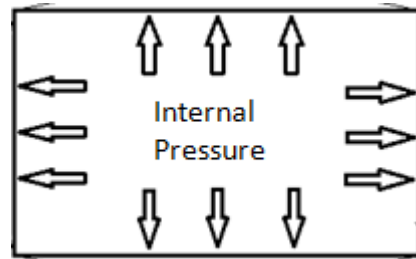


Figure 11

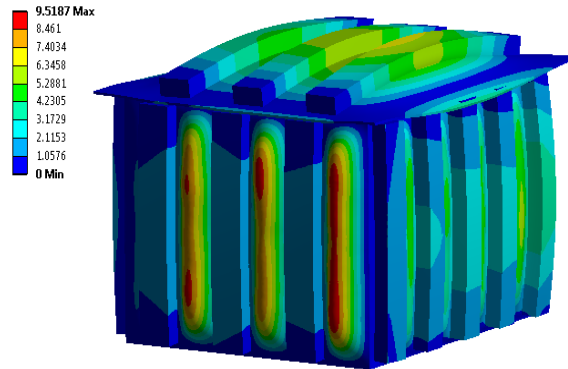


Figure 12

The displacement plot obtained is shown in fig.12. Note that since the same mesh is used, there is no need to perform solution convergence again. Fig.13 shows the induced von Mises stress plot

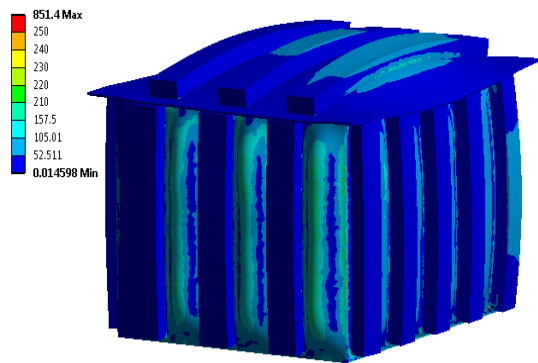


Figure 13

IV. INNOVATIVE SHORTCUT TO REDUCE ANALYSIS TIME

The linear analysis equation is of the form

$$[k] [Q] = \{f\} \dots \text{eqn.3}$$

Where $\{f\}$ is the load vector which in this case, depends on the pressure applied and varies linearly with the pressure. It must be noted that if the pressure

is scaled, the force vector gets scaled by the same factor which in turn means that the displacement gets scaled by the same factor since the stiffness matrix remains constant.

In a linear analysis, Displacement, $u \propto P$ and Stress, $\sigma \propto P$,

Where,

P is the pressure

It may be noted that that the proportionality constants of u and σ with P are, in general, different but remain constant with a change in P . This means that if P is scaled by a factor, C , then both displacement and stress get scaled by C .

Since the loading of the loading of pressure is only a scaling of the loading of vacuum test load, this transformation can be applied to the problem and once one of the simulations – pressure or vacuum - is performed, it is not necessary to run the simulation again for the other test. For example in this case, the simulation was run for a vacuum of 0.1 MPa, in order to get the displacement and stress in pressure test simulation, the results have only to be scaled by a

$$C = \frac{Pr}{Va}$$

factor,

Where, Pr is the magnitude of pressure and Va is the magnitude of vacuum.

In this particular case, $c = -0.14/0.1 = -1.4$. The scaled displacement and von Mises stress plot results are shown in fig.14 and fig.15.

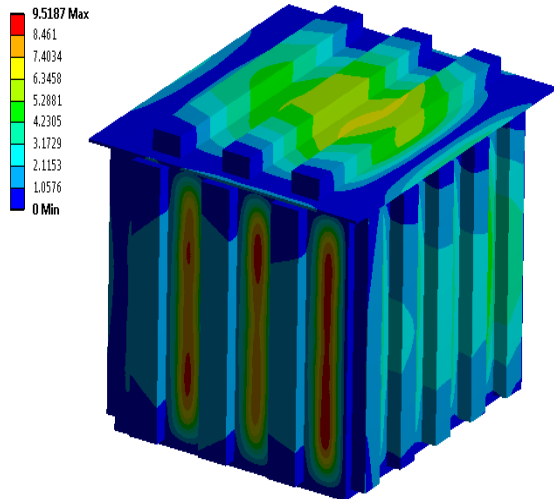


Figure 14

V. ANALYTICAL VS SIMULATED RESULTS

The tabulation of the simulated Vs the analytical results is given in table.1 and 2.

Pressure Test			
Deflection (mm)		Stress (Mpa)	
Analytical	Simulated	Analytical	Simulated
7.54	9.52	393.71	851.4

Table 1

Vacuum Test			
Deflection (mm)		Stress (Mpa)	
Analytical	Simulated	Analytical	Simulated
5.38	6.799	281.22	608.14

Table 2

It may be seen that there is a significant difference between the analytical and the simulated results. The reason for this is that the analytical calculations are based on the assumption of a fixed panel while the simulations take into account the elastic deformation of the rest of the structure. It may also be noted that the values of the deflection and pressure obtained by simulation are consistently more than those calculated by analytical formulae implying that the design by analytical formulae should be performed with a large factor of safety.

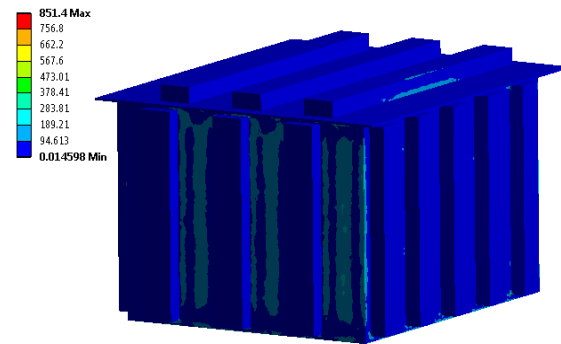


Figure 15

VI. COMPARISON OF SIMULATED AND SCALED RESULTS OF PRESSURE TEST SIMULATION

The comparison of the simulated and scaled results of the pressure test is shown in the table.2

Entity	simulated Results	Scaled Results	Comparison
Displacement (mm)	9.5187	9.5187	No difference
von Mises stress (Mpa)	851.4	851.4	No difference

Table 3

It may be seen that the results are exactly the same for both displacement as well as stress. This validates the process.

Simulation Time

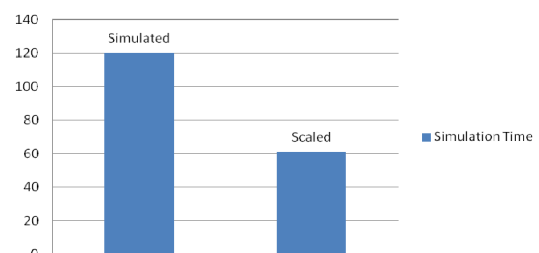


Figure 16

The comparison of the simulation run time is shown in the fig.10. The scaling of results eliminated the need for second simulation thereby reducing the simulation by almost half.

VII. CONCLUSION

The scaling of results by the method shown eliminates the need for separate simulations for pressure and vacuum tests while achieving 100% accuracy thereby saving almost half of the simulation time for the transformer tank linear analysis.

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AN INNOVATIVE APPROACH OF DESIGN OF CMOS BASED PLL CIRCUITS FOR BIOMEDICAL APPLICATIONS – AN OVERVIEW

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Abstract - CMOS based devices are highly recommended for low static power consumption and noise immunity. CMOS technology is used in various analog circuits like comparators, Amplifiers, Digital to Analog, Analog to Digital Converters, Phase Locked Loop(PLL) and many others. Here, in this paper we have studied various CMOS based PLL Circuits using different technologies like True Single phase Clock(TSPC), Injection Locked frequency Divider(ILFD) etc. to achieve low power consumption .

Keywords - CMOS, Biomedical Applications, Phase Lock Loops(PLL), Voltage Controlled Oscillator(VCO), Frequency Divider.

I. INTRODUCTION

A PLL is a feedback system where one signal tracks to another signal till both of the signals get synchronized in the mean of frequency as well as in phase. Basically we can say that PLL is a server system which controls or try to reduced the phase error to minimum between output and reference phase Fig. shows the block diagram of PLL in which we have connected different components like phase detector, low filter and VCO [1].

II. BASICS OF THE COMPONENTS OF PHASE LOCK LOOP (PLL) CIRCUITS

a) Phase Detector

Basically the phase detectors are divided into two categories that is square signal detector and another one is the sinusoidal Phase detector. The square signal phase detectors may also named as sequential phase detector because they have their implementation mostly in sequential circuits. Since sequential phase detector have passed amount of memory which is used to generate phase detector character which is difficult or we can impossible to get by any multiplier circuit while sinusoidal phase detector has interval of phase detection from $-\pi/2$ to $+\pi/2$. It operates as a multiplier i.e zero memory device and square signal phase detectors characteristic are of linear type over interval of phase detection is from $-\pi/2$ to $+\pi/2$ for any triangular phase detector, for saw tooth phase detector is from $-\pi$ to $+\pi$ and for sequential frequency or phase detection is from -2π to $+2\pi$ and in square signal phase detector if we increase interval of phase detector then it will provided the larger tracking range, increase the lock limit than which can be obtained from sinusoidal phase detector [2].

b) Voltage Controlled Oscillator (VCO)

The VCO which is an oscillator whose output frequency is proportional to the applied input voltage

and it can be oscillate from frequency of few Hertz to hundred of GHz the VCO has an LC tank circuit with an inductor, a capacitor along with one or two transistors the VCO used in PLL or very same as that we used for other application like we used in modulation and automative frequency control. There are few basic requirement of VCO i.e 1. it should have phase stability 2. it should have large frequency deviation 3. It should have linearity of frequency versus controlled voltage. 4. It should have the capability to accept wide band modulation 5. It should have high modulation sensitivity the other four requirements are in direct position to the phase stability [3].

c) Loop Filter

The Loop Filter used in the PLL is a low pass filter. it is used to suppress the signal component of high frequency generate from phase detector and to suppress noise. it also helps to provide a DC controlled signal to the voltage controlled oscillator (VCO). if we assumed that the loop is in lock range then we can say that phase detector is linier and its outputs voltage to phase error because the loop filters the phase error voltage. the loop filter also affect the ability of loop to change frequency. A filter with low cutoff frequency will only pass low frequency and this corresponds to slow changes in voltage level while a loop filter with high cutoff frequency will performed the changes faster [4].

III. OPERATIONAL FUNCTIONALITY OF PHASE LOCK LOOP (PLL) CIRCUITS

Let the phase difference between signal and VCO voltage is ϕ radians, then the output voltage of phase detector is given by

$$V_o = 2I_Q R_L \left(\frac{2|\phi|}{\pi} - 1 \right) = \frac{4I_Q R_L}{\pi} \left(|\phi| - \frac{\pi}{2} \right) \quad (1)$$
$$= k_\phi \left(|\phi| - \frac{\pi}{2} \right)$$

k_ϕ is the phase angle to voltage transfer coefficient of phase detector then the loop filter which is a low

pass filter filters the High frequency component of output voltage of phase detector after that the output of loop filter is amplified and applied as a control voltage V_c or input voltage to the VCO it is given by

$$V_c = K_\phi A (|\phi| - \frac{\pi}{2}) \quad (2)$$

where A is voltage gain of Amplifier and the input voltage or control will shift the VCO frequency from its free running frequency f_0 to a new frequency f and it is given by

$$f = f_0 + K_v V_c \quad (3)$$

where K_v is voltage to frequency transfer coefficient of VCO.

