International Journal for Modern Trends in Science and Technology, 8(06): 524-530, 2022

ISSN: 2455-3778 online
DOI: https://doi.org/10.46501/IJMTST0806090
Available online at: http://www.ijmtst.com/vol8issue06.html

UV Degradation of Linear Low-Density Polyethylene-Polyvinyl Alcohol Blends Using TiO_2 Photocatalyst

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To Cite this Article
Vidya Francis, Princy K.G and Eby Thomas Thachil. UV Degradation of Linear Low-Density Polyethylene-Polyvinyl Alcohol Blends Using TiO_2 Photocatalyst. International Journal for Modern Trends in Science and Technology 2022, 8(06), pp. 524-530. https://doi.org/10.46501/IJMTST0806090

Article Info
Received: 22 May 2022; Accepted: 18 June 2022; Published: 24 June 2022.

ABSTRACT

Linear Low-Density Polyethylene (LLDPE) is a thermoplastic widely used for packaging and other applications. These synthetic polymers are normally not biodegradable until they are degraded into low molecular mass fragments that can be assimilated by micro-organisms. Blends of nonbiodegradable and biodegradable commercial polymers such as poly (vinyl alcohol) (PVA) can facilitate a reduction in the volume of plastic waste when they undergo partial degradation. In this investigation, LLDPE was mixed with different proportions of PVA in an internal mixer and effect of TiO_2 on UV degradation of LLDPE/PVA blends were investigated. Biodegradation studies of these samples were also carried out. Tensile properties, FTIR spectra and SEM were employed to investigate the degradation behavior.

KEYWORDS:LLDPE-PVA blends, TiO_2, UV Degradation, Photocatalyst.

1. INTRODUCTION

Plastic waste is a major environmental problem when it is not managed effectively. It is predicted that between 4.8 and 12.7 million tons of plastics enter the oceans annually, which is likely to continue to increase by an order of magnitude within the next decade [1]. While plastics have been detected in almost every environment, those within aquatic ecosystems are perhaps of most concern due to their global transportability, e.g., by wind [2], or ocean currents [3], reaching even uninhabited parts of our planet [4,5]. Polyethylene is a material used in large amounts for packaging because of its relatively low cost, versatile properties including high tensile strength, elongation at break, good barrier properties against water-borne organisms, higher energy effectiveness, light weight and good water resistance [6].

The role of TiO_2 and other metallic compounds on the photo-degradation of polyethylene has been studied by some authors [7]. The environmental hazard from polyethylene is associated with its excellent outdoor durability and inherent resistance to hydrolysis and

biodegradation in the environment. Partially biodegradable polymers obtained by blending biodegradable and nonbiodegradable commercial polymers can effectively reduce the volume of the plastic waste by partial degradation. Incorporation of pro-oxidant additives can also play a significant role in the degradation of polymers.

In this work the pro-oxidant activity of TiO_2 in the UV degradation of biodegradable LLDPE-PVA blend is investigated in the presence as well as absence of vegetable oil. The degradation due to UV exposure was monitored by various techniques like physical property measurements, FTIR spectroscopy, and scanning electron microscope (SEM) for surface morphology among other things. These UV degraded samples were then subjected to biodegradation studies in a culture medium containing Vibrio species isolated from marine benthic environments.

2. EXPERIMENTAL

Materials

General purpose film grade LLDPE (LL20FS010) used in this study was supplied by Reliance Industries Ltd, Mumbai, India. It has a melt-flow index of 1g/10min at 190^{0}C and 2.16kg load. The density of the LLDPE sample is 0.920g/cm^3. Hot water-soluble polyvinyl alcohol used in this study was industrial grade obtained from Rolex Chemical Industries, Mumbai. Molecular formula is $(C_4H_{10}O)_n$; viscosity at 4% concentration in water at 20^{0}C is 3mPa.s. TiO_2 was purchased from M/S TravancoreTitanium Products, TVM.

Sample preparationUV-Degradation Procedure

Blending was carried out at 185^{0}C in a Thermo HAAKE Polylab internal mixer equipped with a pair of roller rotors. The rotor speed was maintained at 50rpm.Varying amounts of commercial rutile and anatase forms of TiO_2 (0.25%-1% w/w) were added to LLDPE-PVA blends during mixing. Blends containing different proportions of LLDPE, PVA and metal oxides were compression molded into sheets to form thin films. Molded samples, cut into strips according to ASTM D882, were used for all the tests. The details of film samples prepared along with their designation are presented in Table 1. LLDPE-PVA (L0 = LLDPE containing 10% PVA) blends containing glycerol alone have been designated as F and those containing both glycerol and vegetable oil as FV. Samples containing additionally anatase and rutile have been designated as FVA and FVR respectively, the numerical suffix indicating the % concentration of the oxide additive.

L10 + Glycerol = F

L10 + Glycerol + Veg. Oil = FV

L10 + Glycerol + Veg. Oil + Rutile = FVR

L10 + Glycerol + Veg. Oil + Anatase = FVA

L10 + Glycerol + Rutile = FR

L10 + Glycerol + Anatase = FA

Table 1 Details of formulations and their sample designation

Sample designation	LLDPE (g)	PVA (g)	Glycerol (g)	Vegetable oil (g)	TiO_2 (g)
F	45	4.5	0.675	_	_
FV	45	4.5	0.675	0.45	_
FVA-0.25	45	4.5	0.675	0.45	0.1125
FVA-0.50	45	4.5	0.675	0.45	0.225
FVA-0.75	45	4.5	0.675	0.45	0.3375
FVA-1	45	4.5	0.675	0.45	0.45
FA-0.50	45	4.5	0.675	_	0.225
FVR-0.25	45	4.5	0.675	0.45	0.1125
FVR-0.50	45	4.5	0.675	0.45	0.225
FVR-0.75	45	4.5	0.675	0.45	0.3375
FVR-1	45	4.5	0.675	0.45	0.45
FR-0.50	45	4.5	0.675	_	0.225

UV-Degradation Procedure

Samples were UV-irradiated using a low-pressure mercury vapor discharge lamp (TUV 30W, λ = 253.7nm) in air atmosphere at room temperature. Samples were mounted on racks positioned 5cm from the lamps and the temperature in the cabinet was maintained at 30±2°C. Sampling was carried out at regular intervals of 120, 240, 360, 480, and 600 h, respectively, and the degradation was monitored by various techniques. TiO_2

photocatalyst absorbs only UV light ($\lambda < 387$ nm); thus, only UV-light place a role in the solar degradation of PE-TiO_2 composites.

The UV-degraded samples were then subjected to biodegradation studies.

Biodegradation in Culture Medium

Biodegradation of the samples were carried out using a consortium consisting of four PVA degrading *Vibrio sp.* isolated from benthic marine environment, according to ASTM D 5247–92. Bacterial cultures isolated from sediment samples collected from different locations of Cochin back waters and Mangalavanam mangroves, identified as genus *Vibrio* and maintained in the culture collections of Microbial Genetic Lab, *Dept. of Biotechnology, Cochin University of Science and Technology* were utilized in this study.

Evaluation of Extent of Degradation

Samples with a gauge length of 100 mm and width of 10 mm were cut from the films for tensile strength measurements as per ASTM 882-85. Six samples were tested for each experiment and the average value was taken.

Structural changes upon exposure were investigated using FTIR spectroscopy. FTIR spectra were recorded at regular intervals using a Thermo Nicolet (Avatar 370) spectrophotometer in the spectral region between 4000 and 400cm-1. For each sample a total of 32 scans were averaged at a resolution of 4 cm-1.

Scanning electron microscopy was performed on the samples before and after degradation to investigate the changes in the morphology due to UV exposure. Sample surfaces were sputtered with gold using usual techniques and then analyzed in a JEOL (JSM-6390LV) electron microscope.

3. RESULTS AND DISCUSSION

Mechanical Properties

The UV exposure of any polymeric material depends on various parameters like UV content, temperature and humidity [8]. It has been reported that the surface temperature of plastics exposed to sunlight can be much higher than that of the surrounding air due to heat buildup [9].

Figure 1 & 2 represent the effect of exposure time on the tensile strength of LLDPE-PVA blends containing anatase and rutile after UV exposure and biodegradation.

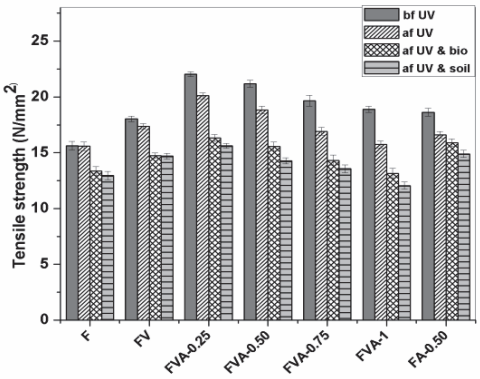


Fig.1Effect of UV exposure time on the tensile strength of LLDPE-PVA blends containing anatase.

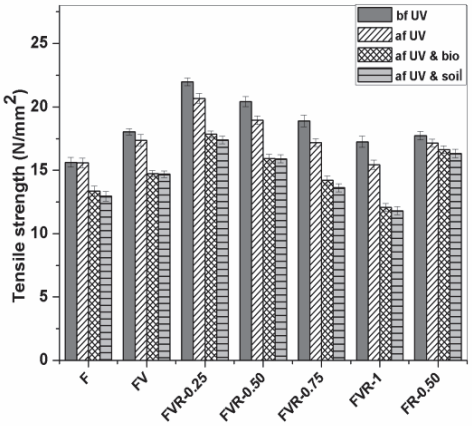


Fig.2 Effect of UV exposure time on the tensile strength of LLDPE-PVA blends containing rutile

The samples containing a mixture of vegetable oil and TiO_2 show a decrease in tensile strength within 240 hours of exposure time. After UV exposure, the greatest reduction in tensile properties was observed in the case of samples containing anatase form of TiO_2. For the case of 0.50% of TiO_2, the tensile strength decreased by 3.33% for samples containing rutile (FR-0.50), and 10.84% for anatase (FA-0.50).

Both rutile and anatase forms of TiO_2 played a significant role in promoting the photo-oxidative

degradation of LLDPE films, the decrease is more in the case of samples containing anatase.

The % decrease in tensile strength of the blends after weathering is shown in Table 2. The stiffness of the materials increased considerably within a month of exposure time due to additional cross linking prior to degradation.

Table 2 % decrease in tensile strength of the samples after UV exposure

Sample designation	Tensile strength (N/mm²)		
	Before UV exposure	After UV exposure	% Decrease
F	15.63	15.58	.32
FV	18.03	17.37	3.66
FVA-0.25	22.04	20.10	8.80
FVA-0.50	21.19	18.83	11.14
FVA-0.75	19.67	16.92	13.98
FVA-1	18.90	15.74	16.72
FA-0.50	18.63	16.61	10.84
FVR-0.25	21.97	20.68	5.87
FVR-0.50	20.42	18.96	7.15
FVR-0.75	18.89	17.19	8.99
FVR-1	17.25	15.44	10.49
FR-0.50	17.74	17.15	3.33

FTIR Studies

The FTIR spectrum of LLDPE/PVA blends (F) containing anatase (A) and rutile (R) before and after 600 hours of UV exposure in the presence as well as absence of vegetable oil are shown in Figure 3 to 6 respectively.

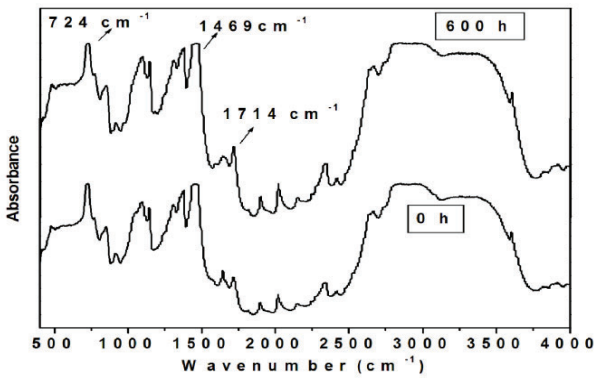


Fig.3 The FTIR spectra of LLDPE-PVA blends with anatase after 600 hours of UV exposure in the absence of vegetable oil.

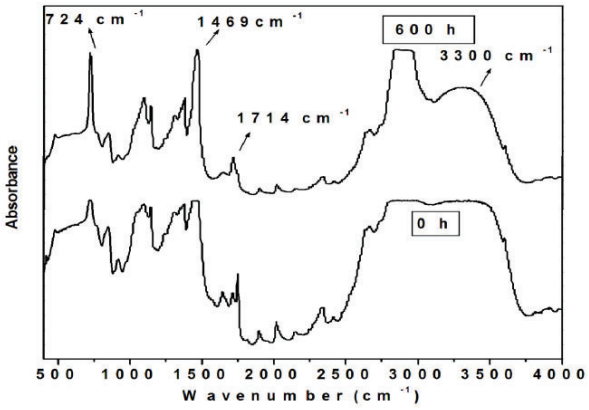


Fig.4 The FTIR spectra of LLDPE-PVA blends with anatase after 600 hours of UV exposure in presence of vegetable oil.

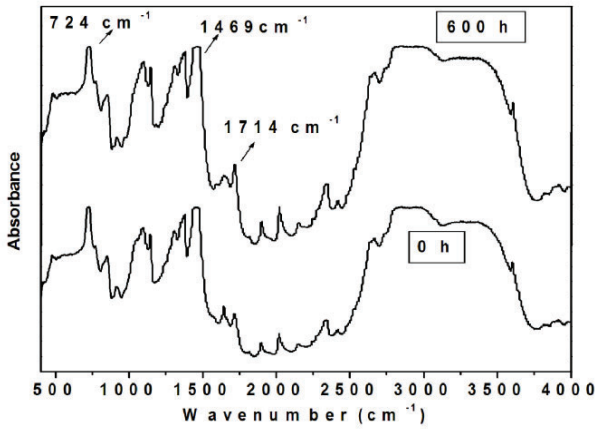


Fig.5 The FTIR spectra of LLDPE-PVA blends with rutile after 600 hours of UV exposure in the absence of vegetable oil.

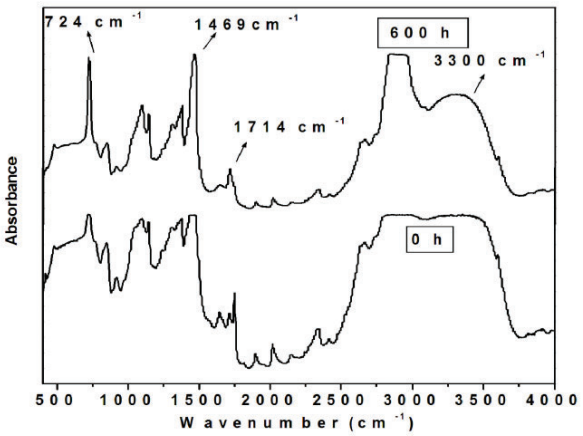


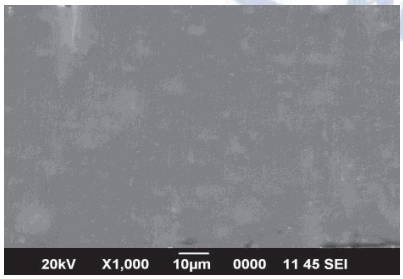
Fig.6 The FTIR spectra of LLDPE-PVA blends with rutile after 600 hours of UV exposure in presence of vegetable oil.