LOCK-IN RANGE

When the PLL is initially locked state with the signal a phase difference ϕ is established between VCO output voltage and signal voltage and it is given by [5]

$$\phi = \frac{\pi}{2} + \frac{f_s - f_0}{K_v K_\phi A} \quad (4)$$

and then frequency will be in extent synchronization. Lock-in frequency range is PLL is 2Δ , where

$$\Delta f_L = K_v K_\phi \left(\frac{\pi}{2}\right) A \quad (5)$$

$$\text{Lock-in range} = 2\Delta f_L = K_v K_\phi \pi A \quad (6)$$

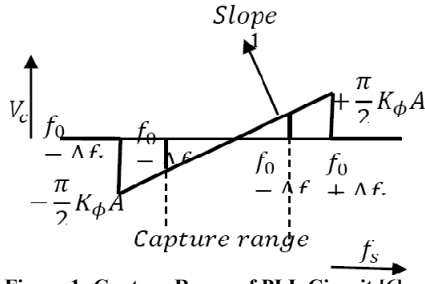


Figure 1: Capture Range of PLL Circuit [6]

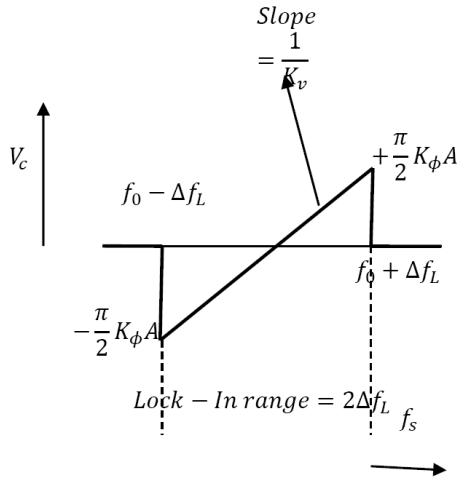


Figure 2: Capture Range of PLL Circuit [7]

CAPTURE RANGE

Initially when the PLL is not in the locked state the frequency of VCO is f_0 which is the free running frequency. Therefore the phase angle between the VCO voltage and signal is

$$\begin{aligned} \phi &= (\omega_s t - \theta_s) - (\omega_0 t - \theta_0) \\ &= (\omega_s - \omega_0)t + \Delta\theta \end{aligned} \quad (7)$$

change with respect to time is given by

$$\frac{d\phi}{dt} = \omega_s - \omega_0 \quad (7)$$

if the loop filter is simple RC low pass network and its transfer function is approximately is given by

$$|T(\Delta f)| \approx \frac{f_1}{\Delta f} = \frac{f_1}{(f_s - f_0)} \quad (8)$$

Therefore,

$$V_c = V_{0(\text{phase detector})} \times T(F) \times A \quad (9)$$

has

$$V_{c \max} = \pm K_\phi \left(\frac{\pi}{2}\right) \left(\frac{f_1}{\Delta f}\right) A \quad (10)$$

Therefore maximum frequency shift of VCO is

$$(f - f_0)_{\max} = K_v V_{c \max} = \pm K_v K_\phi \frac{\pi}{2} A \frac{f_1}{\Delta f} \quad (11)$$

and since $f = f_s$ to capture maximum signals μ frequency and the maximum signals frequency range captured by PLL is [8]

$$(f_s - f_0)_{\max} = \Delta f_c \approx K_v K_\phi \frac{\pi}{2} A \frac{f_1}{\Delta f_c} \quad (12)$$

Where

$$\Delta f_c = (f_s - f_0)_{\max} \quad (13)$$

Therefore, the range of frequency that can be captured by PLL

$$\text{Capture range} = 2\Delta f_c \approx 2\sqrt{f_1 \Delta f_L} \quad (14)$$

IV. LITERATURE SURVEY OF CMOS BASED PHASE LOCK LOOPS (PLLs) CIRCUITS

Jeng-Han Tsai, Shao-Wei Huang and Jian-Ping Chou (2014) analyzed that by utilizing the transformer feedback VCO and a high speed True Single Phase Clock (TSPC) divider, the 5.5 GHz PLL achieves the low power consumption of 9.23 mW and they placed a rail-to-rail buffer amplifier in between VCO and TSPC to get the full swing of voltage for TSPC input because it is the challenge for using high speed TSPC i.e it needs full voltage swing of input voltage. In the design of high frequency PLL, the Injection Locked Frequency Divider (ILFD) for divider's chain first stage and Current Mode Logic (CML) Frequency Divider requires large power consumption for high frequency operation therefore at the place of Injection Locked Frequency Divider (ILFD) and Current Mode Logic (CML) divider authors have used TSPC Divider which consumes less power than CML is utilized at the Divider's chain first stage [9-12]. Finally authors have designed a 5.5 GHz PLL and implemented on the TSMC standard 0.18 μ m IP6M CMOS process. The PLL consist of a transformer feedback VCO and high speed TSPC to reduce power consumption in PLL. Authors have measured the total power consumption was 9.23mW and In-band phase noise is -85dBc/Hz.

I-Wei Tseng and Jen-Ming Wu presented a 10 GHz PLL design for high speed networking with low power consumption. Authors had implemented a mixed design of Current Mode Logic (CML) and True Single Phase Clock (TSPC) to reduce the power consumption of Frequency Divider. In addition of gain boosting design of charge pump and this design leads to low jitter and low reference spur. To improve the gain of the VCO authors had proposed an additional diversity of VCO i.e user body bias. The PLL circuit by RF CMOS process in TSMC 0.13 μ m. The three main contribution of this paper are firstly authors had proposed a combination of CML and TSPC based design to optimize the frequency divider for low power consumption, Second contribution is the use of charge pump with gain boosting final and the last one is the VCO with gain boosting to improve gain. The frequency divider combine low speed divider with high speed divider to reduce the power consumption and takes two step to reduce power consumption. Firstly authors removed current tail from the high power consumption divider (CML-DFF). Mainly the function of current tail is to give current stability. To improve the operation speed authors had removed current tail because the CML buffer which is connected to first divider and appropriate amount of swing can be provided from each divider stage. Secondly, they have removed the number of high speed divider replaced by TSPC-DFF which is a low power consumption divider. The TSPC-DFF takes more time to switch the logic level, contrary, TSPCDFF is a dynamic logic and save more power of the divider compared to CML-DFF. In this proposed PLL they had chosen the divider number $N=64$ and therefore 6 divider of 2 are needed. they had chosen 4 divider with medium speed (2.5GHz and below) and 2 divider with high speed (10 GHz, 5GHz) to reduce the power consumption in the frequency divider section of the PLL [13-18].

Therefore finally they had implemented a 10GHz PLL which is fabricated in 0.13 μ m CMOS and it consumes only 18.7mW which is the lowest power consumption by any 10GHz PLL design and to get lower jitter and much better spur they had used a charge pump to get better performance of PLL. Architecture of PLL designed by authors is given in Fig below

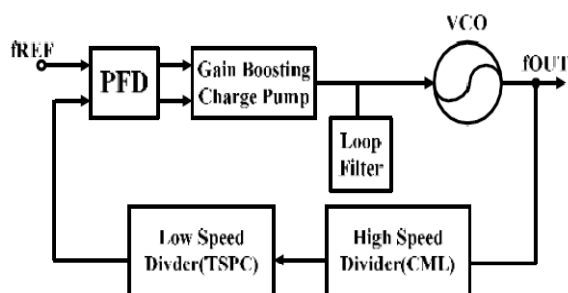


Figure 3: Architecture of PLL Circuit [I-Wei Tseng and Jen-Ming Wu]

Changhua Cao, Yanping Ding and Kenneth K.O had proposed a 50GHz charge pump PLL that utilized an LC oscillator which is based on Injection Locked Frequency Divider (ILFD) and it was fabricated in 0.13 μ m logic CMOS process. By adding ILFD the PLL can be lock from 45.9 to 50.5 GHz and its output power level is about -10dBm. They had increased the operating frequency range by tracking the selfoscillation frequencies of the frequency divider and the VCO.

The static frequency divider which are widely used can be operated above 44GHz till that time and if one want to operate at much higher frequency then it can be made possible only to built the static frequency divider in SiGe BiCMOS technology but their power consumption will be high. Therefore to get low power consumption and to achieve higher frequency operation authors had proposed an Injection Locked Frequency Divider (ILFD). However operating frequency of ILFD is much narrower than that for static frequency divider. In this they had worked to increase the range of operating frequency by using an ILFD and by tracking the VCO and ILFD's self-oscillation frequencies. Oscillator Injection Pulling or Locking phenomena is defined as when a continuous wave close to the fundamental of oscillator subharmonic or super-harmonic will pull away or even it may lock the oscillator output. If one further want to extend the locking range the ILFD is designed in such a manner that the resonant frequency of its tank tracks that of the VCO and to tune the self-oscillation frequency of the ILFD they had used the MOS varactors. MOS varactors control voltage tied with the control voltage of the VCO and therefore the self-oscillation frequency of the ILFD tracks that of the VCO. Therefore self-oscillation frequency of VCO should be twice as that of ILFD. ILFD output frequency is around 25GHz and at this frequency a static divider can be used but its main advantage is that it can achieve much wider range of frequencies and it also occupies much smaller area like the 1/512 static divider which contains nine divider-by-2 stage and schematic of divider-by-2 stage based on Masterslave D flip flop in which they had connected the inverted slave output to the master input and each of the master slave latch is implemented by Current Mode Logic (CML).

The result of this paper is that the loop can be locked from 45.9 to 50.5 GHz and power consumption is 57mW. This is the highest frequency to be locked by PLL despite of noise fabricated in Si technology even they had arose a problem also that to understand the noise at push-push node. A 192 GHz push-push VCO can be built in 0.13 μ m CMOS. Therefore CMOS PLL which can be operate at hundreds of GHz also be possible [19-23]. The architecture designed by authors is given below:

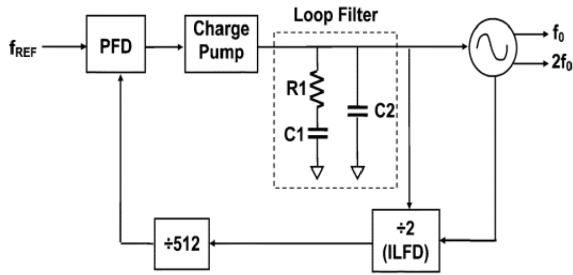


Figure 4: Architecture of PLL [Changhua Cao, Yanping Ding and Kenneth K.O]

Jri Lee, Mingchung Liu and Huaide Wang had presented a paper in which they had designed and verified experimentally a 75GHz Phase Locked loop (PLL) which they fabricated in 90nm CMOS technology. In the circuit they had incorporated a three quarter wavelength oscillator to achieve two major issue , first one was high frequency operation another one was to get appropriate Phase and frequency detector based on SSB mixer which is used to suppress the reference feed through and PLL shown in figure given below Figure 5: Architecture of PLL [Jri Lee, Mingchung Liu and Huaide Wang] This architecture demonstrates an operation range of 320MHz and consumed 88mW of power from 1.45 voltage supply. A robust VCO with properly arranged dividers are main requirements to design an Ultra high speed PLL and their operation locking range should be overlapped with each other. At such high frequency , to make blocks individually is easy to build than to make connecting blocks with aligned frequency in a loop because any unexpected change may shift the VCO frequency that may prohibited the loop from lock. One more issue is in the charge pump PLL i.e the spurs occurs because of the comparison of pulse width in phase detector which is used to translate the periodic perturbation to the control line and this issue may cause serious interferences in wireless system.

Therefore authors had presented a fully integrated PLL fabricated in 90nm CMOS technology to tackle with above described issues. The stringent tradeoff between locking range and operation speed could be relaxed by appropriate arrangement used for different divider topologies. For this authors had proposed a new frequency and phase detector topology which is based on SSB mixer to obviate the pulse generation that leads to 'quiet' phase comparison and substantially suppressed the reference sidebands. Till that time to authors best knowledge it was the fastest and fully integrated PLL for all technologies [24-26]. The three main technical aspects used in this paper are Novel VCO topology which leads to improve the speed and noise , second is appropriate arrangement for dividers which ensures the locking along loop, third and the final one is SSB mixer based phase frequency divider which is used to achieve quiet phase comparison that leads to ultra-low spurs.

V. CONCLUSION & DISCUSSIONS

This paper Review shows the various design method of CMOS based PLL circuits that have been discussed here such as utilizing an LC oscillator based Injection Locked Frequency Divider (ILFD) to achieve low power consumption and higher frequency operation , by utilizing transformer feedback VCO and high speed True Single Phase Clock (TSPC) , using a combination of Current Mode Logic (CML) and True Single Phase Clock (TSPC) these all logic designed to reduce the power consumption of the frequency divider circuit of the PLL . This paper provides us a comprehensive solution to many of the solution that will impact on power consumption of PLL Circuit

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HEALTH MONITORING IN REMOTE AREAS USING WBAN

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Abstract - With the increasing success of Wireless Sensor Network(WSN) and RFID technologies using this theory continues to set a milestone, but as far as the Medical Areas are concerned these technologies are still lacking in such domains. This is the domain where the part of Body Area Network comes into play. WSN is one of the effective technology which can be used in the advancement of medical fields and applications. This technology can be used vastly in the future advancements of e-health and thus helping remote areas in an effective manner and can even track patient's condition from a far distance. This leads to an independent living of a hearing or vision impaired person without even caretakers. With an advantage comes a disadvantage, similarly is the case with the mentioned technology of Body Area Network. Due to this emerging technology, the demand for hospitals, doctors and clinics are getting reduced.

Also there is a danger for leaking the Patient Information leading to manipulation of any personal information. Thus, keeping all the constraints in mind we have designed this paper to make the Body Area Network effective, compiling the technologies and bringing it all over to remote controlled sensors as well as securing the data transmission and thus securing the patient's information to a good extend.

Keywords - Wireless Sensor Networks, RFID, E-health, Secure Transmission Channel.

I. INTRODUCTION

With the increasing population and urbanization, mankind tends to head towards an unhealthy lifestyle resulting in diseases such as diabetes, heart attacks and hypertension. These chronic ailments slowly dominate the body and many people do not have access to health centres and proper medical attention. Also, the rate at which these diseases are occurring is greater than the number of health centres ready to provide assistance. It is important that a patient gets enough medical care even if doctors and hospitals are out of reach. This can happen in cases such as floods, calamities and people staying in deserted/ rural areas. By creating an economically and geographically feasible solution through technological advancements, people can get help without having to take any stress about the cost and reach of the available treatment.

According to [12], the role of electronic health care is an important part of Wireless Body Area Network. Apart from devices available in hospitals, there is a requirement for devices which can be easily available at a person's doorstep. In [1] the author has explained how Wireless sensor devices cater this need as they have the capability of mobility along with transmission of data. Therapeutic and diagnostic functions can be monitored and a treated sooner.

These sensors can be internally or externally attached to the body and can indicate whenever an odd condition or an abnormality strikes the body through an alarm, reminder, etc. The internally placed sensors once configured cannot be changed in future. The abnormal conditions (pH change, heart attack, blood pressure, cancer, etc.) after being detected can be sent over the wireless channel in the form of processed

data to any health caretaker. The caretaker can then take care of the patient's condition by sending across a certain treatment or prescription through the same wireless channel. The role of these devices doesn't end here. Even after a treatment is given, the device can trustfully be set to an option where it will keep reminding the patient of his medicine timings, lifestyle routine, etc.

Suppose a situation where an aged person is staying alone and independently at home and he suddenly suffers a heart attack. The person won't be able to move or go to the hospital; neither will any neighbour or relative be aware of this incident. In this case, the sensor device on the body of the patient will detect the heart attack and transmit the issue in the form of a phone call on an alert to the hospital. The location of the person will be detected through GPS and an ambulance will be sent immediately. Similarly, this can be helpful for a person wanting a body diagnosis. The data can also be sent through an app on a Smart phone and the doctor can prescribe treatment through the same application. Featuring another use, after the treatment is prescribed; the device can be placed on a box containing capsules. When it's time to have the medicine, the amount of dose will be popped out of the box and a reminder for the same will be sent to the patient through an alarm.

This treatment can be modified according to a person's need. If a person is deaf or blind, the alert can be sent through vibrations in a device which the person can wear as a ring or a smart band. The paper has been divided into 6 sections. In Section II we have discussed about the related works, where we have explained about the works previously done. In Section III we have described the problem formulation for which we have proposed a solution.

In Section IV we have explained about the patient monitoring and system design in which we have discussed about the architecture of the system and also discussed about the process and where it is applicable. The proper working of the system is explained in Section V. We have discussed about the future works and concluded our paper in Section VI.

II. RELATED WORK

A number of research works have been proposed in the area of WSN and also the concept of Big Data was also used. According to [5], in recent years the concept of e-health has emerged which has helped people in digitalized treatment. As given in [4], the sensor nodes or the motes collect data from the environment and then it transfers it to other intermediate nodes. This is a simple and handy process and not that expensive. As soon as any abnormal condition occurs, a message is sent through mobile. When the risk increases then e-solutions are taken care of and the ambulance is sent to the location of the person. Here the doctor is updated with the patient's profile and medical history and the ways of avoiding any risk.

The communication between the patient and the doctor/ caretaker is divided into priority. For e.g.: If a person is having fever and the other person gets a heart attack then the person who got heart attack will be given priority and steps would be taken accordingly.

According to [9], Wireless Sensor Networks (WSN) has been popular in the news in recent years and is expected to flourish further in fields like: cyber security, underwater sensing, privacy control, etc.

Mobile IP protocol is used when the home network is informed by the foreign network about a care of address where the user's device's packets will be sent. Location independent routing of IP datagram is allowed on the internet by the mobile IP protocol.

Ignoring its current location, a mobile node is identified by the address it is associated with (home address). The feature of mobile IP is that it specifies how a datagram are routed to the mobile node through the tunnel by the home agent, and also how a mobile node is registered with its home agent.

In [21] the author suggests that in order to track a target, the sensor nodes within the range of the target can sense the target and are kept in an active mode, whereas the rest of them are kept in an inactive mode. This enables conservation of energy at the same time. A group of sensors is required to be kept active as the target may be mobile and it would be mandatory to monitor the target continuously. The amount of sensors that need to be kept active depends upon how fast the target is moving. CODA or Continuous

Object Detection And Tracking Algorithm for Wireless Sensor Networks is a widely used algorithm for the same.

The author in [7] has used RFID readers to manipulate working objects by mounting them on hand gloves. This was done for activity recognition.

The author in [3] and [17] proposed wireless sensor network architecture for smart home care that has the crucial elements of each of the future medical applications like:

- Wearable sensors,
- Assistance to the old and chronic patients,
- Long term, Real time, remote monitoring.

The author in [2] and [19] used the sensors and pervasive computing infrastructure to help the staff identify when elderly patients actually need assistance, such as when one becomes restless and could not sleep in the night and wander here and there. The paper aimed at front line delivery.

In [22] the author has focused on Biometrics to identify and verify the patient by certain characteristics. This technique was useful in terms of security as it ensured data integrity, confidentiality and proper authenticity.

But our paper proposes a much better way to ensure security. This is possible by using a mobile which has an in-built sensor that could sense the fingerprint and ensure if the person is the actual patient or not.

In [23] the author has explained about various environments where the sensor networks can be used and which proved to be of an important use in the e-health sector. An infrastructure named Ayushman could collect data. Software was also designed to collect data from people who live in remote areas.

But our paper talks about the way people who live in remote areas can actually consult doctors while being away from the hospital. It has allowed the interaction of doctor and patient by using a mobile app. In today's world Smart phone is handy and mostly everyone knows about its features and applications. Therefore it helps a patient to get primary treatment.

The paper [24] aims at giving help to elderly by the data generated by the sensors. Then this data is sent to the medical servers and caregivers.

But our paper focuses on giving help to not only elders but physically challenged people with alternative ways to alert them about their medication and the intelligent pillbox automatically pops correct dosage of medicine for the patient to have. The data is shared between a doctor and patient only and it is stored in the cloud.

III. PROBLEM FORMULATION

It is a common problem of all patients to forget about taking their medicines on time. Most of the times they don't remember which medicine to take at what time. In this case it becomes difficult for the doctor to supervise the patient's recovery by remote monitoring. Is there any intelligent hardware available to alert the patients as well as the guardian to take the medicine dosage properly on time?

IV. SYSTEM ARCHITECTURE

To solve such a problem, we are proposing a model of Intelligent Pillbox – a device which automatically reminds the patient about their medication.

System Design: The hardware of our system consists of a Motor Controlled Pill Box. Here the box contains the PIC microcontroller (PIC16F877A) which controls the motor that dispenses the medicine after daily monitoring of the patient as prescribed by the doctor.

The backbone of the system is Body Area Network (BAN) and Personal Area Network (PAN) which are maintained by a gateway node. At the application level when an abnormal situation is encountered, it is taken care of by the caretakers who get a message through the app which has been made keeping in mind, the progress of the patient. An emergency situation is tackled by the alarm produced by the mobile device which notifies the needful person as given in figure 1.