The FTIR spectra clearly show that the photo oxidative degradation of LLDPE/PVA blends result in the formation of several functional groups; however, the

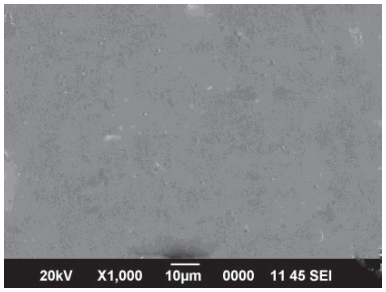
amount of such functional groups is much more in the presence of TiO_2 and vegetable oil. The most significant changes are in the carbonyl and hydroxyl regions. The absorption band around 1712 cm^{-1}, due to C=O stretching, increases in intensity and a band broadening is observed, which indicate the presence of multiple oxidation products overlapping in the same region. The carbonyl band can be assigned to C=O stretching vibrations in aldehydes and/or esters (1733 cm^{-1}), carboxylic acid groups (1700 cm^{-1}), and γ lactones (1780 cm^{-1})[10–13]. Similar behavior is observed in all the samples. The ratio of the absorbance of carbonyl band around 1712 cm^{-1} and internal thickness band at 2020 cm^{-1}, which characterize the degree of photo-oxidation of polyethylene, [14] has been used to calculate the carbonyl index (CI). The incorporation of TiO_2 and vegetable oil into the polymer leads to a significant increase in CI in a relatively short span of time. Scanning electron micrographs shows that extent of degradation is more in the case of compositions containing a combination of TiO_2 and vegetable oil. Large cavities are created around the TiO_2 particles which show the chalking effect of TiO_2.

Morphological Studies

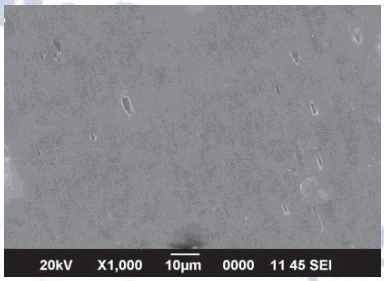
The challenge of studying plastic biodegradation is that the entire process is too slow to be visualized through traditional microbiology methods such as microbial growth or substrate depletion. Different techniques have been employed to assert biodegradation, such as plastic weight loss, decrease of polymer chain length (via gel permeation chromatography, GPC), or surface oxidation (via X-ray photoelectron spectroscopy, XPS, or Fourier transform infrared spectroscopy, FT-IR along with SEM studies [15]. The Scanning Electron Micrographs (SEM) of the samples after UV exposure and biodegradation are shown in Figs. 7 and 8.



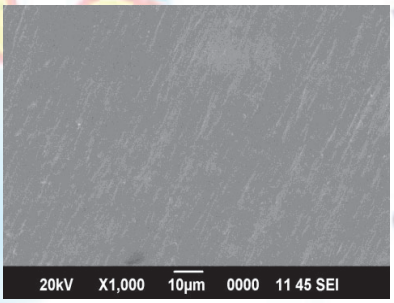
Rutile before UV exposure



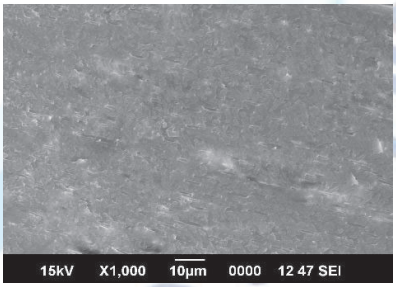
Rutile after UV exposure



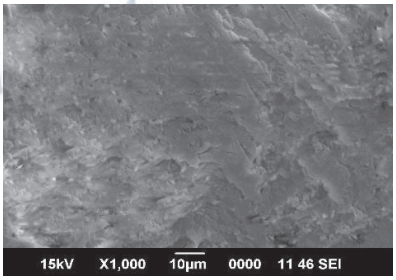
Rutile after biodegradation



Anatase before UV exposure



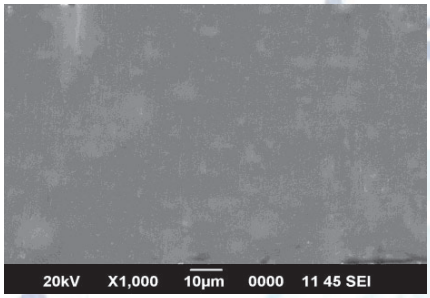
Anatase after UV exposure



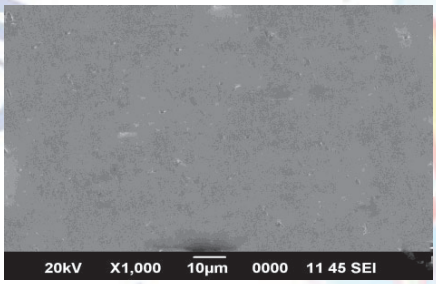
Anatase after biodegradation

Fig. 7 Morphology of UV degraded samples without vegetable oil

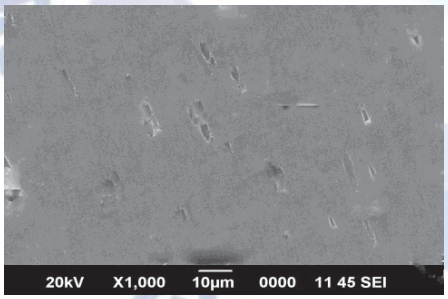
The photodegradation of PE mainly happens on the film surface. Photocatalytic reaction first starts at the interface between PE and exposed TiO_2 photocatalyst which leads to the formation of cavities around TiO_2 particles. That is after UV irradiation also cavities are observed on the surface of the film. The formation of these cavities was induced by the escape of volatile products from the PE matrix.



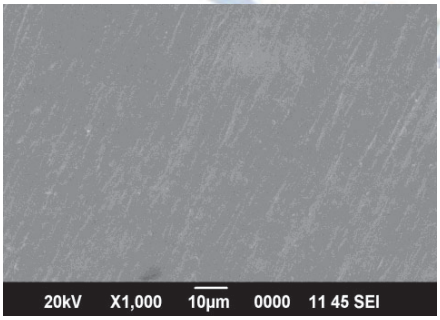
Rutile before UV exposure



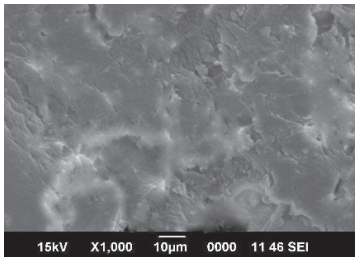
Rutile after UV exposure



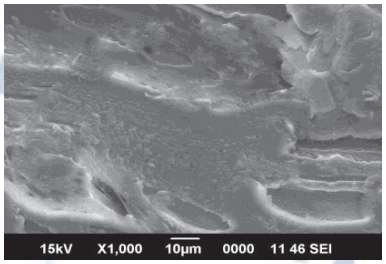
Rutile after biodegradation



Anatase before UV exposure



Anatase after UV exposure



Anatase after biodegradation

Fig. 8 Morphology of UV degraded samples with vegetable oil

Examination of the films by SEM shows the formation of holes in the film which scatter light and cause whitening.It can be seen that there are some deep cavities on the film surface with the extension of irradiation time. This suggests that in the vicinity of the titania particles the polymer gets totally degraded to water and carbon dioxide or other volatile substances.

4. CONCLUSIONS

The incorporation of TiO_2 as the key pro-degradant has increased the rate of degradation tremendously. Vegetable oil is also capable of accelerating the oxidation of LLDPE/PVA blends during UV exposure. The pores seen in scanning electron micrographs are an indication of degradation. The reduction in tensile properties of the blends after UV exposure also confirms this. Both TiO_2 and vegetable oil are capable of accelerating the photooxidation of LLDPE-PVA blends by UV exposure.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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Biological Forum – An International Journal **15(2): 683-688(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Anthoceros extract as Growth Promotor and Biochemical Stimulant in Okra Plants

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(Received: 02 January 2023; Revised: 11 February 2023; Accepted: 15 February 2023; Published: 18 February 2023)
(Published by Research Trend)

ABSTRACT: Bryophytes are the amphibians of the plant kingdom. In fact, the work on the bryophyte as biofertilizer is less. They are seasonal also. In the present study the effect of *Anthoceros* extract on growth performance and biochemical properties of *Abelmoschus esculentus* was studied and its antimicrobial effect was also detected. For this study germination rate of the seeds of the bhindi plants were recorded at various concentrations of the *Anthoceros* extract like 20%, 40%, 60%, 80% and 100%. The one without any extract was regarded as control. The length of roots, shoots, length and width of leaf, etc were also examined in the concentrations 60%, 80% and 100%. In addition to this the biochemical analysis for detection of carbohydrates and protein was also performed. Antimicrobial activity against *Staphylococcus aureus* was detected. Of the various concentrations studied, the 60% showed maximum seed germination within minimum days as compared to the others, and the length of roots, shoots, length and width of leaf, etc. were also high in this concentration. The root length was 4.5cm, shoot length was 13.2 cm, leaf length was 3.3cm and leaf width was 3.1. In this concentration the highest value of protein and carbohydrate was also recorded. The control showed lowest rate of germination, root length, shoot length, leaf length and leaf width. The protein content and amount of carbohydrate also less in control. It shows the influence of *Anthoceros* extract in seed germination and growth of bhindi plant. The extract of *Anthoceros* showed antibacterial property towards *Staphylococcus aureus.* This may be due to its symbiotic association of blue green algae *Anaebena*. Through this study it was made clear that the Anthoceros like bryophytes are good source of biofertilizers with antibacterial potential, and we have to explore it. More studies has to be conducted to isolate the compounds present in Anthoceros and to find out the effects of these compounds.

Keywords: Anthoceros, Biochemical analysis, Antimicrobial activity, symbiotic, germination.

INTRODUCTION

Bryophytes are non-vascular thalloid forms well adapted in their physiology and organization. They can grow in harsh conditions where other plants cannot grow. They have the ecological and evolutionary significant as they are the first group of plants migrated from water to land. They play major role in mineral cycling and also trap the nutrients in the soil so they can be considered as nutrient filters. Some of the bryophytes are the encrust the nitrogen fixing bacteria and so increase the fertility of the soil. Our rice fields are the good habitats of the bryophytes and help in retaining the water holding capacity of the soil there. Fungicidal, bactericidal and insecticidal activity of the bryophytes are well known (Asakawa *et al*., 1980; Ando and Matsuo 1984).

Anthoceros is one of the important bryophyte having the cyanobacteria as symbiont and is seen widely in the rice fields of our state. They are improving the texture of the soil by Increasing the pores of the soil by their filamentous structure and producing some adhesive substances , Excreting growth promoting substances, such as hormones (auxin, gibberlin), vitamins, aminoacids etc (Roger and Renaud 1982; Rodriguez *et al*., 2006), they are also responsible for Increasing the water holding capacity through their jelly structure (Roger and Reyanud 1982), soil biomass is getting enhanced after their death and decomposition, Decrease in soil salinity, Preventing weed growth and also Increase in soil phosphate by excretion of organic acids. They can also be used as biomonitors of metal in order to get an idea about metal precipitation.

Bryophytes are rich sources of oligosaccharides, polysaccharides, sugar alcohols, amino acids, fatty acids, aliphatic compounds, phenyl quinones and aromatic and phenolic compounds but few studies have been made between any medical effects and specific bryophyte species or compounds. They have been used as medicines in China, India and Americans from the ancient time onwards. Bryophytes like *Sphagnum* and *Rhodobryum* sps. Are well known for their antibiotic properties. They are contributing much towards carbon balance of the nature (Bisbee *et al*., 2001; Gowar *et al.,* 1997).

In horticulture, soil additives are prepared from the bryophytes. Some bryophytes are used against *Phytophthora infestans* or *Alternaria solani* etc. They can also be used for decorative purposes, land scaping, insect repellent, mounting medium for epiphytes etc.

Comparatively less works were conducted on the effect of Anthoceros extract or extract from any other bryophytes. There is good symbiotic relation between the two. In India about 25 species have been reported by various workers. *Anthoceros himalayensis, A. erectus* and *A. chambensis* are the common the three common Himalayan species.

There are some works on the effects of bryophytes on plant growth. Matsuo *et al*. (1981, 1984a, 1984b) studied the structures of various substances from liverworts which are having plant growth inhibitory activities. Huneck and Meinunger (1990) tested 52 species of mosses and 29 species of liverworts on growth regulation activity and found out that the bryophytes have the wonderful capacity to enhance the shoot and root growth. The studies of Mishra *et al.* (2014) showed that the bryophytes have good amount of flavonoids, terpenoids, glycosides and sterols in high amount which can have positive effect on growth of plants. Here an attempt was made to study the effect of Anthoceros extract on the growth performance and biochemical aspects of okra plant. Anthoceros sps are good host to the blue green algae Nostoc.

In the field of aquatics and fuel the bryophytes can be act as bio and radioactive indicators respectively (Saxena and Harinder 2004; Glime, 2007).

In addition to this they have a number of active constituents which demonstrates a variety of activities like antimicrobial, antifungal, cytotoxic, antitumor, and insecticidal properties (Asakawa 2008; Üçüncü *et al.,* 2010). These property of bryophytes can also be used in the field of agricultural and medicinal process.

Large number of bryophytes have secondary metabolites which can be used as potential A significant pharmacological, economic, or biotechnological sources. Potential plant-protection agents, enzyme inhibitors, anti-cancerous compounds, neurotrophic compounds, and compounds that relax muscles and strengthen the heart etc are some of the biologically active compounds that can be obtained from bryophytes (Asakawa, 2007).

In the high altitude areas the bryophytes control the ecosystem functioning by controlling the carbon and nitrogen cycles (Koranda and Michelsen 2020).

Some mosses are associated with N_2 fixing cyanobacteria and provide which may provide high N input in high latitude ecosystems (DeLuca *et al.,* 2002; Lindo *et al.,* 2013; Rousk *et al.,* 2013). They also serve as substrate for green roofs as such or in combination with some other plants as they are good colonizers and desiccation tolerant (Anderson *et al.,* 2010).

Mosses are useful as moss garden which are more common in Japan, UK, US, Canada (Glime 2017; Martin 2015). These moss gardens as they do not require fertilizer, and they form habitat for beneficial insect, salamanders, and other organism which traditional lawns do not support. More than this due to naturally occurring secondary metabolites in them, the need for herbicides and pesticides is lower; water usage is also less as compared to lawns; and there is no need of machine powered garden tools .Some species of bryophytes are also used as bioindicators like source of cadmium pollution (Donovan *et al*., 2016). Bryophytes have good allelopathic effects too (Meiners *et al.,* 2012). Mosses influence microorganisms that fix nitrogen by regulating soil temperature and moisture especially in artic systems (Gornall *et al.,* 2007).

Different biologically active compounds like Neomarchantins A and B, and Marchantin C have been found in bryophytes (Commisso *et al*., 2021). In this experiment also we found that Anthoceros have antibacterial effect. The work on biofertilizer activity of Anthoceros or any other bryophyte is very rare.

MATERIALS AND METHODS

Collection of bryophyte. The bryophyte *Anthoceros* has been selected to study their effect on germination behaviour of *Abelmoschus esculentus,* as they contain the blue green algae in symbiotic association. The bryophyte was collected by regular and repeated local field trips at different localities of Mala. The plants were collected in the first week of August. Fresh plants, devoid of dead tissue were collected. The plants were freed from contaminant parts of other plants, if present, and were carefully scooped out. Plants thus collected were kept in separate polyethylene bags and sealed immediately. The collected plant material taken to the laboratory.

Preparation of *Anthoceros* extract. The bryophyte material was washed thoroughly to remove adhering soil particles and blotted. As specimens were small and were not collected in large amounts due to conservation viewpoint, extracts were prepared from entire green part of the thallus. Water was used as extracting solvent. For preparing extract 100 g fresh material of bryophyte was ground with a pinch of sand in mortar to yield a pulp and dissolve in 100 ml of water and shaked well and filtered with Whatman No. 1 filter paper. Final volume of the extract was made upto 100 ml by adding respective solvent and considered as full concentration (100%). Then this extract was diluted to 20%, 40%, 60%, 80% concentration.