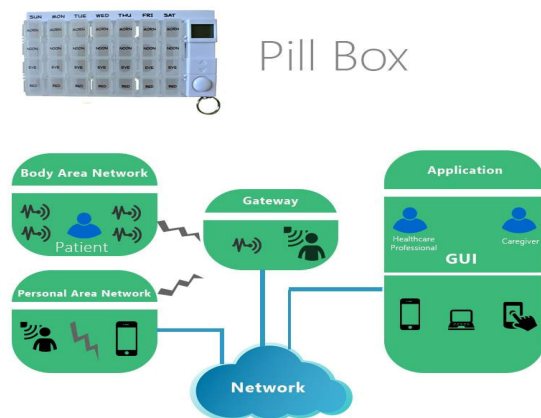


Figure 1: The working of the Intelligent Pillbox System.

The scenario of the following sub-system:

- 1) *Body Area Network Subsystem:* It helps to connect different nodes which can be sensor and actuators that are located internally or externally of a human body. According to [6], it is widely spread over the whole body of the human and the nodes communicate with each other. These sensors can quantify different biological functions. By this network the

patients' lives become easy, accurate and faster.

- 2) *Personal Area Network Subsystem:* It comprises of all IT devices interconnected together in a range of an individual. For e.g. it can be mobile, laptop or P.D.A. Nowadays wireless technologies are mostly preferred. *Intelligent Pillbox Subsystem:* According to [18], features of the intelligent pillbox are as follows: -

- The medicines pop out of the box according to the doses prescribed by the doctor after the checkup. An alert is sent on the phone for the same.
- For physically handicapped people; like the ones who are deaf/blind, a smart band can be worn on the wrist which will indicate the alert in the form of vibrations; which can be felt.

- 3) *Gateway to Wide Area Network:* Security gateway is the platform which provides us a secured communication between the backbone and the application. It also prevents the network from congestion, by managing the transfer of data. The gateway provides context awareness which helps in choosing a suitable network through which the proposed data can be sent securely. This security is mainly handled by the subsystem gateway. It should process the data which comes from the verified identity of the source and it makes sure it is not a modified patients' data.

Security: According to [11],[13] and [14], the scheme which we have proposed in this paper consists of keys which protect gateway attacks. It also provides us with a solution which prevents any middle way attack, fake data injection and session keys.

It also contains a RFID tag that helps in collecting data by operations which are battery free with the help of low cost tags.

- 4) *Wide Area Network:* Wide Area Network connects different equipment from remote areas that are located in diverse areas to connect with the areas from all over the globe. Even if there is a malfunction in the Personal Area Network then it allows the data to be stored in the cloud which can be restored when the devices start functioning properly.
- 5) *End User Health care Monitoring Applications:* The interface the health care centres uses are secure and protect the personal concerns of a patient and maintain a standard. The user interface of the application is expandable and user-friendly. It is the most important part of the system which allows data to be collected and then an action is delivered in response to the data. The processing of the data can be done by using processing

algorithms. The graphical user interface is used to identify real time problems by identifying vital signs during emergency.

According to [16], there can be three types of patients:

- 1) Children and Acute ill people: These particular groups of patients consist of young aged people who are unable to take care of themselves. For e.g. those people who need to be told about their dosage.
- 2) Aged and Permanent disease struck: According to [8] the ones who are not comfortable in moving from one place to another, so they prefer this technology so that they can be diagnosed even when they are sitting at home.

People living in remote areas: According to [20] they usually live in the outskirts and they are not able to avail the hospital facilities. From those areas they can consult with the specialized doctors of dignified hospitals.

The types of caregivers:

- 1) Caretakers: This group consists of people such as the parents, and helpers of baby, children, and aged people.
- 2) Professionals: They are the trained professionals, physicians or other staffs from the health care centre who monitors the emergency situations and deals with it accordingly.

V. SYSTEM WORKING AND PATIENT MONITORING

The working of our pillbox is described in this section with steps that helps in monitoring the patient and as well as understand it properly.

Step I: Doctor and patient download the app on their smart devices as discussed in [10] and register themselves for further use. Patient applies the sensors on the body – anywhere and at any time. The sensor then collects data, said to be the full body diagnosis which is processed into the app and saved. The working of the system is given in figure 2.



Figure 2: Working of the system

Step II: A particular doctor nearest to the patient’s location is detected and the diagnosis is sent to him. The diagnosis is compared to the standard ranges. If the patient’s readings are within the normal range, the reading is shown with a green light, else a red light, indicating that the patient needs attention. The doctor can go through the same and prescribe medicines if needed, via a sms alert which is shown in figure 3.1 and 3.2.

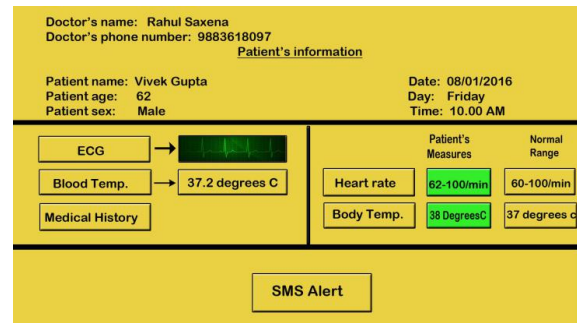


Figure 3.1: Doctor- Front Panel (Normal condition)

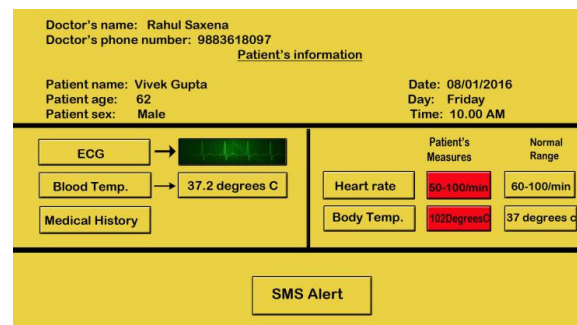


Figure 3.2: Doctor- Front Panel (Abnormal condition)

Step III: After the dosage and timing of medicine is saved on the patient’s dashboard, the SMS alert is shown on the patient’s device whenever it is time to take the medicine as shown in figure 4.

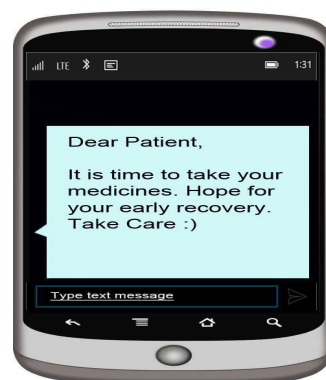


Figure 4: First sms alert on patient’s mobile

Step IV: If the medicine is not consumed within one hour of the SMS alert, another warning message is shown. If the patient again fails to abide by the prescription; an alert is sent to the doctor, and the concerned caretakers are contacted through the app as shown in figure 5.



Figure 5: Sms sent to the caretakers/ Relatives

Step V: If the entire diagnosis is normal and a sudden change in the patient readings occur, say, the blood pressure rises unexpectedly, in that situation the doctor alerts the patient instantly as shown in figure 6.

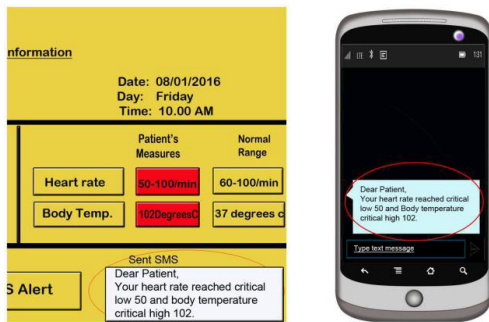


Figure 6: Sms alert by the doctor to the patient

VI. CONCLUSION AND FUTURE WORKS

The automatic pillbox which has been described in this paper has made the work of the doctors much easier. It even helps the patients to take their medicines in a timely manner. It alerts the patients to whenever there is an emergency. Along with other patients it also serves physically disabled people who cannot visit the hospital frequently. The e-prescription helps to keep record of the patient's medical information. It's better than the paper-based concept. It helps the doctor to access their patient's report from anywhere. The only thing required to keep the pill box activated is to keep it charged and keep it connected with the internet. Researchers have worked a lot to emerge different application of WSN and it has made the life of researchers and patients life easier.

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OPTIMAL TRANSMISSION EXPANSION PLANNING WITH GENERATOR/LOAD MODELS AND FREQUENCY CONTROLS USING DIFFERENTIAL EVOLUTION ALGORITHM

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Abstract - Cost-effective transmission expansion planning (TEP) is a major challenge of the power system optimization problems. The main purpose of TEP problem is to determine the optimal expansion plan of the electrical transmission system. Furthermore, TEP should specify the new circuits that have to be added to an existing network to guarantee adequate operation for a specified planning horizon. Usually, TEP can be categorized as static or dynamic (multistage) planning according to the study period. Static planning involves a single planning horizon, whereas dynamic planning is a derived generalization that considers the separation of the planning horizon into multiple stages. In the past few years, various evolutionary algorithms, heuristic or metaheuristic algorithms are being applied for expansion planning. Differential evolutionary algorithm (DEA) has been used to solve a wide range of power system problems such as static TEP, short-term scheduling of hydrothermal power systems, power system planning etc. In a number of cases, DEA is proven to be reliable providing optimal solutions with acceptable computational effort. In this paper DEA is proposed to solve the TEP, based on AC-OPF problem, using AC model. In practical scenario, the load/generator is not in a single type. In this paper TEP is approached to be carried out with generator model and various load models. In order to optimize the transmission network topology by minimizing the objective function, this paper deals with selection of new circuits which should be added to the existing transmission network. It is, however subjected to operating conditions for generating units and transmission network.

Keywords - AC-OPF, Differential Evolution Algorithm, Frequency Control, Generator Model, Load Models, Transmission Expansion Planning.

I. INTRODUCTION

The objectives of transmission expansion planning are based on existing systems, future load, generation scenarios, available right-of-ways, cost of line etc. The TEP is an important part of power system planning. It consists of determining the optimal expansion plan of transmission network such that the total cost of new constructed transmission lines to be minimize, while satisfying the operational constraints of the power system. TEP can be divided in to two types 1) static TEP and 2) dynamic TEP. Static TEP performs all the expansions in a single stage of planning horizon. While dynamic TEP decides when, where and the number of new circuits to be installed to meet the growing electricity demand in an optimal way. The heuristic and metaheuristic techniques prove to be very well suited for many optimization problems. Many techniques such as genetic algorithm (GA), particle swarm optimization (PSO), simulated annealing (SA), tabu search (TS) etc. have been proposed and tested.

Recently an accurate AC network modeling has been proposed [3]. In the first phase use of the AC model is found incipient. Later there are a few technical literatures on the subject [3, 7, and 8]. Owing to the large-scale nature of a transmission system and its complexities, TEP has always been a complex and

non-convex optimization problem. For better power systems utilization, developing a TEP model for the operating conditions is therefore desirable. Therefore reactive power sources are desire for increasing power transfer, improving power factor, reducing real power losses and maintaining voltage profile in a permissible range.

A differential evolution algorithm (DEA) introduced by Storn and Price in 1995 [9] is an evolutionary computation method. DEA developed is a reliable and versatile function optimizer readily applicable to a wide range of optimization problems [10]. DEA uses rather greedy selection and less stochastic approach to solve optimization problems than other classical evolutionary algorithms. There are also a number of significant advantages when using DEA, which were summarized by Price in [11] are (i) Ability to find the true global minimum regardless of the initial parameter values, (ii) Fast and simple with regard to application and modification, (iii) Requires few control parameters, (iv) Parallel processing nature and fast convergence, (v) Capable of providing multiple solutions in a single run, (vi) Effective on integer, discrete and mixed parameter optimization and (vii) Ability to find the optimal solution for a nonlinear constrained optimization problem with penalty functions etc. TEP has been studied on the standard test systems Garver – 6 bus system.

II. FREQUENCY CONTROLS AND MODELS

A. Generator Models

Under normal conditions, system frequency is maintained constant and generators are operated at a scheduled voltage and output. When system load changes, however, output of generators is varied by instruction from the Automatic Load Frequency Control (AFC). Governor setting is changed so that operation returns to a point on the governor load-speed curve corresponding to system operating frequency. When the system is disturbed by loss of generation or tie line support, the governor restores balance automatically, while generator terminal voltage is kept to a reference voltage within the limits of the exciter rating, and some generators are controlled automatically by their reactive power output.

Generator real power output is adjusted by the static response of the prime mover. This may be expressed as

$$P_{gi} = P_{g0i} - \frac{P_R}{R} \Delta f \quad (1)$$

and

$$P_{gi}^{\min} \leq P_{gi} \leq P_{gi}^{\max} \quad (2)$$

P_{gi} - is the real power output of the generator at i^{th} bus

P_{g0i} - is the scheduled power output of the generator at i^{th} bus

P_R - is the rated output of the generator

R - is the speed regulation in per unit

B. Frequency Controls

Automatic Load-frequency Control (AFC): Frequency fluctuations due to changes in load are monitored continuously, and the frequency is maintained constant by using a governor motor or limit to control generator output. AFC does this automatically and are (i) Flat Frequency control (FFC), and/or (ii) Flat Tie-line Control (FTC), and/or flat (iii) Flat Tie-line frequency Bias Control (TBC) on interconnected systems.

Flat Frequency control (FFC): In response to changes in system frequency, the power outputs of generators within a prescribed area are automatically regulated to maintain scheduled system frequency. Since the system frequency remains constant (i.e., $\Delta f = 0$), Δf is replaced by the new variable P_{RQ} .

Power output for the regulating generators is

$$P_{gi} = P_{g0i} + \alpha_i P_{RQ} \quad (3)$$

Where P_{gi} - is the real power output of the generator at i^{th} bus

P_{g0i} - is the scheduled power generation at i^{th} bus

P_{RQ} - is the supply insufficiency in a given area,

α_i - is the load distribution factor of i^{th} generator

such that $\sum \alpha_i = 0$

C. Load Models

Load models are traditionally classified into two broad categories, static models and dynamic models.

Static Load Models: These models express the active and reactive powers, at any instant of time, as a function of the bus voltage magnitude and frequency. Static load models are used in both static and dynamic load components.

Dynamic Load Model: A Dynamic load model expresses the active and reactive powers at any instant of time as functions of the voltage magnitude and frequency. Studies of inter area oscillations, voltage stability, and long term stability often require load dynamic to be modeled.

Different types of Static and Dynamic Load Models: The following different types of static and dynamic load models

a. *Constant impedance load model* is a static load model where the power varies directly with the square of the voltage magnitude. It may also be called a constant admittance load model.

b. *Constant current load model* is a static load model where the power varies directly with the voltage magnitude.

c. *Constant power load model* is a static load model where the power does not vary with changes in voltage magnitude. It may also be called constant

MVA load model.

The static load model that represents the power relationship to voltage magnitude as a polynomial equation, usually in the following form:

$$P_{di} = P_{d0i} (1 + C_P \Delta f) \left[K_{pp} + K_{pi} \left(\frac{v}{v_0} \right) + K_{pz} \left(\frac{v}{v_0} \right)^2 \right] \quad (4)$$

$$Q_{di} = Q_{d0i} (1 + C_Q \Delta f) \left[K_{qp} + K_{qi} \left(\frac{v}{v_0} \right) + K_{qz} \left(\frac{v}{v_0} \right)^2 \right] \quad (5)$$

where

P_{di} - active power demand at i^{th} bus

Q_{di} - reactive power demand at i^{th} bus

P_{d0i} - active power consumptions at rated voltage, v_0 at i^{th} bus

Q_{d0i} - reactive power consumptions at rated voltage, v_0 at i^{th} bus

C_P, C_Q - constant of frequency characteristics of load

v - supply voltage

v_0 - rated voltage

III. TEP PROBLEM FORMULATION

TEP problem is usually refers as a static transmission model. Generally, the objective of fitness function is to find optimal solution, measure performance of candidate solutions and check for violation of the planning problem constraints. Fitness function of the static TEP problem is basically a combination between objective function and penalty functions. The purpose of applying penalty functions to the fitness function is to represent violations of equality and inequality constraints. In this static TEP problem, there are two equality constraints, which is node balance of AC active and reactive power flow. In contrast, there are several inequality constraints to be considered, namely power flow limit on transmission lines constraint, active and reactive power generation limit, injection right of way constraint and bus voltage limit.

The TEP based on AC-OPF problem can be mathematically expressed as follows:

$$\text{Min } F(x,u) \quad (6)$$

Subject to $b(x,u) = 0; w_{\min} \leq w \leq w_{\max}$

Where: F – is an objective function which has to be minimized

x – is a static vector which denotes the dependent variables

v – is a vector representing all control variables

b – is equality constraint which is active and reactive power equilibrium condition

w – is inequality constraints which represents limits of control variables and system operating limits.

A. Objective Functions

Minimization of investment cost: The objective of this function is to minimize the investment cost IC of the system and this objective can be formulated as follows:

$$IC = \sum_{ij=1}^{nl} c_{ij} n_{ij} \quad (7)$$

Where IC is the investment cost, c_{ij} is the cost of the candidate circuit for addition to the branch i - j and n_{ij} is number of circuits added to the branch i - j and nl is the number of candidate circuits.

Minimization of operation cost: The objective of this function is to minimize the operation cost OC of the system and this objective can be formulated as follows:

$$OC = \sum_{i=1}^{ng} (a_i P_{gi}^2 + b_i P_{gi} + c_i) \quad (8)$$

Where OC is the operation cost (fuel cost), P_{gi} is the power generation of i^{th} generator, a_i , b_i and c_i are the constant coefficients of power generation

Minimization of real power loss: The objective of this function is to minimize the real power loss PL of the

system and this objective can be formulated as follows:

$$PL = \sum_{ij=1}^{nl} G_{ij}(n_{ij}) (v_i^2 + v_j^2 - 2 v_i v_j \cos(\delta_i - \delta_j)) \quad (9)$$

Where PL is the real power loss of the system, n_{ij} is the number of candidate lines between buses i and j , v_i , v_j are the bus voltages and δ_i and δ_j are the voltage angles at buses i and j respectively.

State Variables: The state variables of a TEP based on AC-OPF consists of active power generation at slack bus (P_{g1}), voltage magnitude and phase angles

of all load buses (v_i, δ_i), generator reactive power outputs (Q_{gi}), transmission line loadings (S_{li}). The state vector X can be expressed as:

$$X = [P_{g1}, v_1, \dots, v_n, Q_{g1}, \dots, Q_{ng}, S_{l1}, \dots, S_{nl}] \quad (10)$$

where nl , n and ng represents the number of transmission lines, number of buses and number of generators respectively.

Control Variables: The control variables of TEP based on AC-OPF consists of active power generation output (P_{gi}), number of additional lines

(n_i) and reactive power injections (q_{ci}). The control vector u can be represented as:

$$u = [P_{g2}, \dots, P_{ng}, n_1, \dots, n_{nl}, q_{c1}, \dots, q_{cnq}] \quad (11)$$

where ng , nl and nq are the number of generators, number of transmission lines and number of reactive power injections

B. Constraints

The TEP based on AC-OPF has to follow equality and inequality constraints strictly. The real and reactive power equilibrium is considered as equality constraints and various operating limits are considered as inequality constraints.

Equality constraints: These constraints are shows load flow equations of both active power and reactive power. Mathematically represented as follows:

$$V_i \sum_{j=1}^{nb} V_j (G_{ij}(n) \cos \delta_j + B_{ij}(n) \sin \delta_j) - P_{gi} + P_{di} = 0 \quad (12)$$

$$V_i \sum_{j=1}^{nb} V_j (G_{ij}(n) \sin \delta_j + B_{ij}(n) \cos \delta_j) - Q_{gi} + Q_{di} - q_{ci} = 0 \quad (13)$$

where P_{gi} , Q_{gi} are active and reactive power generations at i^{th} bus respectively. P_{di} , Q_{di} are active and reactive power demands at i^{th} bus respectively. q_{ci} is injected reactive power at i^{th} bus.

n is number of added lines vector. G and B are the conductance and susceptance matrices respectively and are given by

$$G = \begin{cases} G_{ij}(n) = -(n_{ij}g_{ij} + n_{ij}^0g_{ij}^0) \\ G_{ii}(n) = \sum_{j=1}^{nb} (n_{ij}g_{ij} + n_{ij}^0g_{ij}^0) \end{cases} \quad (14)$$

$$B = \begin{cases} B_{ij}(n) = -(n_{ij}b_{ij} + n_{ij}^0b_{ij}^0) \\ B_{ii}(n) = \sum_{j=1}^{nb} (n_{ij}b_{ij} + n_{ij}^0b_{ij}^0) \end{cases} \quad (15)$$

where g_{ij}^0 and b_{ij}^0 are conductance and susceptance of the transmission line connected between buses i and j at initial conditions and g_{ij} and b_{ij} are conductance and susceptance of the transmission line connected between buses i and j at added line conditions. n_{ij}^0 and n_{ij} are the number of lines between buses i and j at initial and added line condition respectively.