Collection of *Ablemoschus esculentus* seeds. The seeds of *Ablemoschus esculentus* were collected from Kerala agricultural University, Thrissur. The variety was *Arka anamika*. Seeds were brought to the laboratory, air dried and healthy seeds were sorted out.

Preparation of potting mixture. Potting mixture was prepared by using coir pith, sand in 1: 1 ratio after sterilization.

Experimental design. In special trays germination test was conducted for the six treatments namely C, T_1, T_2, T_3, T_4, T_5, T_6 with control, 20%, 40%, 60%, 80% and 100% concentration of extract. In a germination tray 4 rows were selected each with five wells. They were filled with potting mixture and one control and three treatments were selected. Seeds were sown in each row. First row was control which was without any extract. Distilled water was used in this. Before sowing the seeds

were soaked in respective concentrations of extract for 12 hours. The experiments were done at room temperature (30-33°C) and were carried out for 15 days. The seeds were considered germinated if the radical exceeded 3 mm in length. After the germination test the best three were selected.

Percentage of seed germination. Germination test was conducted in germination trays. The temperature of 25 ± 10°C was maintained during the germination test. The first and final germination counts were recorded on fifth and eighth days of germination test respectively for normal seedlings and germination was expressed in percentage.

$$\text{Germination (\%)} = \frac{\text{No. of seeds germinated}}{\text{No. of seeds put for germination}} \times 100$$

Measurement of growth performance. Growth performance was studied by measuring root length, shoot length, leaf length and leaf width.

Biochemical analysis. After the germination performance the 60%, 80% and 100% was again grown for biochemical analysis. After 20 days of growth performance the seedlings are dried and taken for the biochemical analysis. For analysis of protein lowry's method was done for carbohydrate analysisphenol – sulphuric acid assay was performed.

Antimicrobial Activity. The acetone, methanol, ethanol, hot and cold aqueous *Anthoceros* extracts were used for evaluation of the antimicrobial activity by the agar well diffusion method (Ahmad and Beg 2001; Aneja *et al*., 2009).

In this method, pure isolate of microbe *Staphylococcus aureus* was subcultured on the agar media plates at 37ºC for 24 h. One plate of each microorganism was taken and a minimum of four colonies were touched with a sterile loop and transferred into normal saline (0.85%) under aseptic conditions. Microbial suspension used as the inoculum for performing agar well diffusion assay. Inoculum of test organism was spread onto the agar plates so as to achieve a confluent growth. The agar plates were allowed to dry and wells of 8mm were made with a sterile borer in the inoculated agar plates and the lower portion of each well was sealed with a little specific molten agar medium. The dried extracts were reconstituted in 20% dimethylsulphoxide (DMSO) for the bioassay analysis (Rajasekaran *et al*., 2008). A 100µl volume of extract was propelled directly into the wells (in triplicates) of the inoculated agar plates for test organism. The plates were allowed to stand for 1hr for diffusion of the extract into the agar and incubated at 37ºC for 24h (Okeke *et al.,* 2001; Rios *et al.,*1980). Sterile DMSO (20%) served as the negative control.

RESULTS AND DISCUSSION

In the present study the rate of germination was high in 60 % concentration in the first 4 days followed by the 80% and 100%. Lowest rate of germination was in control. Then in the next 3 days there was full germination in all except the 20%, 40%. In control 5 seeds were germinated. 20% concentration showed the germination of 7 seeds. 6 seeds were germinated in 40 concentration. 10, 9, and 7 seeds were germinated in 60%, 80% and 100% concentrations respectively.

The root length and shoot length, leaf length, breadth etc were also measured. It was found that in 60% there is more increase in the length of root, shoot, leaf length, breadth, etc. It was followed by the 80% and 100%. The root length, shoot length, leaf length and leaf width were 4.5, 13.2, 3.3 and 3.1 respectively in 60% concentration. In 80% concentration 3.8 cm root length, 11.3cm shoot length, 2.7cm leaf length and 2.8 cm leaf width were observed. 100% shows 3 cm root length, 11 cm shoot length, 2.4 cm leaf length and 2.6 cm leaf width. The least was observed in control. In control 3.2 cm root length, 5.4 cm shoot length, 2.1 cm leaf length and 1.8 cm leaf width were seen. Percentage of seed germination, root and shoot length, leaf length, breadth on each concentration was shown in Graph 1.

The biochemical analysis was conducted. It was observed that the biochemical contents were high in 60% concentration as compared to the control and other 80% and 100%. The 60% concentration shows 1.50 µg/ml protein and 0.90 mg/g carbohydrate. 1.40 µg/ml protein and 0.85 mg/g carbohydrate observed in 80% concentration. 1.20 µg/ml protein and 0.82mg/g carbohydrate were detected in 100%. The results of biochemical analysis was given in Graph 2.

Antimicrobial activity was also observed for the microbe used. *Anthoceros* extract showed antibacterial effect on *Staphylococcus aureus.*

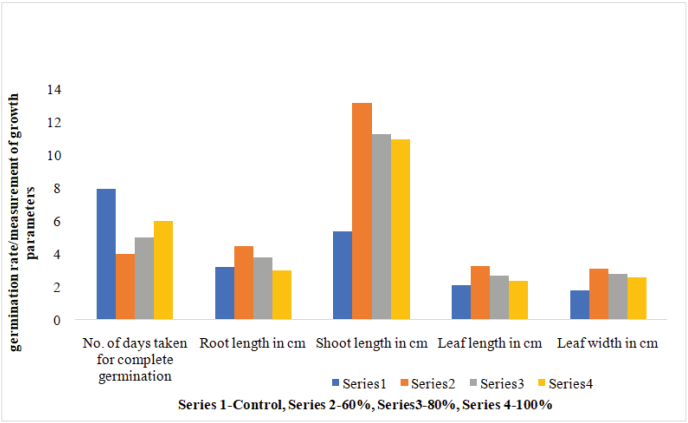

Fig. 1. Effect of Anthoceros extract on germination rate and growth parameters of Okra plant.

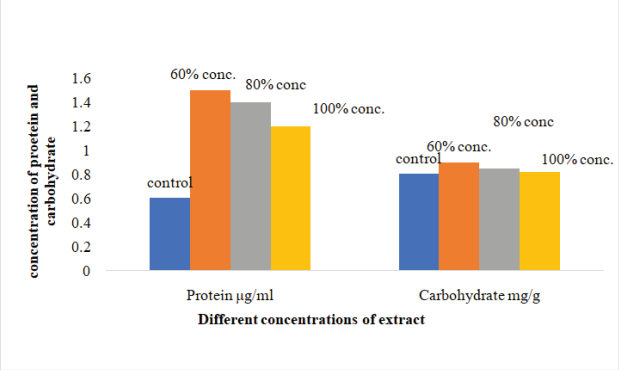

Fig. 2. Biochemical analysis of the seedlings treated with Anthoceros extract.

In this experiment in bhindi plant fastest seed germination was observed by 60% treated plant (4 days) and minimum by control, 20% and 40% concentrations. In all case 100 percentage germination rate was there but there was variation in number of days taken for full germination.

The maximum root length, shoot length, leaf length, leaf width etc was noted for the 60% concentration followed by 80%, and 100%. The value of root length for 60% was 4.5, shoot length was 13.2, leaf breadth and length was 3.3 and 3.1respectively. In 80% concentration the root length, shoot length, leaf length and leaf width were 3.8, 11.3, 3.3 and 3.1 respectively. 100% shown 3 cm root length, 11 cm shoot length, 2.4 cm leaf length and 2.6 cm leaf width. The lowest root length, shoot length, leaf length, leaf width were observed in control. These results suggest that the better germination and growth of bhindi seed was seen in 60 % concentration and also shown that the *Anthoceros* extract have some influence in seed germination and plant growth.

Biochemical analysis showed the maximum value for 60% for protein and carbohydrate. It was 1.50 and 0.90 respectively. It was followed by 80% and 100%. Lowest for control.

Many bryophytes like *Sphgnum* are considered as ecological engineers, as they modify their environment to create habitat thereby helping to modify the environment to maintain biodiversity (Jassey *et al*., 2013). In this study also the extract of bryophyte is performing well for plant growth.In addition to this antibacterial activity is observed by about 93% of bryophytes (Zhu *et al*., 2006)

The extract at 60% concentration increased leaf area and root,shoot length content to maximum when compared to control and other treatments. Protein synthesis turnover in growing plants is a basic component of metabolic regulation which provides a way for varying the enzymatic complement during the response to environmental conditions (Huffaker and Peterson 1974). Protein and carbohydrate content increased at all treatment compared to the control. It showed maximum content at T_1 treatment as compared to control and other treatments. According to Das *et al*. (2007), biomass increased progressively irrespective of treatments over control. However, the total fresh biomass production was recorded highest with combined application of biofertilizer when compared to sole application.

The aqueous extracts of bryophytes germination of *B,biternata* seeds was completed between 10 and 4 days (*Marchantia* and *Targionia*) in liverworts and between 3 (*Plagiomnium*) and 9 (*Rhodobryum*) days in mosses (Alka Sharma 2009). Total time taken for the completion of germination of seeds varied according to the type of the extracts. Variation in total germination period appears to be independent of the concentration of the moss extract. Some other factors like size of the seeds may be responsible for delaying the completion of germination in certain extracts. Among liverworts, maximum time was taken by *Marchantia* (10 days in 20 percent aqueous extract). Several species of bryophytes sowed antibacterial activity against *Staphylococcus aureus* (Vizma *et al*., 2012). The antibiotically active substances of *Atrichum* and *Dicranum* spp. are considered to be polyphenolic compounds (Mc Clery *et al.,* 1966). In particular, flavonoids, including phenolic acids, are the main group of phenols obtained from mosses (Mc Clery *et al.,* 1966). From the present study it is clear that *Anthoceros* extract has significant effect on the seed germination, growth performance, biochemical parameters of the bhindi plant. It also shows the antibacterial property. This fact can lighten the work in case if any of the extracts would be introduced in future practice.Bryophytes contains numerous secondary metabolites and their extract have significant antioxidant properties (Klavina, 2015).

CONCLUSIONS

From this study it was clear that the extract of bryophyte especially *Anthoceros* sps is having very good effect on the seed germination and also for having good biochemical constitution. It is also showing good antimicrobial activity against *Staphylococcus aureus.* All these points out towards the need of conservation of the bryophytes and their utilization in various medicinal, biofertilizer aspects.

In short we can say that the biofertilizers like Anthoceros, or any other bryophytes are low cost and can be used by farmers, they have no side effects, can reduce pollution, thereby increases the soil fertility. The blue green algae inhabiting inside the bryophyte will secrete various growth promoting substances like vitamins, protein etc, there by improving the texture, pH and water holding capacity of the soil. The extract of the bryophytes speed up the plant growth and will provide

quick results. So thay can be used in the coming days popularly as biofertilizers.

Acknowledgement. The authors acknowledge the technical support provided from the Post Graduate and Research Department of Botany, Carmel College, Mala, Thrissur, Kerala, India.
Conflict of Interest. None.

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How to cite this article: Bindhu K.B., Gopika V.D. and Dhanya Thomas T.T. (2023). Anthoceros extract as Growth Promotor and Biochemical Stimulant in Okra Plants. *Biological Forum – An International Journal, 15*(2): 683-688.

ISSUE: VOL. 5200 NO. 3: 28 OCT. 2022 TYPE: ARTICLE PUBLISHED: 2022-10-28 DOI: 10.11646/ZOOTAXA.5200.3.2 PAGE RANGE: 232-246 ABSTRACT VIEWS: 255 PDF DOWNLOADED: 44

Eumasia thomasii sp. nov. a new species of the subfamily Eumasiinae (Lepidoptera: Psychidae) from India

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LEPIDOPTERA • BAGWORM • EUMASIA • KERALA • INDIA • COI

PDF(13M)

Abstract

A new species of bagworm, *Eumasia thomasii* **sp. nov.** is described from Kerala, India. This is the third species in the genus *Eumasia* reported from India and the tenth from Asia. The report presents the morphology of adults, larva, and cases along with information on distribution and ecology.

○ Abstract
○ References

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ISSUE: VOL. 5159 NO. 1: 28 JUN. 2022 TYPE: ARTICLE PUBLISHED: 2022-06-28 DOI: 10.11646/ZOOTAXA.5159.1.7 PAGE RANGE: 136-144 ABSTRACT VIEWS: 278 PDF DOWNLOADED: 26

Neotype designation, redescription, biology and distribution of *Acanthopsyche alstoni* Watt & Mann, 1903 (Lepidoptera: Psychidae) from India

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LEPIDOPTERA • ACANTHOPSYCHE • DISTRIBUTION • PSYCHIDAE • REDESCRIPTION • REDISCOVERY

PDF(9M)

○ Abstract
○ References

Abstract

Acanthopsyche alstoni Watt & Mann, is a lesser known psychid previously known only from the description of its larval cases collected from Assam, India in 1903. There were no descriptions of the adult moth or biology of the species. During surveys for Psychidae in the human inhabited regions of Kerala State, India, more than 100 larval cases were recovered. They were allowed to hatch and characteristics were recorded. This paper provides a detailed redescription of this species and designation of a neotype.

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Threat assessment of *Manatha albipes* Moore (Lepidoptera: Psychidae) from Kerala, India using GIS with comments on its taxonomy, biology, distribution and host plants

Original Research Article | Published: 12 August 2022
Volume 42, pages 3133–3141, (2022) Cite this article

International Journal of Tropical Insect Science

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Usha A U, Thomas Sobczyk, Roby T J & Joyce Jose

Abstract

The detailed description of the distribution, morphology and relationships with host plants (19 species; 15 new records as host plants) of *Manatha albipes* from Kerala, India is presented here. Significant differences in the morphology from populations of *M. albipes* from other areas of India have been described. The larval stages of these moths are

Rediscovery of *Impatiens parvifolia* and reinstatement of *I. omissa* (Balsaminaceae) in India

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Published
2023-03-28

Title

A Retrospective Study on Applications of the Lindley Distribution.

Authors

Tomy, Lishamol; Chesneau, Christophe; Jose, Meenu

Abstract

The need for efficient statistical models has increased with the ow of new data, which makes distribution theory a particularly interesting and attractive field. Here, we provide a thorough study of the applications of the Lindley distribution and its diverse generalizations. More precisely, we review some special applications in various areas, such as time series analysis, stress strength analysis, acceptance sampling plans and data analysis. We also conduct a comparative study between the Lindley distribution and some of its generalizations by using four real-life data sets.

Publication

Journal of Nonlinear Modeling & Analysis, 2022, Vol 4, Issue 2, p291

ISSN

2562-2854

Publication type

Academic Journal

Ethylene-propylene-diene (5-ethylidene-2-norbornene) terpolymer/aluminium hydroxide nanocomposites: Thermal, mechanical and flame retardant characteristics

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https://doi.org/10.1016/j.matpr.2022.09.369

Abstract

Ethylene-propylene-diene rubber (EPDM) composites were fabricated by incorporating aluminium hydroxide (ATH) and high abrasion furnace (HAF) carbon black using two-roll mill mixing strategy. The thermal stability, flammability and mechanical properties of the composites were investigated by thermogravimetric analysis (TGA), limiting oxygen index (LOI), horizontal burning test (UL94 HB), mechanical testing (UTM) and dynamic mechanical analysis (DMA). TGA profiles showed that,EPDM/ATH composites presented incremented char residue and reduced mass loss rate compared to control EPDM. The incorporation of ATH was found to benefit the flame retardancy of composites. The storage modulus (E') of composites peaked due to the increased stiffness of the material with filler loading. Investigation of visco-elastic properties showed the existence of

Issue	A&A Volume 662, June 2022
Article Number	A55
Number of page(s)	17
Section	Extragalactic astronomy
DOI	https://doi.org/10.1051/0004-6361/202142511
Published online	14 June 2022

A&A 662, A55 (2022)

The dark matter halo masses of elliptical galaxies as a function of observationally robust quantities

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Received: 22 October 2021 | **Accepted:** 28 March 2022

Abstract

Context. The assembly history of the stellar component of a massive elliptical galaxy is closely related to that of its dark matter halo. Measuring how the properties of galaxies correlate with their halo mass can therefore help to understand their evolution.