Inequality constraints: These constraints are represent the system operating limits and are as follows:

Generation constraints: Generator voltages, real power outputs and reactive power outputs should be within their minimum and maximum limits.

$$v_{gi}^{\min} \leq v_{gi} \leq v_{gi}^{\max}, \quad gi = 1, \dots, ng \quad (16)$$

$$P_{gi}^{\min} \leq P_{gi} \leq P_{gi}^{\max}, \quad gi = 1, \dots, ng \quad (17)$$

$$Q_{gi}^{\min} \leq Q_{gi} \leq Q_{gi}^{\max}, \quad gi = 1, \dots, ng \quad (18)$$

Reactive power injection limits: Reactive power injection at load buses should be within minimum and maximum limits

$$q_{ci}^{\min} \leq q_{ci} \leq q_{ci}^{\max}, \quad ci = 1, \dots, nq \quad (19)$$

Security limits: These constraints include the limits of voltage magnitudes at all load buses, voltage angles at all buses and transmission line loadings of candidate lines.

$$v_i^{\min} \leq v_i \leq v_i^{\max}, \quad i = 1, \dots, npq \quad (20)$$

$$\delta_i^{\min} \leq \delta_i \leq \delta_i^{\max}, \quad i = 1, \dots, nb \quad (21)$$

$$(n+n^0)S_l^{\min} \leq (n+n^0)S_l^{\max}, \quad l = 1, \dots, nl \quad (22)$$

Number of lines limits: The number of lines added in the candidate lines should not exceed the maximum number of lines

$$0 \leq n_i \leq n_i^{\max}, \quad i = 1, \dots, nl \quad (23)$$

IV. DE ALGORITHM FOR TEP PROBLEM

The proposed optimization program is expected to be able to solve a number of mathematical and engineering problems, such as economic power

dispatch, unit commitment, optimal power flow, power system planning, transmission expansion planning, etc. The overall procedure of the DEA optimization program for TEP based on AC-OPF has been described as follows:

Step 1: Set up all required parameters of the DEA optimization process i.e. Set up control parameters of the DEA optimization process that are population size (NP), scaling mutation factor (F), crossover probability (CR), convergence criterion (ϵ), number of problem variables (D), lower and upper bounds of initial population (x_i^{\min} and x_i^{\max}) and maximum number of iterations or generations (G^{\max});

Step 2: Set generation $G = 0$ for initialization step of DEA optimization process;

Step 3: Initialization step i.e. Initialize population P of individuals according to equation (24) where each decision parameter in every vector of the initial population is assigned a randomly selected value from within its corresponding feasible bounds;

$$x_i = x_i^{\min} + rand(x_i^{\max} - x_i^{\min}) \quad (24)$$

Step 4: For each generation check the equality criteria i.e. sum of all generations should be equal to load demand

$$\sum_{i=1}^{ng} P_{gi} = P_d \quad (25)$$

Step 5: Run optimum power flow

Step 6: Calculate and evaluate the fitness values of the initial individuals according to the problem's fitness function;

Step 7: Rank the initial individuals according to their fitness;

Step 8: Set iteration $G = 1$ for optimization step of DEA optimization process;

Step 9: Apply mutation, crossover and selection operators to generate new individuals using equations (26 – 28)

$$v_i^{(G)} = x_{r1}^{(G)} + F(x_{r2}^{(G)} - x_{r3}^{(G)}) \quad (26)$$

$$U_i^{(G)} = u_{j,i}^{(G)} = \begin{cases} v_{j,i}^{(G)} & \text{if } rand_j(0,1) \leq CR \text{ or } j = s \\ x_{j,i}^{(G)} & \text{otherwise} \end{cases} \quad (27)$$

$$X_i^{(G+1)} = \begin{cases} U_i^{(G)} & \text{if } f(U_i^{(G)}) \leq f(x_i^{(G)}) \\ x_i^{(G)} & \text{otherwise} \end{cases} \quad (28)$$

Step 10: For each generation check the equality criteria i.e. sum of all generations should be equal to load demand

$$\sum_{i=1}^{ng} P_{gi} = P_d \quad (29)$$

Step 11: Run optimum power flow

Step12: Calculate and evaluate the fitness values of new individuals according to the problem's fitness function;

Step 13: Rank new individuals by their fitness;

Step 14: Update the best fitness value of the current iteration (g_{best}) and the best fitness value of the previous iteration (p_{best})

Step 15: Check the termination criteria; i.e. If $|X_i^{best} - X_i| > \varepsilon$ or $|p_{best} - g_{best}| > \varepsilon$ but the number of current generation remains not over the maximum number of generations $G < G^{max}$, set $G = G + 1$ and return to step 9 for repeating to search the solution. Otherwise, stop to calculate and go to step 16;

Step 16: Output g_{best} of the last iteration as the best solution of the problem.

V. SIMULATION RESULTS

The Transmission Expansion Planning is executed using Differential Evolution Algorithm has been implemented in MATLAB 7.10.0.499, 32 bit, 3 GB RAM, Intel Core 2 Duo T6600 2.20 GHz Processor with Windows 7 Operating System. Garver 6 – bus standard electrical transmission network is considered for the expansion planning. The TEP problem has been investigated in three case studies. The objective functions are investment cost, operation cost and power losses are tested in case studies. The generated power at each generator varies between P_g^{max} and P_g^{min} . Garver 6 – bus system consists of 6 buses, 15 possible branches, 760 MW, 152 MVAR demand and maximum 5 lines can be added to each branch. The complete data of the system is available in [3] and also shown in Fig.1. The dotted lines represent new possible line additions and solid lines are the existing lines. The detailed data of the test system was available in the above paper. Reactive power injections are at all the load buses 2, 4 and 5, the upper and lower limit of bus voltages are 1.05 and 0.95 p.u respectively are considered. The minimum generation g_i^{min} of each generator is considered as zeros, the maximum generation g_i^{max} of each generator, resistance and reactance of candidate line, permissible line loading of each line is given in [14]. To obtain optimum values of all objective functions, the algorithm was run for 10 times. DE parameter are

$D=15$, $NP=50$, $F=0.358$, $CR=0.458$ and maximum iterations are 500.

TEP has been studied for Garver – 6 bus system by considering three (3) case studies are as follows:

Case – I: Reactive power is not injected at any load bus, investment cost \$130 million obtained in base case [12].

Case – II: The selection of reactive power injections at all load buses has been varied between minimum and maximum limits (0 MVAR and 0.1 MVAR respectively). Thus the investment cost \$110 million obtained in base case [13]

Case – III: The selection of reactive power injections at all load buses has been varied between minimum and maximum limits (0 MVAR and 1.5 MVAR respectively) so that investment cost has been decreased to \$ 80 million compared to Case – I and Case – II.

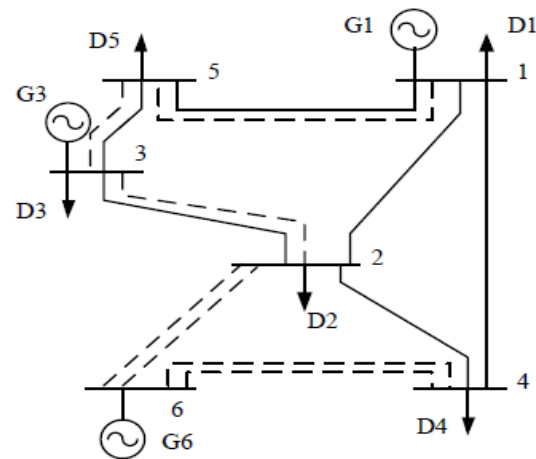


Fig.1 IEEE 6-bus Garver test system

A. Case- I results

Transmission Expansion Planning based on AC-OPF using AC network. TEP using DEA with various DE parameters and system parameter and constraints are considered. In this case reactive power is not injected at any load buses. The results are tabulated as shown in TABLE 1 for investment cost, operation cost and real power loss as the objective function simultaneously.

Without injection of reactive power at load buses, investment cost as objective function, investment cost \$ 130 million was in base case and the optimum investment cost \$ 80 million was resulted in combination of flat frequency control generator model and constant impedance load model i.e. FFC+CZ LM.

By maintaining the system security and all constraint limits, operation cost as the objective function, optimum operation cost 593.4596 \$/h resulted in combination of flat frequency control generator

model and constant impedance load model (FFC+CZ LM). The healthy system voltage profile has been maintained and also line loadings are within the permissible limits by without injection of reactive power at load buses.

Power loss as the objective function, the optimum loss 2.8507 MW resulted in combination of flat frequency control generator model and constant impedance load model (FFC+CZ LM).

Model/Objective Function	Investment Cost (\$) $\times 10^6$	Operation Cost (\$/h)	Power Loss (MW)
Base Case	130	614.5779	2.975
CP LM	130	614.5792	2.9748
CC LM	110	606.6646	2.9328
CZ LM	110	595.0875	2.8949
Mixed LM	110	612.2742	2.9517
FFC	130	614.6339	2.9825
FFC + CP LM	130	614.6339	2.9825
FFC + CC LM	110	605.8142	2.9149
FFC + CZ LM	80	593.4596	2.8507
FFC + Mixed LM	110	612.2214	2.9486

TABLE 1: SUMMARIZED RESULTS OF GRAVER 6-BUS SYSTEM FOR CASE - I

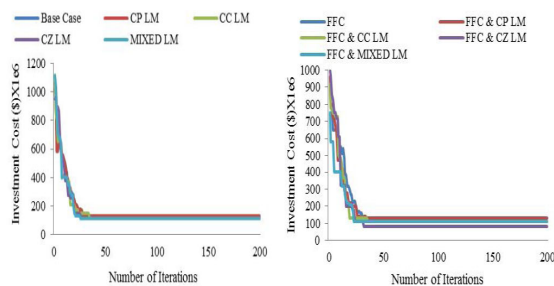


Fig 2: Convergence characteristics of Investment cost for Case - I

B. Case- II results

The reactive power injection at all load buses was varied between upper and lower limits (0 MVAR and 0.1 MVAR respectively). The optimum values of investment cost, operation cost and power loss as objective function are presented in TABLE 2.

With injection of reactive power at all load buses, investment cost \$ 110 million was in base case where as the optimum investment cost \$ 80 million resulted in (a) constant impedance load model (CZ LM), (b) combination of flat frequency control generator model and constant current load model (FFC+CC LM) and (c) combination of flat frequency control generator model and constant impedance load model (FFC+CZ LM).

By maintaining the system security and all constraint limits, operation cost as the objective function, optimum operation cost 593.4513 \$/h resulted in combination of flat frequency control generator model and constant impedance load model (FFC+CZ LM). The healthy system voltage profile has been

maintained at all buses and also line loadings are within the permissible limits in all lines.

Power loss as the objective function, the optimum real power loss 2.8188 MW resulted in combination of flat frequency control generator model and constant impedance load model (FFC+CZ LM).

C. Case- III results

In this case study to obtain better results, compared to case – I and case – II the reactive power injections are varied between upper and lower limits (0 MVAR and 1.5 MVAR respectively) at all load buses. Summarized results of investment cost, operation cost and power loss are objective functions are shown in TABLE3.