Aims. We investigate how the dark matter halo mass of elliptical galaxies varies as a function of their properties, using weak gravitational lensing observations. To minimise the chances of biases, we focus on the following galaxy properties that can be determined robustly: the surface brightness profile and the colour.

Biological Forum – An International Journal **15(2): 683-688(2023)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Anthoceros extract as Growth Promotor and Biochemical Stimulant in Okra Plants

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(Received: 02 January 2023; Revised: 11 February 2023; Accepted: 15 February 2023; Published: 18 February 2023)
(Published by Research Trend)

ABSTRACT: Bryophytes are the amphibians of the plant kingdom. In fact, the work on the bryophyte as biofertilizer is less. They are seasonal also. In the present study the effect of *Anthoceros* extract on growth performance and biochemical properties of *Abelmoschus esculentus* was studied and its antimicrobial effect was also detected. For this study germination rate of the seeds of the bhindi plants were recorded at various concentrations of the *Anthoceros* extract like 20%, 40%, 60%, 80% and 100%. The one without any extract was regarded as control. The length of roots, shoots, length and width of leaf, etc were also examined in the concentrations 60%, 80% and 100%. In addition to this the biochemical analysis for detection of carbohydrates and protein was also performed. Antimicrobial activity against *Staphylococcus aureus* was detected. Of the various concentrations studied, the 60% showed maximum seed germination within minimum days as compared to the others, and the length of roots, shoots, length and width of leaf, etc. were also high in this concentration. The root length was 4.5cm, shoot length was 13.2 cm, leaf length was 3.3cm and leaf width was 3.1. In this concentration the highest value of protein and carbohydrate was also recorded. The control showed lowest rate of germination, root length, shoot length, leaf length and leaf width. The protein content and amount of carbohydrate also less in control. It shows the influence of *Anthoceros* extract in seed germination and growth of bhindi plant. The extract of *Anthoceros* showed antibacterial property towards *Staphylococcus aureus.* This may be due to its symbiotic association of blue green algae *Anaebena*. Through this study it was made clear that the Anthoceros like bryophytes are good source of biofertilizers with antibacterial potential, and we have to explore it. More studies has to be conducted to isolate the compounds present in Anthoceros and to find out the effects of these compounds.

Keywords: Anthoceros, Biochemical analysis, Antimicrobial activity, symbiotic, germination.

INTRODUCTION

Bryophytes are non-vascular thalloid forms well adapted in their physiology and organization. They can grow in harsh conditions where other plants cannot grow. They have the ecological and evolutionary significant as they are the first group of plants migrated from water to land. They play major role in mineral cycling and also trap the nutrients in the soil so they can be considered as nutrient filters. Some of the bryophytes are the encrust the nitrogen fixing bacteria and so increase the fertility of the soil. Our rice fields are the good habitats of the bryophytes and help in retaining the water holding capacity of the soil there. Fungicidal, bactericidal and insecticidal activity of the bryophytes are well known (Asakawa *et al*., 1980; Ando and Matsuo 1984).

Anthoceros is one of the important bryophyte having the cyanobacteria as symbiont and is seen widely in the rice fields of our state. They are improving the texture of the soil by Increasing the pores of the soil by their filamentous structure and producing some adhesive substances , Excreting growth promoting substances, such as hormones (auxin, gibberlin), vitamins, aminoacids etc (Roger and Renaud 1982; Rodriguez *et al*., 2006), they are also responsible for Increasing the water holding capacity through their jelly structure (Roger and Reyanud 1982), soil biomass is getting enhanced after their death and decomposition, Decrease in soil salinity, Preventing weed growth and also Increase in soil phosphate by excretion of organic acids. They can also be used as biomonitors of metal in order to get an idea about metal precipitation.

Bryophytes are rich sources of oligosaccharides, polysaccharides, sugar alcohols, amino acids, fatty acids, aliphatic compounds, phenyl quinones and aromatic and phenolic compounds but few studies have been made between any medical effects and specific bryophyte species or compounds. They have been used as medicines in China, India and Americans from the ancient time onwards. Bryophytes like *Sphagnum* and *Rhodobryum* sps. Are well known for their antibiotic properties. They are contributing much towards carbon balance of the nature (Bisbee *et al*., 2001; Gowar *et al.,* 1997).

In horticulture, soil additives are prepared from the bryophytes. Some bryophytes are used against *Phytophthora infestans* or *Alternaria solani* etc. They can also be used for decorative purposes, land scaping, insect repellent, mounting medium for epiphytes etc.

Comparatively less works were conducted on the effect of Anthoceros extract or extract from any other bryophytes. There is good symbiotic relation between the two. In India about 25 species have been reported by various workers. *Anthoceros himalayensis, A. erectus* and *A. chambensis* are the common the three common Himalayan species.

There are some works on the effects of bryophytes on plant growth. Matsuo *et al*. (1981, 1984a, 1984b) studied the structures of various substances from liverworts which are having plant growth inhibitory activities. Huneck and Meinunger (1990) tested 52 species of mosses and 29 species of liverworts on growth regulation activity and found out that the bryophytes have the wonderful capacity to enhance the shoot and root growth. The studies of Mishra *et al.* (2014) showed that the bryophytes have good amount of flavonoids, terpenoids, glycosides and sterols in high amount which can have positive effect on growth of plants. Here an attempt was made to study the effect of Anthoceros extract on the growth performance and biochemical aspects of okra plant. Anthoceros sps are good host to the blue green algae Nostoc.

In the field of aquatics and fuel the bryophytes can be act as bio and radioactive indicators respectively (Saxena and Harinder 2004; Glime, 2007).

In addition to this they have a number of active constituents which demonstrates a variety of activities like antimicrobial, antifungal, cytotoxic, antitumor, and insecticidal properties (Asakawa 2008; Üçüncü *et al.,* 2010). These property of bryophytes can also be used in the field of agricultural and medicinal process.

Large number of bryophytes have secondary metabolites which can be used as potential A significant pharmacological, economic, or biotechnological sources. Potential plant-protection agents, enzyme inhibitors, anti-cancerous compounds, neurotrophic compounds, and compounds that relax muscles and strengthen the heart etc are some of the biologically active compounds that can be obtained from bryophytes (Asakawa, 2007).

In the high altitude areas the bryophytes control the ecosystem functioning by controlling the carbon and nitrogen cycles (Koranda and Michelsen 2020).

Some mosses are associated with N_2 fixing cyanobacteria and provide which may provide high N input in high latitude ecosystems (DeLuca *et al.,* 2002; Lindo *et al.,* 2013; Rousk *et al.,* 2013). They also serve as substrate for green roofs as such or in combination with some other plants as they are good colonizers and desiccation tolerant (Anderson *et al.,* 2010).

Mosses are useful as moss garden which are more common in Japan, UK, US, Canada (Glime 2017; Martin 2015). These moss gardens as they do not require fertilizer, and they form habitat for beneficial insect, salamanders, and other organism which traditional lawns do not support. More than this due to naturally occurring secondary metabolites in them, the need for herbicides and pesticides is lower; water usage is also less as compared to lawns; and there is no need of machine powered garden tools .Some species of bryophytes are also used as bioindicators like source of cadmium pollution (Donovan *et al*., 2016). Bryophytes have good allelopathic effects too (Meiners *et al.,* 2012). Mosses influence microorganisms that fix nitrogen by regulating soil temperature and moisture especially in artic systems (Gornall *et al.,* 2007).

Different biologically active compounds like Neomarchantins A and B, and Marchantin C have been found in bryophytes (Commisso *et al*., 2021). In this experiment also we found that Anthoceros have antibacterial effect. The work on biofertilizer activity of Anthoceros or any other bryophyte is very rare.

MATERIALS AND METHODS

Collection of bryophyte. The bryophyte *Anthoceros* has been selected to study their effect on germination behaviour of *Abelmoschus esculentus,* as they contain the blue green algae in symbiotic association. The bryophyte was collected by regular and repeated local field trips at different localities of Mala. The plants were collected in the first week of August. Fresh plants, devoid of dead tissue were collected. The plants were freed from contaminant parts of other plants, if present, and were carefully scooped out. Plants thus collected were kept in separate polyethylene bags and sealed immediately. The collected plant material taken to the laboratory.

Preparation of *Anthoceros* extract. The bryophyte material was washed thoroughly to remove adhering soil particles and blotted. As specimens were small and were not collected in large amounts due to conservation viewpoint, extracts were prepared from entire green part of the thallus. Water was used as extracting solvent. For preparing extract 100 g fresh material of bryophyte was ground with a pinch of sand in mortar to yield a pulp and dissolve in 100 ml of water and shaked well and filtered with Whatman No. 1 filter paper. Final volume of the extract was made upto 100 ml by adding respective solvent and considered as full concentration (100%). Then this extract was diluted to 20%, 40%, 60%, 80% concentration.

Collection of *Ablemoschus esculentus* seeds. The seeds of *Ablemoschus esculentus* were collected from Kerala agricultural University, Thrissur. The variety was *Arka anamika*. Seeds were brought to the laboratory, air dried and healthy seeds were sorted out.

Preparation of potting mixture. Potting mixture was prepared by using coir pith, sand in 1: 1 ratio after sterilization.

Experimental design. In special trays germination test was conducted for the six treatments namely C, T_1, T_2, T_3, T_4, T_5, T_6 with control, 20%, 40%, 60%, 80% and 100% concentration of extract. In a germination tray 4 rows were selected each with five wells. They were filled with potting mixture and one control and three treatments were selected. Seeds were sown in each row. First row was control which was without any extract. Distilled water was used in this. Before sowing the seeds

were soaked in respective concentrations of extract for 12 hours. The experiments were done at room temperature (30-33°C) and were carried out for 15 days. The seeds were considered germinated if the radical exceeded 3 mm in length. After the germination test the best three were selected.

Percentage of seed germination. Germination test was conducted in germination trays. The temperature of 25 ± 10°C was maintained during the germination test. The first and final germination counts were recorded on fifth and eighth days of germination test respectively for normal seedlings and germination was expressed in percentage.

$$\text{Germination (\%)} = \frac{\text{No. of seeds germinated}}{\text{No. of seeds put for germination}} \times 100$$

Measurement of growth performance. Growth performance was studied by measuring root length, shoot length, leaf length and leaf width.

Biochemical analysis. After the germination performance the 60%, 80% and 100% was again grown for biochemical analysis. After 20 days of growth performance the seedlings are dried and taken for the biochemical analysis. For analysis of protein lowry's method was done for carbohydrate analysisphenol – sulphuric acid assay was performed.

Antimicrobial Activity. The acetone, methanol, ethanol, hot and cold aqueous *Anthoceros* extracts were used for evaluation of the antimicrobial activity by the agar well diffusion method (Ahmad and Beg 2001; Aneja *et al*., 2009).

In this method, pure isolate of microbe *Staphylococcus aureus* was subcultured on the agar media plates at 37ºC for 24 h. One plate of each microorganism was taken and a minimum of four colonies were touched with a sterile loop and transferred into normal saline (0.85%) under aseptic conditions. Microbial suspension used as the inoculum for performing agar well diffusion assay. Inoculum of test organism was spread onto the agar plates so as to achieve a confluent growth. The agar plates were allowed to dry and wells of 8mm were made with a sterile borer in the inoculated agar plates and the lower portion of each well was sealed with a little specific molten agar medium. The dried extracts were reconstituted in 20% dimethylsulphoxide (DMSO) for the bioassay analysis (Rajasekaran *et al*., 2008). A 100µl volume of extract was propelled directly into the wells (in triplicates) of the inoculated agar plates for test organism. The plates were allowed to stand for 1hr for diffusion of the extract into the agar and incubated at 37ºC for 24h (Okeke *et al.,* 2001; Rios *et al.,*1980). Sterile DMSO (20%) served as the negative control.

RESULTS AND DISCUSSION

In the present study the rate of germination was high in 60 % concentration in the first 4 days followed by the 80% and 100%. Lowest rate of germination was in control. Then in the next 3 days there was full germination in all except the 20%, 40%. In control 5 seeds were germinated. 20% concentration showed the germination of 7 seeds. 6 seeds were germinated in 40 concentration. 10, 9, and 7 seeds were germinated in 60%, 80% and 100% concentrations respectively.

The root length and shoot length, leaf length, breadth etc were also measured. It was found that in 60% there is more increase in the length of root, shoot, leaf length, breadth, etc. It was followed by the 80% and 100%. The root length, shoot length, leaf length and leaf width were 4.5, 13.2, 3.3 and 3.1 respectively in 60% concentration. In 80% concentration 3.8 cm root length, 11.3cm shoot length, 2.7cm leaf length and 2.8 cm leaf width were observed. 100% shows 3 cm root length, 11 cm shoot length, 2.4 cm leaf length and 2.6 cm leaf width. The least was observed in control. In control 3.2 cm root length, 5.4 cm shoot length, 2.1 cm leaf length and 1.8 cm leaf width were seen. Percentage of seed germination, root and shoot length, leaf length, breadth on each concentration was shown in Graph 1.

The biochemical analysis was conducted. It was observed that the biochemical contents were high in 60% concentration as compared to the control and other 80% and 100%. The 60% concentration shows 1.50 µg/ml protein and 0.90 mg/g carbohydrate. 1.40 µg/ml protein and 0.85 mg/g carbohydrate observed in 80% concentration. 1.20 µg/ml protein and 0.82mg/g carbohydrate were detected in 100%. The results of biochemical analysis was given in Graph 2.

Antimicrobial activity was also observed for the microbe used. *Anthoceros* extract showed antibacterial effect on *Staphylococcus aureus.*

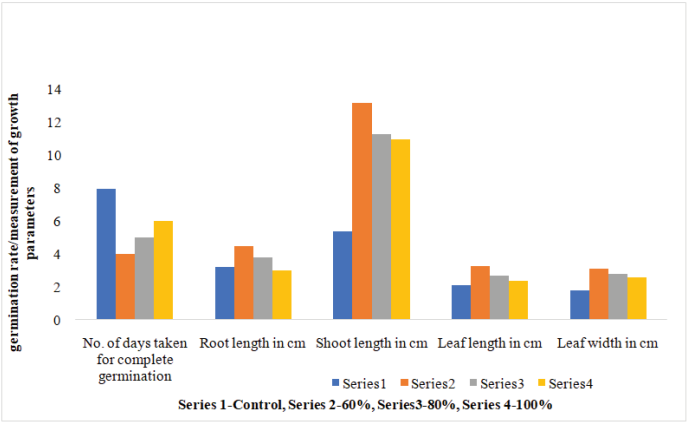

Fig. 1. Effect of Anthoceros extract on germination rate and growth parameters of Okra plant.

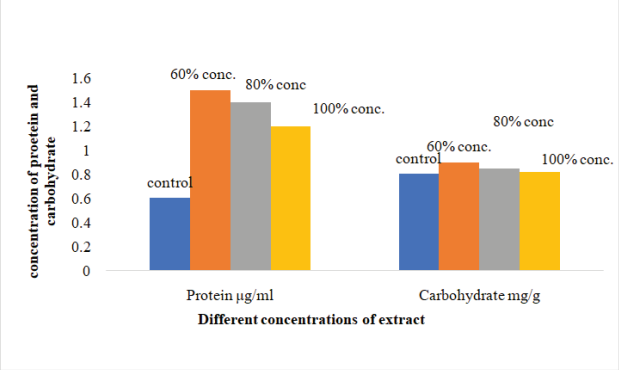

Fig. 2. Biochemical analysis of the seedlings treated with Anthoceros extract.

In this experiment in bhindi plant fastest seed germination was observed by 60% treated plant (4 days) and minimum by control, 20% and 40% concentrations. In all case 100 percentage germination rate was there but there was variation in number of days taken for full germination.

The maximum root length, shoot length, leaf length, leaf width etc was noted for the 60% concentration followed by 80%, and 100%. The value of root length for 60% was 4.5, shoot length was 13.2, leaf breadth and length was 3.3 and 3.1respectively. In 80% concentration the root length, shoot length, leaf length and leaf width were 3.8, 11.3, 3.3 and 3.1 respectively. 100% shown 3 cm root length, 11 cm shoot length, 2.4 cm leaf length and 2.6 cm leaf width. The lowest root length, shoot length, leaf length, leaf width were observed in control. These results suggest that the better germination and growth of bhindi seed was seen in 60 % concentration and also shown that the *Anthoceros* extract have some influence in seed germination and plant growth.

Biochemical analysis showed the maximum value for 60% for protein and carbohydrate. It was 1.50 and 0.90 respectively. It was followed by 80% and 100%. Lowest for control.

Many bryophytes like *Sphgnum* are considered as ecological engineers, as they modify their environment to create habitat thereby helping to modify the environment to maintain biodiversity (Jassey *et al*., 2013). In this study also the extract of bryophyte is performing well for plant growth.In addition to this antibacterial activity is observed by about 93% of bryophytes (Zhu *et al*., 2006)

The extract at 60% concentration increased leaf area and root,shoot length content to maximum when compared to control and other treatments. Protein synthesis turnover in growing plants is a basic component of metabolic regulation which provides a way for varying the enzymatic complement during the response to environmental conditions (Huffaker and Peterson 1974). Protein and carbohydrate content increased at all treatment compared to the control. It showed maximum content at T_1 treatment as compared to control and other treatments. According to Das *et al*. (2007), biomass increased progressively irrespective of treatments over control. However, the total fresh biomass production was recorded highest with combined application of biofertilizer when compared to sole application.

The aqueous extracts of bryophytes germination of *B,biternata* seeds was completed between 10 and 4 days (*Marchantia* and *Targionia*) in liverworts and between 3 (*Plagiomnium*) and 9 (*Rhodobryum*) days in mosses (Alka Sharma 2009). Total time taken for the completion of germination of seeds varied according to the type of the extracts. Variation in total germination period appears to be independent of the concentration of the moss extract. Some other factors like size of the seeds may be responsible for delaying the completion of germination in certain extracts. Among liverworts, maximum time was taken by *Marchantia* (10 days in 20 percent aqueous extract). Several species of bryophytes sowed antibacterial activity against *Staphylococcus aureus* (Vizma *et al*., 2012). The antibiotically active substances of *Atrichum* and *Dicranum* spp. are considered to be polyphenolic compounds (Mc Clery *et al.,* 1966). In particular, flavonoids, including phenolic acids, are the main group of phenols obtained from mosses (Mc Clery *et al.,* 1966). From the present study it is clear that *Anthoceros* extract has significant effect on the seed germination, growth performance, biochemical parameters of the bhindi plant. It also shows the antibacterial property. This fact can lighten the work in case if any of the extracts would be introduced in future practice.Bryophytes contains numerous secondary metabolites and their extract have significant antioxidant properties (Klavina, 2015).

CONCLUSIONS

From this study it was clear that the extract of bryophyte especially *Anthoceros* sps is having very good effect on the seed germination and also for having good biochemical constitution. It is also showing good antimicrobial activity against *Staphylococcus aureus.* All these points out towards the need of conservation of the bryophytes and their utilization in various medicinal, biofertilizer aspects.

In short we can say that the biofertilizers like Anthoceros, or any other bryophytes are low cost and can be used by farmers, they have no side effects, can reduce pollution, thereby increases the soil fertility. The blue green algae inhabiting inside the bryophyte will secrete various growth promoting substances like vitamins, protein etc, there by improving the texture, pH and water holding capacity of the soil. The extract of the bryophytes speed up the plant growth and will provide

quick results. So thay can be used in the coming days popularly as biofertilizers.

Acknowledgement. The authors acknowledge the technical support provided from the Post Graduate and Research Department of Botany, Carmel College, Mala, Thrissur, Kerala, India.
Conflict of Interest. None.

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How to cite this article: Bindhu K.B., Gopika V.D. and Dhanya Thomas T.T. (2023). Anthoceros extract as Growth Promotor and Biochemical Stimulant in Okra Plants. *Biological Forum – An International Journal, 15*(2): 683-688.

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DUAL LAYER SECURITY USING MODIFIED AES ENCRYPTION AND SECURE SYSTEM FOR HIDING MULTIMEDIA FILES IN DUAL RGB COVER IMAGES

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Abstract: The fast growth in communication technologies and the increased availability of the public networks facilitated data transfer. However, the public communication channels are vulnerable to security attacks that may lead to unauthorized access to some information. Now a day's there is a challenges faced by data or information security field. We have to make this data free from harm during transmission. The primary aim is to make an application which enable information by covering securely in statistically undetectable communication channel. The two important concept of securely transmitting information or data over a medium like steganography and cryptography. Although cryptography and steganography are used to provide data security. Steganography and encryption combined enhance security by providing dual layer protection to the data, as steganography aims at hiding the existence of the data itself and encryption prevents the correct interpretation of the data. Firstly, the Modified Advanced Encryption Standard (AES) algorithm is used to encrypt the secret message. Secondly, the encrypted message has hidden into two color RGB cover image. The multimedia files split vertically into two parts; one part contains the least significant half-bytes, and the other part contains the most significant half-bytes. The two parts are hidden inside to uncompressed RGB cover images using a least significant 4-bit replacement technique. The dual stego images are expected to be send separately, through separate channels, to avoid capture of both stego files by an adversary. Extraction of the secret file is achieved through merging LSB half-bytes and MSB half-bytes from the two stego files. The extracted file is identical in content and structure with the original secret message.

Index Terms **- Security, Steganography, Cryptography, AES algorithm, dual hiding, MSB, LSB, LSB technique,Modified AES Algorithm.**

I. INTRODUCTION

The concept of what you see is what you get with respect to digital image is no longer accurate. Image may be more than what we can see using our human visual system because it can hold an embedded data that cannot be seen. Securing multimedia data requires preventing unauthorized users from access, distortion, destruction, detection or modification of the data during its transfer. There are two primary methods for data security protection encryption, and steganography [1]. Cryptography method is used for secret communication. It involves converting a message text into an unreadable cipher. Cryptography differs from steganography. In that steganography hides the messages so it cannot be seen while the cryptography technique scrambles the messages so it cannot be understood. However, both of them can be combined to produce better security and protection of the message. Three objects are involved in the embedding process; the secret message, the original cover file and the stego file which combines the secret and cover files. Some data hiding scheme use lossy compression, to allow for higher hiding capacity at the expense of losing bits of the secret message [1]. The work in this paper presents a data hiding technique for the protection of multimedia files, through embedding in dual cover RGB images, with the aim of reducing the cover image size, increasing the hiding capacity, and protecting the secret messages through a safe partitioning scheme.

II.EXISTING SYSTEM

In the existing system, the original message is encrypted using AES algorithm. AES method is a non-Feistel cipher that encrypt and decrypt a data block of 128 bits. It uses 10, 12, or 14 rounds. The key size, which can be 128,192, or 256 bits, and the number of rounds depended on the key size because it allows the secret key to be expanded to produce sub key for each round. In AES method, the input and output sequence have the same length. According to AES method, substitution bytes, shift rows, mixing column and key adding steps are implemented in every encryption round to encrypt the message, but the Mixing Column step doesn't include in the last round. In the decryption, the four steps are implemented in the reverse way. Also, the inverse of mixing column step doesn't include in the last round of the decryption. The pseudo code of AES is as follows

```
InitialRound (State, RoundKey)
{
AddRoundKey (State, RoundKey)
}
Rounds (State, RoundKey)
 {
 SubBytes (State);
 ShiftRows (State);
MixColumn (State);
AddRoundKey (State, RoundKey);
 }
FinalRound (State, RoundKey)
{
 SubBytes (State);
ShiftRows (State);
AddRoundKey (State, RoundKey);
 }
```

The advantages of using AES algorithm are; it is more secure, faster in both hardware and software, reasonable cost, and its main characteristics flexibility and simplicity [3]. In this phase the message is encrypted using AES algorithm.

III. PROPOSED SYSTEM

The aim of proposed scheme is to make a more secure and robust method of information exchange so that confidential and private data must be protected against attacks and illegal access. To order to achieve the required robustness, we combined cryptography and steganography together. For hiding large volumes of data in images by combining cryptography and steganography while incurring minimal perceptual degradation and to solve the problem of unauthorized data access. In this method first select two images, then encrypt a message using Modified AES algorithm to provide security to secret messages. After encryption we can receive cipher message. Then, the cipher message is split into two. They are MSB bit and LSB bit. These bits are hided into two cover images using LSB embedding method. Then the original messages are retrieved using Modified AES decryption.

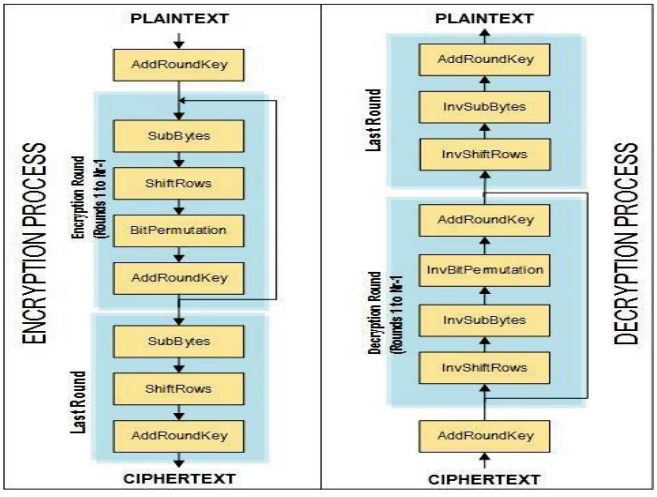
IV. METHODOLOGY

- **TEXT PHASE**

The text phase requires first to select two cover image. Then write the secret message for their hiding purpose.

- **ENCRYPTION PHASE**

The encryption phase we are used Modified AES algorithm.In Modified-AES encryption and decryption process resembles to that of AES, in account of number of rounds, data and key size. The round function consists of four stages. To overcome the problem of high calculation we skip the Mixcolumn step and add the permutation step. Mixcolumn gives better security but it takes large calculation that makes the encryption algorithm slow . The other three junctures remain unbothered as it is in the AES. A single 128-bit block is the input to the encryption and decryption algorithms.This block is a 4×4 square matrix consisting of 16 bytes. This block is copied into the state array. The state array is modified at each stage of encryption or decryption. Similarly the 128-bit key is also depicted into a square matrix. The 128-bit key is expressed into an array of key schedule words: each word is of four bytes. The total key schedule words for ten rounds are 44 words; each round key is similar to one state. The block diagram of the Modified-AES algorithm with 128 bits data is shown below.



The algorithm is divided into four operational blocks where we observe the data at either bytes or bit levels and the algorithm is designed to treat any combination of data and is flexible for key size of 128 bits. These four operational blocks represent one round of Modified-AES. There are 10 rounds for full encryption. The four different stages that we use for Modified-AES Algorithm are:

- Substitution bytes □□
- ShiftRows □□
- Permutation □□
- AddRoundKey

Substitution Bytes, ShiftRows and AddRoundKey remain unaffected as it is in the AES. Here the important function is Permutation which is used instead of Mixcolumn. These rounds are managed by the IP table. Permutation is widely used in cryptographic algorithms. Permutation operations are interesting and important from both cryptographic and architectural points of view. The DES algorithm will provide us permutation tables. The inputs to the IP table consist of 128 bits. Modified-AES algorithm takes 128 bits as input. The functions Substitution Bytes and ShiftRows are also interpreted as 128 bits whereas the Permutation function also takes 128 bits. In the permutation table each entry indicates a specific position of a numbered input bit may also consist of 256 bits in the output. While reading the table from left to right and then from top to bottom, we observe that the 242th bit of the 256-bit block is in first position, the 226th is in second position and so forth. After applying permutation on 128 bits we again complete set of 128 bits and then perform next remaining functions of algorithm. If we take the inverse permutation it gives again the original bits, the output result is a 128-bit cipher text. he result is cipher message. The cipher message is splitted into two parts. They are LSB bit and MSB bit.

- **STEGANOGRAPHY PHASE**

Steganography has been in use for secret communication since ancient times in multiple forms. In this technological era, it is deployed for secured transfer of data over digital channel in which the information can be hidden in image, text, audio or video and are called image steganography, text steganography, audio or video steganography respectively [2]. We have studied image steganography. In image steganography cover image is converted into a stego image. The information or message is embedded into the cover image which is then called stego image. Also the text message hidden in the two images (i.e.LSB bit hidden in the one image and MSB bit hidden in the another image) cause little distortion as a single bit of the entire byte is altered (i.e. the bits that can be altered as per requirement without affect the original images) which make it easier to hide the information or message in it. LSB i.e. least significant bit technique is a simple and effective technique that can be used for implementing image steganography. In the additive color model 3 primary RGB (Red, Green, Blue) colors are combined in various proportions in order to make multiple different colors.

- **DECRYPTION PHASE**

After these phases the original message is received using Modified AES decryption.

V. CONCLUSION

In this paper, we proposed the combination of cryptography and steganography has been achieved by using the Modified AES algorithm and LSB technique. Modified Advanced Encryption Standard is used to encrypt secret message and secret message is splitted into two, LSB bit and MSB bit.LSB technique is used to hide encrypted secret message into two cover images. When steganography is combined with encryption a good security was achieved between two parties in case of secret communication, it is hardly attracted from eavesdropper by naked eye. Finally,we can conclude that the proposed technique is effective for secret data communication. In future we can use audio, video in case of image as cover for hiding the data.

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IJRAR.ORG E-ISSN: 2348-1269, P-ISSN: 2349-5138
INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS (IJRAR) | IJRAR.ORG
An International Open Access, Peer-reviewed, Refereed Journal

RECENT TRENDS IN HUMAN RESOURCE MANAGEMENT

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ABSTRACT

Persistent changes in innovation, financial, social and Psychological understandings and structures have influence on both Human Resources and their management. Current models of HRM recommend that expectations about HR parts are changing as organisations are endeavouring to form the HR work leaner and more 'strategic'. In current scenario, employing diversified workforce is a necessity for every organization but to manage such diversified workforce is also a big challenge for management.

Human assets are fundamental portion of each company's administration network. It makes the company more mindful of how human capital influences the victory of the organization. HR can offer assistance to diminish the costs of a company by analyzing the costs and benefits that are related with annual turnover, counteraction, and recruiting replacement workers. Human assets are committed to provide a secure working environment. There is a need for managing any dangers which will emerge for the representatives as a result of the process. HR secures and minimizes any illegal employment practices that are related with the company's introduction and obligation charges. It moreover helps in the new employee orientation.