Model/Objective Function	Investment Cost (\$) $\times 10^6$	Operation Cost (\$/h)	Power Loss (MW)
Base Case	110	614.5621	2.9241
CP LM	110	614.5617	2.923
CC LM	110	606.6647	2.8883
CZ LM	80	594.3969	2.8548
Mixed LM	110	612.2743	2.9045
FFC	110	614.6126	2.929
FFC + CP LM	110	614.6126	2.929
FFC + CC LM	80	605.8142	2.8722
FFC + CZ LM	80	593.4513	2.8188
FFC + Mixed LM	110	612.2219	2.9011

TABLE 2: SUMMARIZED RESULTS OF GRAVER 6-BUS SYSTEM FOR CASE - II

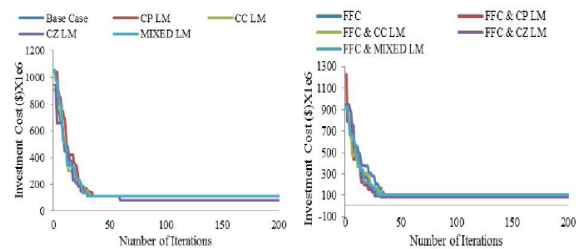


Fig 3: Convergence characteristics of Investment cost for Case - II

Reactive power injected at all load buses are varied between minimum and maximum limits such that bus voltages are within limits and line loadings are also within their limits. Investment cost \$ 80 million was in base case and also the optimum investment cost \$ 80 million resulted in (a) base case, (b) constant power load model (CP LM), (c) constant current load model (CC LM), (d) mixed load model (mixed LM), (e) flat frequency control generator model (FFC), (f) combination of flat frequency control generator model and constant power load model (FFC+CP LM), (g) combination of flat frequency generator model and constant current load model (FFC+CC LM), (h) combination of flat frequency control generator model and constant impedance load model (FFC+CZ LM) and (i) combination of flat frequency control generator model and mixed load model (FFC+mixed LM).

In addition of reactive power injection at all load buses, the power generations are varied by each generator within their minimum and maximum limits to maintain system healthy conditions. Operation cost as the objective function, optimum operation cost 593.4513\$/h resulted in combination of flat frequency control generator model and constant impedance load model (FFC+CZ LM).

Likely the system was stabilized with respect to all equality and inequality conditions with different constraints. Power loss as the objective function, the optimum power loss 2.7851 MW resulted in combination of flat frequency control generator model and constant impedance load model (FFC+CZ LM).

Model/Objective Function	Investment Cost (\$)\times 1e6	Operation Cost (\$/h)	Power Loss (MW)
Base Case	80	614.526	2.8246
CP LM	80	614.526	2.8262
CC LM	90	606.6647	2.8138
CZ LM	110	594.395	2.7998
Mixed LM	80	612.2743	2.8205
FFC	80	614.5754	2.8315
FFC + CP LM	80	614.5754	2.8315
FFC + CC LM	80	605.8142	2.8119
FFC + CZ LM	80	593.4513	2.7851
FFC + Mixed LM	80	612.2236	2.8236

TABLE 3: SUMMARIZED RESULTS OF GRAVER 6-BUS SYSTEM FOR CASE - III

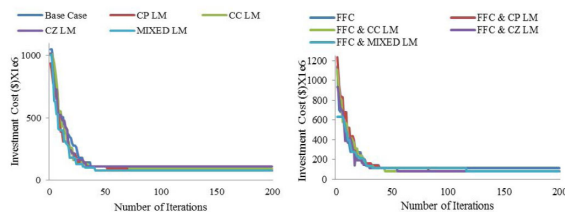


Fig 4: Convergence characteristics of Investment cost for Case - III

VI. CONCLUSIONS

This paper explored the possibility of applying AC-OPF based models to the TEP problem. Nine TEP models are presented in this paper. The formulation of each model is shown and discussed in detail. A validation process guarantees the resultant TEP plan is strictly AC feasible. The conclusions of this paper are: The AC model can be applied to model TEP problems. The solution of DEA-based AC-TEP models is still challenging. By reformulation and relaxation, it is possible to solve the DEA-based ACTEP problem and obtain a optimal solution.

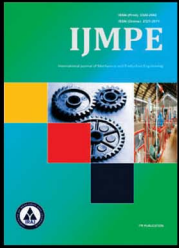
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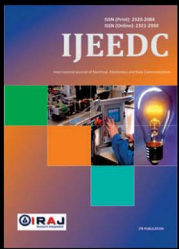
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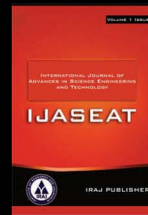
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47. THE CULTURAL HERITAGE OF VIZHINJAM



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Vizhinjam is a small village in Neyattinkara Taluk, situated nearly fifteen Kilometers South of Trivandrum. The place is of great historical and commercial importance. The region can claim a notable historical antiquity, as it was integral part of ancient Tamilakam. Being a natural port and centre of trade it played an important part in the history of South India. In the 8th century Vizhinjam reached the highest pinnacle of its glory and it became a premier educational and cultural centre. The rich and noble historical tradition had given her a cultural identity of her own. The fame of Vizhinjam is not a fading one even in the modern period as it is preserving her cultural marks. The cultural identity of Vizhinjam is perhaps due to its geographical peculiarity and natural blessings. It is gifted with a natural port, a rare advantage which differentiates Vizhinjam from the rest of the regions in Kerala.

The origin of the name Vizhinjam is a disputed matter. Scholars give different opinions with regard to the derivation of its name. Its origin is in obscurity. But Vizhinjam the capital of later Ays is a peculiar name. Perhaps the name is related to Venad because Vizhinjam was a great commercial centre in the Kingdom of Venad. Vizhinjam and Venad have close relation in names.

People of the locality believe that the term Vizhinjam might have been derived from *Vijayalaya Madam* one of the *Mutts* of

South Travancore. Gradually *Vijayalaya* had changed in to *Vijaya* and *Vijaya* became *Vaijaantham*. In course of time *Vaijayantham* began to be called *Vijayantham* and finally it became *Vizhinjam*.¹ There is ever historical evidence is little to prove this matter. *Vizhinjam* may be identified with *Vijayapuri*, the capital of *Vijayasenana*, mentioned in the Prakrit Champu *Kavyamalakatha* written in AD. 779.² The *Madras museum plates* of the 17th year of the Pandya king *Nedumjedeyan* 782AD says that he attacked and conquered the strongly fortified fort of *Vizhinjam* and conquered the king of *Venad* and captured the large numbers of his elephants and horses along with his treasures and his country.³

The *Paliyam Copper Plate* of Ay king *Vikramaditya* Varaguna of the 9th cy. shows that *Aynadu* in this period refers to the territory around *Vizhijam*.⁴ From the above statements it is clear that the strongly fortified city of *Vizhinjam* was subjected to various attacks. *Vizhinjam* in ancient times was the most important towns in South Travancore. It was the major target of attack by any outsider entering Kerala.⁵ The archaeological excavations and the artifacts from *Vizhinjam* supported the inscriptional sources and shows that two locations in *Vizhinjam* namely *Kottappuram* and *Marunnukotta* in *Vizhinjam* have had forts as the word *kotta* in local term means a fort. At *Kottappuram* there are remains of a large thick wall, apparently a fort. However the location and nature of construction seems to indicate an association with colonial period.⁶

Vizhinjam is believed to be the capital of the later Ay kings who reigned in South India in the 9th and 10th centuries AD. Being an important sea port and centre of trade in ancient Kerala, it played a prominent part in the political history of ancient Kerala. The tremendous progress of *Vizhinjam* as a commercial

place attracted the attention of the Pandyas and the Cholas. During the 11th century it was considered to be one of the major scenes of the battle between the Chera and Chola Kings. The Ays were the earliest ruling tribes in South Kerala before the rise of Venad as a political power. They were semi independent under the Cheras and Pandyas and at times asserted their independence. All evidences point to the fact that the areas lying south of Thiruvalla were under the suzerainty of the Ays in the Sangam Age¹⁰. Attur Krishna Pisharadi in his introduction to *Lilathilakam*, states that the *Ayar* family who were ruling from *Aykudi* had been defeated by the Pandyas in the 8th century. It is believed that they had migrated to Vizhinjam¹¹.

Reference of a Kingdom with Vizhinjam as its capital can be traced from ancient works. It was the capital and military centre of the Aykingdom from the earlier days of the Sangam Age, up to 8th century A.D. It has been referred to as their kulapuram in the Village Panchayat reports¹². The frequent Chola and Pandya attacks in the area caused the destruction of the Aykingdom. When the Chera power was revived with Mahodayapuram as the capital the Ays became the feudatories of the Kulasekharas¹³.

The Cheras contributed much to the prosperity of Vizhinjam. The tremendous progress attracted the Pandyas and the Cholas and it led them to wage a series of wars. The place names like Kuthirapanthi, Anakkuzhiy, Thalakkodu, Piravilakam etc. in Vizhinjam are related with the Ays¹⁴. It is necessary to conduct a detailed study about these places and its names. Perhaps it may add a new chapter in the history of Kerala. In short as the centre of Ay kingdom, Vizhinjam can claim an important historical past.

Vizhinjam maintained trade relations with foreign countries from times immemorial. The seaport, the natural gift of the sea

... have attracted the traders. The commercial and naval ... of Kerala is centered around some important ports¹⁵. ... and Europeans reached its shores in the course of their ... All of them might have maintained systematic contacts ... the shore of Vizhinjam. Foreigners used Vizhinjam port ... coastal areas as their resting place and cargo centre. ... provided all facilities to them¹⁶.

Seacoasts of Kerala played a remarkable role in the trade ... with foreign countries during the Sangam Age. ... continued as a prosperous trading centre during the ... period. *Periplus of Erithriaen Sea* by an anonymous ... mentions a notable trading centre Balita, which was a ... and a Village. The reference which can be seen in *Periplus* ... reveal that Balita was perhaps Vizhinjam¹⁷. The identity as a ... seaport helped much to the development of the village.

The famous poets Ayippillai Asan and Ayyanippillai Asan ... in Avaduthurai (Vavadumthura) in Vizhinjam. They are ... as *Kovalam Poets*. Their poetical works *Ramakathapattu* ... and *Bharatam Pattu* have attained a dominant place in Malayalam ... history¹⁸. These songs are sung with the help of ... *chandravalam* a musical instrument¹⁹. There are differences of ... regarding their life time. The generally accepted view is ... that they lived around 1400 A.D.. Thus Vizhinjam has an antiquity ... to the literary history also.

The monuments reveal the splendid cultural heritage of ... the area. Vizhinjam is blessed with a lot of monuments like ... temples, Churches and Mosques. They pour enough light to infer ... idea of the religious beliefs and spiritual life of the people in ... the village.

Temples

In India especially in the South there is no town or village without a temple. Temples serve a vital purpose in Hindu culture. The daily life of every Hindu irrespective of sex, caste, colour and status in life is closely associated with temple worship. A vast number of temples numbering more than two thousand has no match with any other regions of India. Like the other villages of the state Vizhinjam is rich with temples. In stylistic development the temple architecture of Kerala can be divided into three phases. The first phase is that of Rock cut temples. This earliest form is contemporary to Buddhist cave temples. These Rock cut temples are mainly located in Southern Kerala at Vizhinjam. The remains of two stone temples can be seen in Vizhinjam even today. The first one is a Bhagavti temple and the other is a Siva²⁰. The Rock cut Temple and Bhagavathy temple of Vizhinjam bear the historical antiquity²¹.