Keywords : *Human resource management, work force diversity , work environment, employment practices, employee orientation.*

INTRODUCTION

The process of bringing people and organizations together to achieve common objectives is known as human resource management. It is a position in organizations that aims to achieve a company's strategic goals by maximizing employee performance. Over the course of the past century, human resource management (HRM) has undergone significant transformations, the most notable of which has taken place in the last two decades. The role of HRM in businesses has undergone significant change in recent years. With tasks and responsibilities that are strikingly different and extensive, HR is quickly becoming a crucial strategic partner. Workplaces are undergoing rapid transformation. HRM must be prepared to deal with the effects of the changing workplace as part of the organization. Information technology Digital technologies, ICT, automation, and other technological advancements have reshaped the world, possibly in a significant and positive way. Our way of thinking, living, communicating, and working have all changed significantly. These technological shifts have had an impact on our culture, economies, demographics, and even society on a large scale.

OBJECTIVES OF THE STUDY

1. To study about the concept of Human Resource Management
2. To study the how human resource management to deal with effects of changing world of work
3. To study the recent trends in human resource management.

RESEARCH METHODOLOGY

Secondary data was used for the study and this is descriptive in nature. Journals, Websites, articles and various magazines have been used for collecting data.

REVIEW OF LITERATURE

Seeck and Diehl (2017), who identified 35 empirical studies linking HRM and innovation over a 25-year period (from 1990 to 2015), were the first and thus far the only scholars to systematize the HRM innovation theme. The outcomes demonstrate the relationship's significance: Innovation benefits from HRM practices implemented by organizations. It is of the utmost importance to examine the development of this body of literature in light of its growing significance and the rapid pace of innovation. Natalicchio et al. also observe this (2018) who come to the conclusion that there needs to be a larger debate in the literature regarding the moderating role of HR practices and the direct effect of HRM.

S. Muttagi, Umadevi. (2016), Human beings are an organization's most valuable resource. The abilities of its members determine its success. In an organization, the majority of issues, opportunities, frustration, and challenges are related to people. A company's human resources are its lifeblood. Human resources remain relevant and the most adaptable resources of the organization, despite the application of technology in contemporary business management. As a result, the company's success and survival are heavily dependent on its workforce. With the realization that human resource management must play a more strategic role in an organization's success and the changing competitive market environment, the role of the human resources

manager is changing. This paper will discuss the most recent trends in human resource management in the current business environment and how an organization overcomes obstacles.

According to Vishva Prasad (2015) objectives are to establish the significance of human resource management, explain how it came to be, provide some context, and discuss its potential and future growth Humans are a resource that, according to many experts, requires more care and management than any other resource of an organization. The responsibilities of the HR manager need to be in line with the needs of the changing company. Successful businesses are becoming more adaptable, robust, quick to change course, and customer-focused. The HR professional must acquire management skills in the areas of planning, organizing, leading, and controlling in this circumstance. The human resources department and keep up with the development of new employee and training trends.

RECENT TRENDS IN HUMAN RESOURCE MANAGEMENT

Globalisation and its implications

Today, business transcends national borders and spans the globe. Managers of human resources face new challenges as a result of the expansion of multinational corporations. Liberal cross-border trade, the use of technology in communication, and the rise of multinational corporations are likely to continue.

To attract talent from around the world, you need to stay up to date on new methods for finding and attracting talent. For global assignments, the HR department must ensure that the right mix of employees with the necessary knowledge, skills, and cultural adaptability are available. The organizations must provide individuals with training to meet the challenges of globalization in order to achieve this objective. Training management to be more adaptable would be required by HRM. Infosys, a business technology consulting firm, decided to hire graduates from China. To get started, the company invited a select group of Chinese students to its office in Mysore, India, where it taught them English. This allowed the company to hire workers cheaply from a neighboring country.

Diversity in the Workforce

Diversity in the workplace refers to employees' similarities and differences in age, cultural background, physical abilities and disabilities, race, religion, gender, and sexual orientation. Every human being is unique.

The organization's strategic direction relies heavily on diversity. Over time, there is also a shift in the composition of the workforce. The breaking down of the grass ceiling, the elimination of gender bias and inequality in certain occupations, and demands for equal pay for equal work have already been met. A family-friendly business offers benefits like child care and flexible work schedules to its employees. HRM must be aware of the age differences in today's workforce, in addition to the diversity brought about by gender and nationality. HRM needs to teach people of all ages how to effectively manage and interact with one another, as well as how to respect each person's unique points of view. A participative strategy seems to be more effective in these kinds of situations.

Every business today must employ a diverse workforce; however, managing such a workforce presents a significant challenge for management.

Expectations of Employees

In today's workplace, employees are more educated, more adamant, and more prepared to protest vigorously, violently, and collectively if they are not satisfied. The list of needs, both financial and non-financial, is always growing. Turnover rates are rapidly rising in fast-changing industries like software, telecom, entertainment, and pharmaceuticals. If HR managers do not respond positively to employee expectations, recruit acquisition and development costs will continue to rise. Human resource planning, training programs, and appropriate compensation packages are all necessary for an effective organization to anticipate and manage turnover.

Changing skill requirements

Any business concerned about competitiveness, productivity, quality, and effectively managing a diverse workforce must prioritize the recruitment and development of skilled workers. A lack of skills results in significant losses for the business in the form of lower productivity, lower quality work, an increase in employee accidents, and customer complaints. HRM practitioners and specialists will need to convey this information to educators, community leaders, etc. because a growing number of jobs will require more education and language proficiency than they do now. The skill gaps and shortages will need to be carefully considered in strategic human resource planning. In order to fill in the skills gaps and deficiencies, the HRM department will need to develop appropriate training and short-term programs.

Corporate downsizing

An organization's efforts to delay work are motivated by a desire to increase productivity. Many businesses have gone "lean" as a result of the pressure to maintain cost effectiveness, reducing excess fat at every managerial level.

The goal of downsizing is to cut back on the number of employees employed by the company. During this time, HRM personnel must ensure that proper communication takes place. Rumors must be kept to a minimum and factual information must be provided to keep people informed.

Continuous improvement programmes

Programs for continuous improvement are a way for an organization to improve its customer service while also focusing on quality.

This frequently involves a company-wide effort to boost productivity and quality. The company makes changes to its operations to put the customer first and get employees involved in decisions that affect them. Everything a company does, from hiring good people to meeting customer needs to processing administrative paperwork, must be improved. HRM plays a crucial role in the implementation of programs for continuous improvement.

Individuals must be prepared for the change by HRM. This necessitates extensive and precise communication of the reasons for the change, what to anticipate, and its impact on employees.

Reengineering work processes to increase productivity

Despite the fact that many of our organizations have begun with successful continuous improvement initiatives, these initiatives typically focus on ongoing incremental change. The constant and unending pursuit of improvement is a naturally appealing action. However, many businesses operate in an environment that is constantly changing and dynamic. When more than 70% of an organization's work processes are evaluated and changed, this is called re-engineering. It requires members of the organization to reevaluate the work that needs to be done, how it should be done, and the best way to put these decisions into action. Re-engineering has a direct impact on employees and alters how businesses operate. Some employees may be dissatisfied, enraged, and unsure of what to expect during reengineering. As a result, HRM must have mechanisms in place for employees to receive appropriate direction regarding what to do and what to anticipate, as well as assistance in resolving any potential conflicts within the organization. HRM must provide skill training to its employees in order for re-engineering to produce its benefits.

The contingent workforce

Contingent workers make up a significant portion of the modern workforce. Individuals who are typically hired for shorter periods of time are referred to as contingent workers. Without adequate planning, no organization can successfully transition to a contingent workforce. As a result, HRM must actively participate in strategic decision-making discussions. following the entirety of the HRM department's responsibility to locate and integrate these temporary workers into the organization. HRM will also be in charge of quickly integrating new temporary workers into the workforce. HRM will also need to think about how to get quality temporary workers.

Mass Customization

There has already been a lot of activity in HR related to mass customization, or the best way to combine mass production and customization. HR will need to apply marketing techniques for customer and client customization to the task of talent segmentation. Principles for determining the best level of customization in an employment relationship should be developed by HR. HR must develop principles that enable leaders to explain these differences to employees because customization will frequently result in different employment arrangements for different groups of employees based on their needs or contributions.

Involvement of employees

There appear to be a number of employee involvement ideas that are accepted for today's organizations to be successful. Delegation, participative management, work teams, setting goals, employee training, and employee empowerment are all examples of these. Employee engagement can greatly benefit from HRM. Leadership that is demonstrated and management that is supportive are both required. Training employees is necessary, and human resource management plays a significant role in this process.

Technology

New perspectives on HRM have emerged as a result of recent technological advancements and projections for the future. To aid in HRM, a number of computerized systems have been developed that are regarded as simplifying HR functions in businesses. For instance, HRMIS, which can be custom-made or pre-made, is taking the place of paper work files. In lieu of having a room full of file shelves, these systems assist in handling

a large amount of data on a chip. HRM is at the forefront of the need to train employees on how to operate such systems and develop their integrity to handle the sensitive nature of the situation because it is concerned with the safety (confidentiality) of staff data and information.

Health and Safety

Managers are particularly concerned about accident prevention and safety because of the rising number of workplace fatalities and injuries. Managers could face significant fines and even a criminal conviction if they fail to provide a secure workplace. Workers' safety is closely monitored by supervisors.

HRM must move to a new level, such as requiring employees to subscribe to wellness clubs and fitness centers and pay for health insurance for them. This is due to the need for a healthy workforce and the rise of wellness clubs. In addition to being a productivity strategy, this is also a strategy for attracting and keeping talented employees. HRM has shifted to providing health services to staff through health insurance, awareness, and free medical treatment bills in order to maintain relevance. This has resulted in excellent performance as well as the recruitment and retention of highly qualified employees.

Work-life balance between family and work

For a considerable amount of HRM history, the topic of work-life balance between family and work has been the subject of intense debate. Employees have been on the employers' toes to see if justice could be done, and employers have been eager to minimize the consequences. A happy family is like a happy workforce, in fact. With the current trend, HRM must ensure that every employee's family is at least somewhat happy. Therefore, it is inevitable to invest in what may appear to be out of the organization's reach. It is past time for HRM to persuade management to organize a family day out for employees and their families. Employees sometimes give up days off to take care of their families.

Confidentiality

The current trends have been viewed as new costs challenges, particularly in the short term. However, in order for an organization to succeed in this competitive market and take advantage of labor mobility, it is critical to rethink HRM at all levels in light of the current trends. It goes without saying that as long as a company does not have clearly defined strategies for human resource management, there will undoubtedly be a problem there or an explosion will occur. Organizations must go further in order to maintain

CONCLUSION

Globalization is a force that increasingly affects the lives of people living in all countries. This is due to the current trend of managing the organization's most valuable resource. Trade liberalization, rising levels of education among women and workers in developing nations, and advancements in technology are transforming nation borders from barriers to bridges. Global trade in goods, services, and labor talent is now more open than ever.

Organizations can improve job opportunities and raise wages for skilled workers because of the numerous opportunities. Equally numerous are the obstacles. It is necessary for businesses to deal with an aging workforce; They need to find, incorporate, and keep multicultural employment pools. Human resource management usually has to try new things to stay relevant corporate development partner.

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JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

CONDUCTIVITY STUDIES OF POLY (P-PHENYLENEDIAZOMETHINE)/PVC COMPOSITES

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Abstract: In-situ polymerization of Poly(p-phenylenediazomethine) from glyoxal and p-phenylenediamine in different solvents containing different amounts of PVC was done. The d.c. conductivity and microwave conductivity of each sample was measured. The effect of dopants like HClO4, HCl and I2 on conductivity was also studied.

Index Terms: Poly(p-phenylenediazomethine), PVC, doping, d.c. conductivity and microwave conductivity

I INTRODUCTION

Conducting polymer composites have drawn considerable interest in recent years because of their numerous applications in a variety of areas of electrical and electronic industry (Skotheim, 1986; Wessling, 1991; Margolis,1993) . In most of these applications, the main concern is to obtain sufficient level of conductivity in the material. Preparation of blends, composites and interpenetrating network has been widely used as an approach to combine electrical conductivity with desirable mechanical strength of polymers[4]. Several attempts have been described to produce conducting polymer composites with better physical properties by either chemically or electrochemically (Niwa and Tamamura,1984; De Paoli, Waltman, Diaz and Bargon, 1984 & 1985; Niwa, Tamamura and Kakuchi, 1987; Kalaycioglu, Toppare and Akbulut1996). Charge transport mechanism in conducting polymer composites was reported by Radhakrishnan and Hande,1995.

The present study involves In-situ polymerization of glyoxal and p-phenylenediamine in different solvents containing different amounts of PVC. The d.c. conductivity and microwave conductivity of each sample was measured. The effect of dopants like $HClO_4$, HCl and I_2 on conductivity was also studied.

2. EXPERIMENTAL

2.1Materials used

Paraphenylene diamine, Glyoxal hydrate (trimer), Polyvinylchloride, N,N-Dimethyl formamide , Toluene , Tetrahydrofuran, Methanol , Acetone, Hydrochloric acid, Perchloric acid, Iodine, and Carbon tetra chloride.

2.2 Synthesis of poly(p-phenylenediazomethine) –Polyvinylchloride blends

PVC (5g) was dissolved in 50 ml of Tetrahydrofuran. 0.1mole of p-phenylene diamine was added to 300 ml of N,N-dimethylformamide and was dissolved in it by stirring. Then 0.1 mole of glyoxal was added to it and stirred well. The solution of PVC in THF was added to the above reaction mixture and stirred well. Then the temperature of the reaction medium was increased slowly to boiling, with continuous stirring, and was refluxed at the boiling temperature for 4 hours. By that time, the precipitation of the product takes place. It was then allowed to cool to room temperature and then poured into excess of ice-cold water with stirring. It was allowed to settle, filtered, washed with plenty of water until the filtrate was colourless. Then it was washed with methanol, and allowed to dry at room temperature in air for one day. Then the final drying of the sample was done at 70^0C in vacuum.

The same procedure was repeated by varying the amount of PVC. For this, 10 gm of PVC was dissolved in 100ml of THF, 15 gm of PVC was dissolved in 150ml of THF, and 20 gm of PVC was dissolved in 200ml of THF and was added to the reaction mixture containing glyoxal and p-phenylenediamine in DMF.

The dried sample was powdered well, and, pelletized for the density and d.c. conductivity measurements. For the spectral and thermal studies, the sample was extracted with acetone until the extract was colorless, and dried well.

2.3 Doping

1g each of the sample was added to 50ml each of 1M HCl solution, 1M $HClO_4$ solution and saturated solution of I_2 in CCl_4 and kept for 24 hours. Then it was filtered, washed with a little amount of acetone and dried at 70^0 C in dynamic vacuum for one hour.

2.4 Measurements

2.4.1 IR spectra

Particles of the polymer samples were flattened by means of cold compression between two diamond windows. IR spectra of the samples were recorded with a Biorad UMA 500infrared microscope, which is coupled to a Biorad FTS 6000 spectrometer. Spectra were recorded with a resolution of 4 cm^{-1} co-adding 100 scans.

2.4.2 D.C. conductivity

D.C. conductivity of the pressed pellets was determined by the two-probe technique. The samples were sandwiched between two copper electrodes and a constant voltage (6V) was applied to the sample. The current flowing through the sample was measured using a digital multimeter (APLAB model 1087). The conductivity of the sample was calculated using the equation, $\sigma = t / RA$, where 't' is the thickness of the pellet, 'R' is the resistance of the sample ($R = E / I$, where 'E' is the applied voltage and 'I' is the resulting current through the sample), and 'A' is the area of cross section of the pellet ($A = \pi r^2$, where 'r' is the diameter of the pellet).

2.4.3 Density

Density of the pressed pellets were determined using the equation, $D = M/V$, where 'M' is the mass of the pellet and 'V' is the volume of the pellet .