All the cave temples in the southern group are examples of one called shrines mostly enshrining a 'lingam'. The best example of this group is the niche cave on a boulder at Vizhinjam. This cave has unfinished relief's of Siva Kirata Murti and Siva dancing with Parvathy. Some scholars hold the view that reliefs of Vizhinjam show Pallava affinities²². The saivite cult dominated the architectural style of the temples in southern group. Archaeologists are of the opinion that the least those of the southern group are definitely of Pandya origin. In front of the cave there is an inscription of Pasupathana Murthi. It is the rock cell type without the front Mandapa and the characteristic of the Pandya. Mattaraiyar region, is unique in having on either side flank of its door opening²³. The temple was declared as a protected monument in 1966 by the Department of Archaeology.

considering the influence of an alien culture in the Southern part of Kerala.

The Chola style of architecture is used for the construction of the Bhagavati Temple²⁴. It was built around 10th century A.D. Its basement pillars are built of stones and its roof is of stupa model. Totally the temple is in square shape. We can see simple style of construction in its Garbhagriha and Arthamandapa. Seven idols called saptamathrukkal are there in the Bhagavati temple²⁵.

The Bhagavathi temple is regarded as the royal temple of the Ays. It is believed that the Ay king spent a lot of money for its development. Thus the administration of this temple enjoyed a high degree of royal patronage. There is a Siva Temple in the same compound which is attached to the Bhagavathi temple. It was made out of stones²⁶. Usually the idol of Siva is installed eastwards. But in the Siva Temple at Vizhinjam the idol of Siva is installed facing the west direction²⁷. There is a general belief that the main reason for the consecration of Siva on western was due to the high power of the deity. The deity of a temple being a symbolic representation of the supreme reality of God, it becomes the worshipped object of the worshipper. It helps the devotee to control his senses and contemplate God. The temple atmosphere and the ceremonial rites promote this devotee deity relationship²⁸. These two temples are now under the control of the Archaeological Department.

The rock cut temple tradition appears to be an intrusive element in Kerala that drifted from Tamilnadu region. These rock cut caves have two zones of concentration, the northern group occupying the ancient Chera country and southern groups located in the Ay country. Southern group includes the cave located at Vizhinjam, the capital of later Ays.

Vizhinjam is a tiny village lying about 17 km from Thiruvananthapuram town. It is one of the ancient rock temples in Kerala. It is a small shrine with a central cell, having an independent sculpture of seated Dakshinamurthi datable to 8th century AD. On the two sides of the cell are unfinished panels depicting sculptures of Tripurantaka and Siva as Nataraja and Parvati standing close to him.

Tripurantaka carrying a bow and arrow in two of his four hands is a fine example of the 8th century sculptural art. His left foot rests on Apasmara, the crown of hair elegantly carved as a high headdress and is highly ornate. It is interesting that different forms of Tripurantaka had developed at such an early date. This presentation is a precursor of a similar type in metal of the time of Rajaraja I.

This is a centrally protected monument under the control of Archaeological Survey of India since 1965. This granite cave temple is built in the Tamil architectural style. The outer wall of this cave features an unfinished sculpture of Lord Shiva. In this sculpture of Lord Shiva, he is shown dancing and holding a bow.

The Rockcut cave in Vizhinjam has great importance. It is located near Vizhinjam junction. The Archaeological Department states that "the rock cut cave is in the Chera style and it closely follows the pallava pandya style of iconography. It is a simple empty cell in a boulder with the relief of Pasupathandana murthi on the outer flanks of the dressed façade. Historically the cave architecture in India begins with Buddhism and technique of Rock cut architecture in Kerala seems to be a continuation of similar works, in Tamil Nadu under the Pandyas. The rock cut temples are dated prior to 8th century A.D. This temple is also under the control of Archaeological Department.

...that the Ay kings spend a lot of money for the
...of the temples. Thus the administration of this
... a high degree of royal patronage. These two
... monuments under the provisions of the
... and Archaeological sites and Remains Act I
... 1957

...see more than sixty temples in Vizhinjam Panchayat.
...important among them are Neelakesi Mudippura,
... Indivichunna vila Devi Temple, Puraviyil,
... Mulloot mudippura, Therivila mudippura,
... Temple Venganoor, Nellivila Temple Kidarakuzhy,
... Amman Temple, Vizhinjam Muthumari Amman
... Puravilakkodu Temple, Nellikunnu Yakshi temple,
... temple etc. It is said that Neelakesimudippura had a
... background of 450 years. Paravate ceremony is the
... famous celebration in the temple in Venganoor²⁸.

...vilavila Temple is famous for its fireworks. The
... pattu in Nellivila Bhadrakali Temple attracts a lot of
... The story of Vizhinjam Muthumari Amman Temple is
... with that of Kannaki. Ammanakoda is a notable celebration
... Temple. Thus a lot of stories and traditions are related
... temples in Vizhinjam. The archaeological department
... an initiative to preserve the ancient temples in
... which are on the verge of deterioration²⁹.

Churches

The advent of Christianity in South India is a bone of
... among the historians and scholars, which is as old as
... of Christianity itself. On the basis of its historical
... Pandit Jawaharlal Nehru stated "Christianity came to

India as early as the first century after Christ, long before Europe turned to it and established a firm hold in South India. Protagonists of the theory held that the advent of Christianity dates from St. Thomas one of the twelve disciples of Jesus Christ. They adhere to participate it as a reality and they themselves bear witness as the living examples. Though Christianity flourished from very early period and catholic missionaries like Saint Francis Xavier laboured among the oppressed classes, a real social awakening in Kerala society began only with the arrival of Protestant missionaries. Col. Colin Macaulay, the British resident in Travancore from 1801- 1810 and his successor John Munro, who was resident from 1810-1819 were responsible for the establishment of Protestant Christian Missionaries in Kerala.

Absolute toleration has been the dominant feature of the religious life of Travancore from the earliest times. Majority of the Christians believe that the seeds of their faith were originally sown in the state by St. Thomas himself, whatever may be the nature of authenticity of this tradition, it is just to conclude that Christianity has been prevalent here from very ancient times. Vizhinjam was a major port and so all the foreigners' came here for commercial purposes. Dutch French, Portuguese and English people arrived here and as a result large scale conversions took place. Latin Christians and Syrian Christians inhabited here. We can see the churches of both these groups in Vizhinjam³².

The Church in the name of Sindhu Yatramata and Sindhu Yatramata Church in the coastal area are two important churches of Catholics in Kottappuram a new construction and an old one. These churches are otherwise known as "Our lady of Good Voyage Church". Old Church in Kottappuram is famous for its Latin Scripture in the door. This shows that "this church was

...the royal control of Portuguese and J.R. Antanesio Bello
...Goa served as a priest here. This church was dedicated to
...Mary³¹

There is an interesting story behind Our Lady or Good
...Church in Vizhinjam. According to the story a Portuguese
...was conducting voyage in the sea. Then strong wind blew³⁴.
...ship was on the verge of wreck. The sailors prayed of their
... Suddenly they saw an angel who is carrying a baby in her
... hand and a ship in her right hand. Suddenly the sea becomes
... and gentle. One of the escaped sailors made a figure of
... Xaviour. He put it in a box and put it into the depth of the
... along with a letter. That box reached the shores of Vizhinjam³⁵.
... on the basis of the instruction in that letter the church was
... constructed in Vizhinjam. C.S.I church Vizhinjam C.S.I Mulloor,
... kunnucatholic church etc are also important to reveal the
...quity of Vizhinjam.

...ques

The fact that the southern part of Indian sub continent was
... to the Arabs long before the rise of Islam in Arabia. The
... had close commercial relation with West Indian ports and
... spices specially attracted them to the south. Colonies of Arabs
... have existed in the port town of south India for purposes of
... Therefore it stands to support that soon after the rise of
... in Arabia it reached South India with the Arab merchants.
... also reasonable to believe that in the first flush of enthusiasm
... they tried to spread the new religion in South India also as they
... done elsewhere³⁶.

Islam is generally believed to have been introduced into
... before the 9th century AD. The event is generally

associated with the alleged conversion of the Cheraman Perumal to Islam and his supposed pilgrimage to Mecca³⁷. Another factor relating to the rise of Islam in Kerala is connected with Arab traders. The Arab traders used to visit the Kerala coast regularly. It was therefore not surprising that Islam reached Kerala almost immediately after it began to spread in the Middle East. Malik Bin dinar built the first mosque in Kerala as early as 644 AD³⁸. Kerala welcomed this religion with open hands. The support of the local rulers led to a large scale conversion to Islam. Lower castes who suffered a lot due to the rigidity of Hindu caste system came forward in large numbers to embrace the new religion.

The architectural display of mosque in Kerala presents a different style. Mosques are socio cultural centers and have religious schools, libraries, prayer halls³⁹. The old Mosques of Kerala followed the architectural style of the temples whereas the modern tendency is to follow the Indo Sarasan architecture. *Keralopathi* contains local traditions regarding the origin of Islam in Kerala. It states that Cheraman Perumal the last perumal ruler of Kerala had portioned his empire and went to Mecca. He met the prophet and was converted to Islam. On his return journey he died and buried the in Arabian coast⁴⁰.

Muhayiddin Mosque is the most famous and important one in Vizhinjam. This is situated in Mathippuramkodi. It is believed that this place is blessed with the footsteps of Muhayiddin. People from different regions of Kerala come to the mosque without caste or religious discriminations to participate in the Channanakkudam celebrations. Madrasas are functioning under this mosque. We can see the tombs of so many 'siddhas'. People belonging to all castes pay homage to their tombs⁴¹.

There is another important one at Karimpallikkara. This is blessed with the tombs of Sufis. Fishermen in this area regard it as a great holy centre. Vizhinjam juma mosque, central mosque, Kovalam mosque, and Township Mosque etc. are the centres of Muslim worshippers. Each mosque had its own patronage and historical bearings⁴².

Each of these historical monuments has its own stories and legends. All of them reveal the glorious past of Vizhinjam. The presence of temples, churches and mosques made the region a meeting place of different religious followers and contribute much to its cosmopolitan outlook.

Vizhinjam enjoyed a high status as trading centre. The availability of pepper, ginger, cardamom etc, precious jewels and diamonds from the part of coastal area fostered the trade relation of Vizhinjam with foreign countries. The patronage of the Ayazids helped the development of this area. From the above it is clear that Vizhinjam bears a wonderful and unimitable historical antiquity⁴³.

The people of Vizhinjam have the belief that Islam was introduced in the region by Sufis who reached its shores by 7th century AD⁴⁴. The first batch of Muhammadans are believed to have come from Arabia to Malabar in 710 AD. The Arabs might have helped the Sufis in spreading the religion. The legend of Cheraman Perumal strengthens the position of Islam in Kerala. It is said that the Chera Chola Pandya Kings gave patronage and patronages for the spreading of religion⁴⁴.

Vizhinjam is a great cultural centre. It is necessary to preserve the cultural heritage of the region by preserving the monuments of archaeological importance. The new studies on

the particular area will open up new chapters in the annals of South Indian history especially of Kerala history.

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