3. RESULTS AND DISCUSSION

Figure 1 gives the IR spectrum of the conducting polymer- polyp-phemylenediazomethine- blends with PVC. A broad band existed between 3200 and 2400 cm^{-1}. These bands can be assigned to the $-(N\text{-}H_x)\text{-}Cl$ strtetching vibration of amine salts. Other spectral bands were due to the conducting polymer. Some more absorption bands can be ascribed to the PVC spectrum. Figure 2 compares the IR spectrum of the conducting polymer with that of the blend. Some of the spectral bands were common in both of the spectra. From these, we can conclude that conducting polymer was incorporated into the PVC matrix.

As the amount of PVC was increased in the blends, the solubility of the polymer was increased. This may be due to the effect of two solvents, THF and DMF, in the reaction medium, or, it may be due to the removal of HCl from PVC by the action of heat during the course of the reaction. The presence of acid was found to increase the solubility of the conducting polymer. In concentrated acids, the polymer was soluble at high temperature. So the processability of the conducting polymer can be improved by making its blends with PVC without any chemical change in the polymer structure.

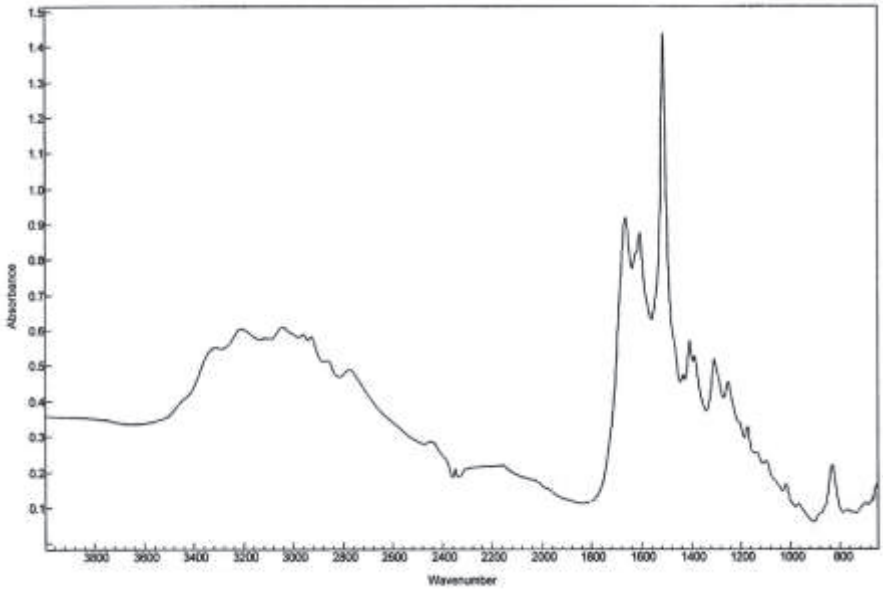

Fig. 1 IR spectrum of the conducting polymer- PVC blend

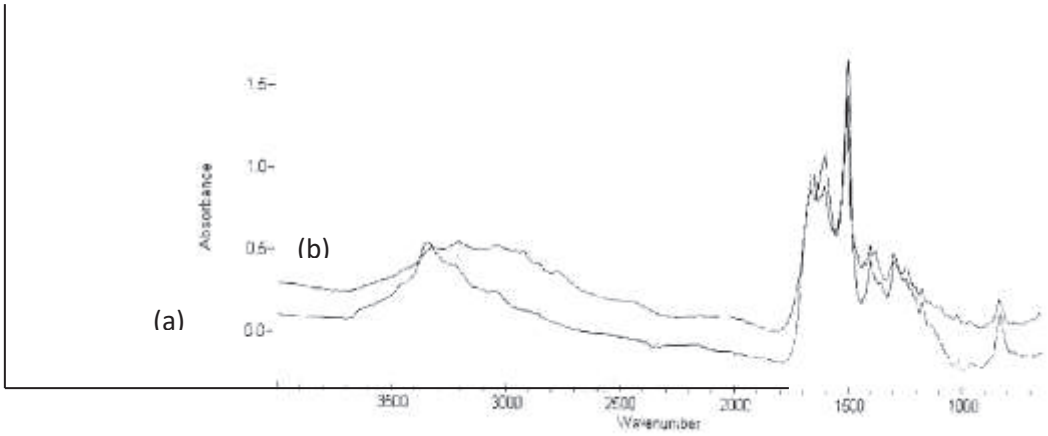

Fig. 2 IR spectra of (a) conducting polymer prepared in DMF and (b) its blend with PVC

Figures 3 and 4 show the IR spectra of the conducting polymer /PVC blends doped with HCl and $HClO_4$. The absorption peak at 3345 cm^{-1} in the undoped polymer was shifted to a broad band in the region of 3338 and 3360 cm^{-1} in HCl and $HClO_4$ doped samples respectively. The strong peak at 1628 cm^{-1} was characteristic of C=N bond in conjugated polymers. The bands at 1094 and 1084 cm^{-1} were due to the dopant molecules HCl and $HClO_4$. The bands at 1512 and 1425 cm^{-1} showed the benzenoid and quinoid rings attached to N atom. Other bands were same in undoped and doped samples.

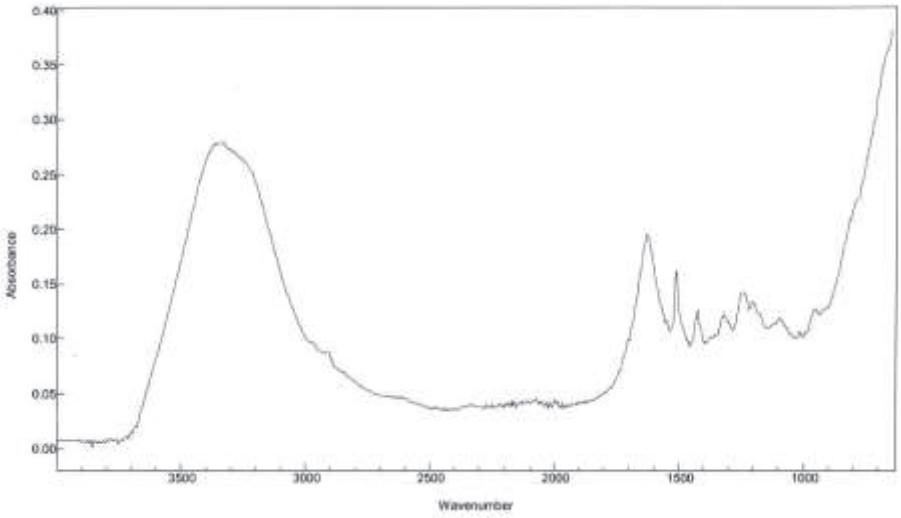

Fig. 3 IR spectrum of the conducting polymer/PVC blends doped with HCl

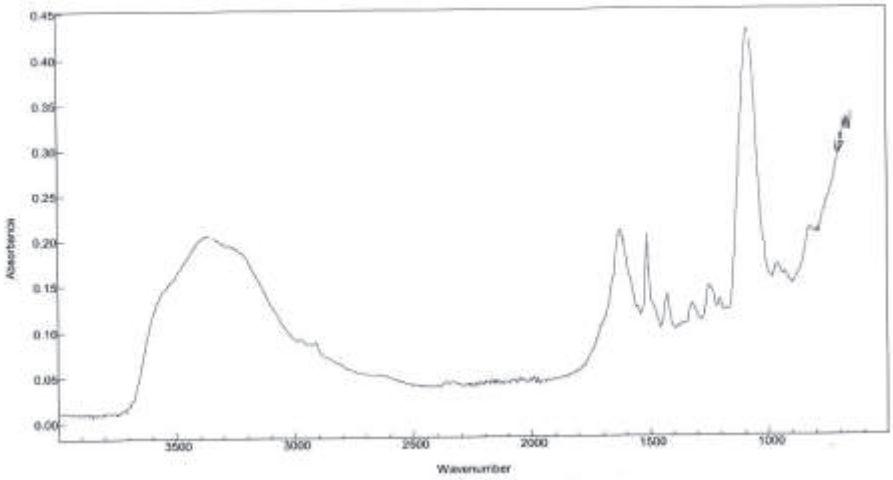

Fig. 4 IR spectrum of the conducting polymer/PVC blend doped with $HClO_4$

D.C. conductivity of the blends of the conducting polymer based on glyoxal, p-phenylene diamine and varying amounts of polyvinyl chloride is shown in the figure5.

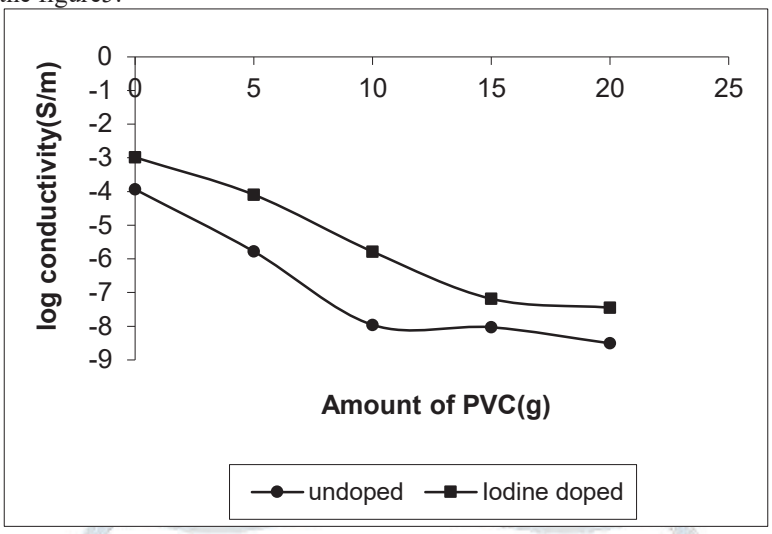

Fig. 5 D.C. Conductivity of the conducting polymer/PVC blends

The d.c. conductivity of the undoped blends decreased with increase in the amount of PVC. It was because, PVC is an insulator and the presence of nonconducting PVC in the composite prevented the free movement of electrons through the conducting polymer chain. Here, the conducting region was separated by a nonconducting region, so that the jumping of electrons from one conducting region to other became difficult. Hence the conductivity was decreased as in the case of polyethylene blends.

The variation in d.c. conductivity of the doped samples with the amount of PVC is given in figure6. The d.c. conductivity of the doped samples was more than that of the undoped samples. This was because, after doping, more charge carriers were introduced into the polymer chain, which helped to increase the conductivity. Conductivity of perchloric acid doped samples containing higher amount of PVC were more than that of other doped samples. HClO4 was found to be the better doping agent because, of the large size of ClO4- counter ion, which helped to tightly attach the dopant to the polymer chain. Hence the removal of the dopant was difficult. This may be due to the attachment of H+ ions to the N atom of the polymer using the lone pair of electrons to increase the charge delocalization as it is clear from the IR spectra.. Conductivity of the I2 doped samples were lower than that of other samples doped with HCl and HClO4. It may be due to the fact that charge delocalization due to iodine on the polymer chain was very low. Also, on drying the samples, the action of heat and vacuum may be removing the iodine easily, compared to acid dopants.

The d.c. conductivity of perchloric acid doped blends were more than that of the pure conducting polymer doped with perchloric acid. As the amount of PVC was increased, d.c. conductivity was increased and remained almost constant at higher amount of PVC. This was because, PVC present in the blend is polar in nature, and the charge delocalization and oxidation takes place with the conducting polymer as well as with PVC molecules as shown in the IR spectra. So the removal of the dopant molecule may be difficult during the drying process and since the charge carriers were not lost, the conductivity was higher for the blends. After a saturation point was reached, the increase in conductivity was negligible because, the amount of insulating region of PVC was increased in the blend.

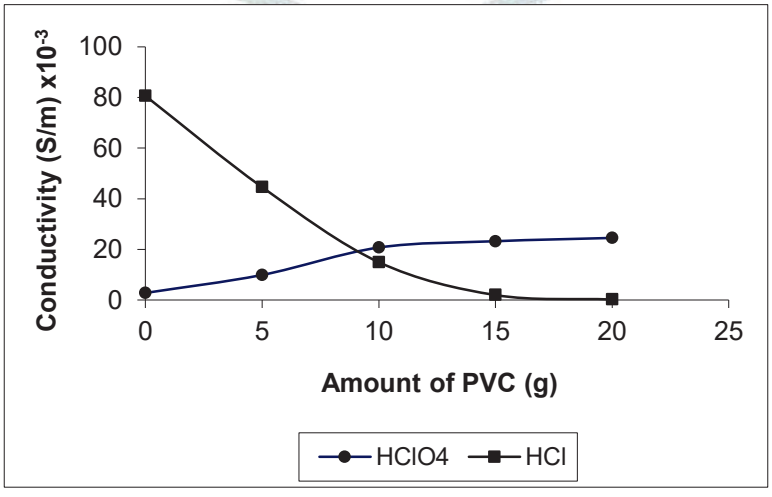

Fig.6 D.C. Conductivity of HCl and $HClO_4$ doped conducting polymer/ PVC blends

4. CONCLUSIONS

1. The d.c. conductivity of the undoped conducting polyme blends was lower than the d.c. conductivity of the conducting polymer.
2. The d.c. conductivity of the undoped polymer blends was decreased with increase in the amount of PVC.
3. The d.c. conductivity of the conducting polymer blends was increased on doping with HCl, $HClO_4$ and iodine.
4. The d.c. conductivity of the blends of conducting polymer with PVC doped with HCl and iodine was decreased with increase in the amount of PVC, but it was increased on doping with $HClO_4$ and it remained constant at higher concentration of PVC.

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Future of Artificial Intelligence in Cyber Security

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Abstract

Artificial intelligence is opening up new avenues for value generation in enterprises, industries, communities, and society as a whole. Technology has been researched to be relevant in many aspects of the world. This factor has made it to be included mainly in different businesses and industries. The applications of AI are endless to discuss. The research below examines the future of artificial intelligence (AI) in Cyber Security. During the last decades, not only the number of cyber-attacks have increased significantly.Traditional security methods are not adequate to prevent data breaches in case of cyber-attacks. Cybercriminals have learned how to use new techniques and robust tools to hack, attack, and breach data. In the digital era, volumes of sensitive data are maintained by governments and enterprises. Artificial intelligence (AI) functions like a computer program focused on gaining success.

Keywords: *Cyber security, Artificial intelligence, Cyber attacks, Threats, Data Privacy*

1. Introduction

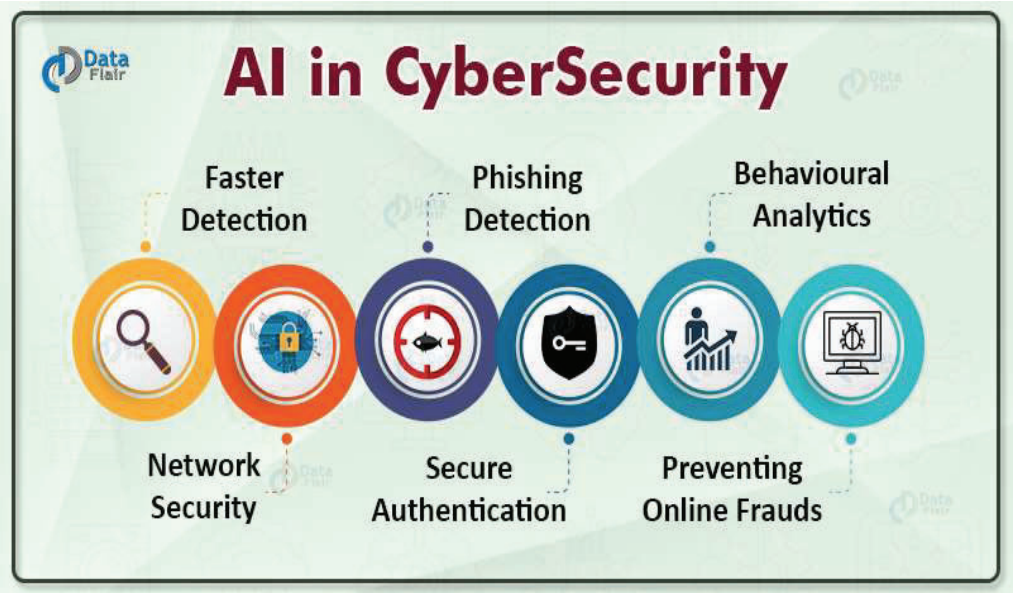
The exponential growth of computer networks has led to a tremendous growth in number of cyber attacks. All sectors of our society, from government to economy, to critical infrastructures, are largely dependent on computer networks and information technology solutions.Therefore; they are obviously vulnerable to cyber attacks. A cyber attack is an attack launched from one or more computers against other computers or networks. With the rapidly increasing prominence of information technology in recent decades, various types of security incidents, such as unauthorized access [1], denial of service (DoS) [2], malware attacks [3], zero-day attacks [4], data breaches [5], social engineering or phishing [6], etc., have increased at an exponential rate in the last decade. Cybercrime and network attacks can result in significant financial losses for businesses and people.

Artificial intelligence (AI) is slowly becoming an integral part of cyber security, helping organizations of different sizes and industries increase the efficiency of their cyber security. Information technology and telecommunications are the industries with the fastest and most advanced AI adoption process. Today, AI and machine learning algorithms are used to automate tasks, crunch data, improve cyber security, and make decisions at a humanly impossible speed. Based on online statistics,

the global market of AI in cyber security is expected to grow at a CAGR (Compound Annual Growth Rate) of 23.6% from 2020 to 2027, reaching **$46.3 billion**. According to the International Data Corporation (IDC), global cyber security spending will reach $174.7 billion in 2024, with security services being the largest and fastest-growing segment. This will increase the importance of AI in cyber security and the fight against top security threats to look out for in 2022. However, the adoption of AI structures and platforms does not come without challenges, as 60% of the organizations that have incorporated AI recognized cyber security risks as the most prevalent ones.

2. The Integration of AI in Cyber security

Artificial intelligence is a crucial asset for organizations that use automation in order to increase productivity and efficacy of their processes. One crucial application that leverages AI more than any other today is data security or cyber security. As digital transformation increases rapidly, so does the number and sophistication of data breaches. AI can be a powerful tool in protecting against cyber-attacks.



- Faster Detection and Response Times

Artificial intelligence can accelerate the recognition of authentic issues, quickly cross-referencing various cautions and wellsprings of security information. Human digital security specialists will even now make the approaches the needs of the episodes to be taken care of. However, it can be additionally helped by AI frameworks that consequently recommend plans for improving reactions.

- Network Security

Two significant pieces of system security are the production of security strategy and making sense of an association's system geography. Normally, both of these exercises

are very tedious. We can utilize AI to speed up these procedures, which it does by watching and learning system traffic designs just as recommending security arrangements.

- Phishing Detection and Prevention Control

One of the most widely utilized digital assault techniques, where programmers attempt to convey their payload utilizing a phishing assault, is phishing. Phishing messages are very common; one in every 99 messages is a phishing assault. Luckily, AI-ML may assume a noteworthy job in forestalling and deflecting phishing assaults. Computer-based intelligence ML can recognize and follow in excess of 10,000 dynamic phishing sources and respond and remediate a lot speedier than people can. Additionally, AI-ML works at filtering phishing dangers from everywhere throughout the world. There is no limitation in its comprehension of phishing efforts to a particular geological territory. Computer-based intelligence has made it conceivable to separate between a phony site and a real one rapidly.

- Secure Authentication

Passwords have consistently been an exceptionally delicate control with regards to security. What's more, they are frequently the main boundary between cyber criminals and our records. The primary way secure verification can be accomplished is physical recognizable proof, where AI utilizes various elements to distinguish an individual. For example, a cell phone can utilize unique finger impression scanners and facial acknowledgment to permit you to sign in. The procedure behind this involves the program examining primary information that focuses on your face and fingers to perceive if the login is true.

- Behavioral Analytics

Another important use of AI in cyber security originates from its ability to analyze behavior. This means ML calculations can learn and make an example of your conduct by breaking down how you utilize your gadget and online stages. In the event that whenever the AI calculations notice uncommon exercises or any conduct that falls outside your standard examples. It can signal it as being finished by a suspicious client or even square the client. The exercises that tick off the AI calculations can be anything from huge online buys transported to addresses other than yours, an abrupt spike in report download from your documented envelopes, or an unexpected change in your composing speed.

- AI in preventing Online Frauds

Companies must have the option to recognize a digital assault ahead of time. This is to have the option to obstruct whatever the foes are endeavoring to accomplish. AI is that piece of Artificial Intelligence which has demonstrated to be amazingly valuable with regards to recognizing digital dangers. It depends on examining information and distinguishing a risk before it misuses helplessness in your data frameworks.AI empowers PCs to utilize and adjust calculations dependent on the information got, gaining from it, and understanding the subsequent enhancements required. In a cyber security setting, this will imply that AI is empowering the PC to foresee dangers and watch any irregularities with much more precision than any human can. Conventional

innovation depends a lot on past information and can't extemporize in the manner that AI can. Customary innovation can't stay aware of the new components and stunts of programmers the manner in which AI can. Also, the volume of digital dangers individuals need to manage is a lot for people. AI handles it in best manner.

3. Importance of Cyber security in Today's Time

In today's digital world, cyber security is as important as regular security. That means, practicing online security like using strong passwords and avoiding innocent-clicks on malware links is as important as locking your door when you go out. The crux of the matter is that cyber security today is a major concern, not only for an individual's security or an organization's but also for the government. Many sectors of government are trying to incorporate AI into their system to provide better security of data and create more opportunities.

The main benefits of investing in cyber security

- Your business is protected against potentially catastrophic disruptions caused by cyber attacks.
- You reduce the risk of violating mandatory security violations.
- The risk of a data breach is significantly decreased.
- The impact of third-party breaches resulting from supply chain attacks is significantly decreased

4. The Use of AI by Cybercriminals

AI is a double-edged sword; it can be used as a powerful protective tool, as well as a powerful attacking mechanism. On the offensive side, malicious attackers can use AI to increase the precision and effectiveness of their attacks. Organizations that adopt AI into their cyber security systems are bound to specific regulations, which often limit the scope of their use. In contrast, cybercriminals have an unlimited playing field, making it easier for them to leverage the technology for harmful purposes. One of the best-known program analysis techniques used by hackers is "fuzzing." This is mostly used to find vulnerabilities in complex software. The main intention of this technique is to cause buffer overflows, crashes, memory errors, and exceptions and expose system weaknesses. The use of AI with this technique increases the precision and efficiency of the attack, thus creating a devastating threat.AI can also be used with phishing attacks. AI-powered phishing has an increased speed of navigating sensitive data and reduced traffic. This helps cybercriminals extract only the necessary information and make the malware harder to detect.

5. Future of Artificial Intelligence in Cyber Security

An organization implementing strong defenses against cyber-attacks need a skilled and experienced cyber security workforce, which is not easy to find, considering the large

demand. The number of individuals interested in taking courses in cyber security is increasing. This trend is expected to grow even more in the future, as the demand is much higher than the supply. If left unattended, cyber-attacks will continually increase and become more dangerous. This can be prevented by making continual significant investment in people. This can be done by hiring cyber security experts or by training employees on the integration of AI in cyber security systems. AI in cyber security may seem like an oxymoron at first glance. But it's the wave of the future that will change how you think about the field forever.

There is no doubt that AI has a great future in cyber security. Here are some reasons why:

- Identify threats more quickly and accurately than humans can.
- Prevent attacks by automatically blocking suspicious activity.
- Improve the resilience of networks against attack.
- Speed up the process of recovering from a cyber attack.
- Improve the overall security of digital systems.

6. Conclusion

So there you have it. Artificial Intelligence in cyber security is the future. There may be a few years away from Sky net taking over. But, there are real-world examples of how AI uses to defend our networks today. As with any new technology, there are pros and cons to consider. But, it is important to decide if AI should be part of your cyber security strategy or not. Given that hackers are getting smarter every day, I think it's safe to say that AI will become an increasingly important tool. It will be useful in our fight against cybercrime. If so, contact us today and let us show you how our machine learning services can help make your network safer than ever before.

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Artificial Intelligence in Internet of Things

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Abstract

The internet of things, or IoT, is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. These IOT devices generate a lot of data that needs to be collected and mined for actionable results through use artificial intelligence (AI) to manage huge data flows and storage in the IOT network. The self-optimizing network and software defined network are parts of the important parameters in the Artificial Intelligence IoT System. IoT is not just about saving money, smart things, reducing human effort, or any trending hype. This is much more than that – easing human life. There are, however, some serious issues like the security concerns and ethical issues which will go on plaguing IoT. The big picture is not how fascinating IoT with AI seems, but how the common people perceive it – a boon, a burden, or a threat.

Keywords: *We internet of things, artificial intelligence, taxonomy, IOT definitions, IOT functional view, architecture.*

1. Introduction

The term 'Internet of Things' was coined in 1999 by the computer scientist Kevin Ashton. While working at Procter & Gamble, Ashton proposed putting radio-frequency identification (RFID) chips on products to track them through a supply chain. The internet is not only a network of computers, but it has evolved into a network of device of all type and sizes , vehicles, smart phones, home appliances, toys, cameras, medical instruments and industrial systems, animals, people, buildings, all connected ,all communicating & sharing information based on stipulated protocols in order to achieve smart reorganizations, positioning, tracing, safe & control & even personal real time online monitoring , online upgrade, process control & administration[1,2]. IoT is a system of interrelated computing devices, mechanical and digital machines or objects with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interactions. A thing in IoT can be a person's heart monitor implant, an automobile with built-in sensors to alert the driver when tire pressure is low, or any other object that can be assigned an internet protocol address and transfer data over a network. The most visible application of the Internet of Things is a smart home. A smart home uses sensors to control and maintain lighting, resource

management, and security systems. A smart home is a smaller, independent version of a smart city. The most visible application of the Internet of Things is a smart home. A smart home uses sensors to control and maintain lighting, resource management, and security systems. A smart home is a smaller, independent version of a smart city. Internet of everything (IoE) [3] is also a similar idea that suggests that every living, non-living, or virtual object is connected to each other through some communication medium. When these concepts are deployed to the physical world, what we get is a cyber-physical system (CPS) [4]. Such a world would be data wealthy; using which knowledge could be extracted. Various disciplines like database management system (DBMS) [5], pattern recognition (PR) [6], data mining (DM) [7], ML [8], and big data analytics (BDA) [9] will need improvised methods to deal with the data, overlapping largely in their scope. This article mainly revolves around intuitions, challenges, and applications of AI in the concepts of IoT, CPS, and IoE.

2. Why IoT needs AI

IoT allows devices to communicate with each other and act on those insights. These devices are only as good as the data they provide. To be useful for decision-making, the data needs to be collected, stored, processed, and analyzed. This creates a challenge for organizations. As IoT adoption increases, businesses are struggling to process the data efficiently and use it for real-world decision making and insights. This is due to two problems: the cloud and data transport. The cloud can't scale proportionately to handle all the data that comes from IoT devices, and transporting data from the IoT devices to the cloud is bandwidth-limited. No matter the size and sophistication of the communications network, the sheer volume of data collected by IoT devices leads to latency and congestion. Several IoT applications rely on rapid, real-time decision-making such as autonomous cars. To be effective and safe, autonomous cars need to process data and make instantaneous decisions (just like a human being). They can't be limited by latency, unreliable connectivity, and low bandwidth. Autonomous cars are far from the only IoT applications that rely on this rapid decision making. Manufacturing already incorporates IoT devices, and delays or latency could impact the processes or limit capabilities in the event of an emergency. In security, biometrics is often used to restrict or allow access to specific areas. Without rapid data processing, there could be delays that impact speed and performance, not to mention the risks in emergent situations. These applications require ultra-low latency and high security. Hence the processing must be done at the edge. Transferring data to the cloud and back simply isn't viable.

3. Applications of Artificial Intelligence in the Internet of Things

Most real-world applications of AI and IoT are used to prevent downtime, streamline operational processes, and make sense of the growing amount of data generated from IoT devices.

• Edge Computing. Edge computing involves processing high volumes of data at high speeds, enabling users to make decisions locally, without sending data to the cloud. Where IoT devices collect the data, it's AI/ML that enables decision-making at the edge.

• Collaborative Robots (Cobots). Cobots represent the fastest-growing segment in industrial automation. They use a combination of IoT sensors and AI-ML models that give robots a sense of perception and environmental awareness that allows them to "make decisions" and work safely alongside human collaborators.
• Digital Twins. Digital twins are virtual replicas of physical objects that enable users to run simulations before deploying actual equipment and devices. For instance, you might use digital twins to test a new engine or wind turbine before sending the design to production.
• Autonomous Delivery Robots. While autonomous delivery robots may well fall under the "cobot" label, the use case is a bit different here. In this case, AIoT technology moves outdoors to address the last-mile delivery problem, reducing shipping costs and increasing delivery speed—a key factor in driving customer satisfaction.

4. What's next for AI and IoT?

Big data without intelligence isn't enough. While IoT without AI is possible, early solutions can't keep up with the amount of data generated by the various sensors, devices, and machines that make up the industrial IoT ecosystem. As IoT sensors and devices become more affordable, more organizations will adopt these new solutions, hoping to cut costs, drive revenue, or improve processes. So, as companies begin to add intelligence to the production line, the supply chain, and so on, it immediately becomes impossible for humans to sort through that information, much less extract anything that can be put to good use.

5. IoT Architecture

Let us now propose taxonomy for research in IoT technologies. Our taxonomy is based on the architectural elements of IoT. IoT architecture is the flow of information or data from the sensors to the large server clouds. The sensors are attached to the "things" and they take in information from the surroundings. Large cloud servers perceive, store and process the incoming data to generate necessary outputs. Data is sent back through the clouds, to the "things" to generate a chain reaction.
Perception layer/ Sensing Layer: This layer that contains IoT devices such as sensors, actuators and machines that have the capacity to sense calculate and connect to other devices. It collects data using sensors, which are the most important drivers of the Internet of Things.. There are various types of sensors used in diverse IoT applications. The most generic sensor available today is the Smartphone. The Smartphone itself has many types of sensors embedded in it such as the location sensor (GPS), movement sensors, camera, light sensor, microphone, and proximity sensor. These are being heavily used in different IoT applications. This layer combines and computes the data.

Network Layer: Network layers provide an overview of how data is moved throughout the application. This layer contains Data Acquiring Systems (DAS) and Internet/Network gateways. A DAS performs data aggregation and conversion functions (collecting and aggregating data from sensors, then converting analog data to digital data, etc.). It is necessary to transmit and process the data collected by the sensor devices. That's what the network layer does. It allows these devices to connect and communicate with other servers, smart devices, and network devices. As well, it handles all data transmissions for the devices.

Processing Layer: The processing layer is the brain of the IoT ecosystem. Typically, data is analyzed, pre-processed, and stored here before being sent to the data center, where it is accessed by software applications that both monitor and manage the data as well as prepare further actions. This is where Edge IT or edge analytics enters the picture.

Application Layer: User interaction takes place at the application layer, which delivers application-specific services to the user. An example might be a smart home application where users can turn on a coffee maker by tapping a button in an app or a dashboard that shows the status of the devices in a system. There are many ways in which the Internet of Things can be deployed such as smart cities, smart homes, and smart health.

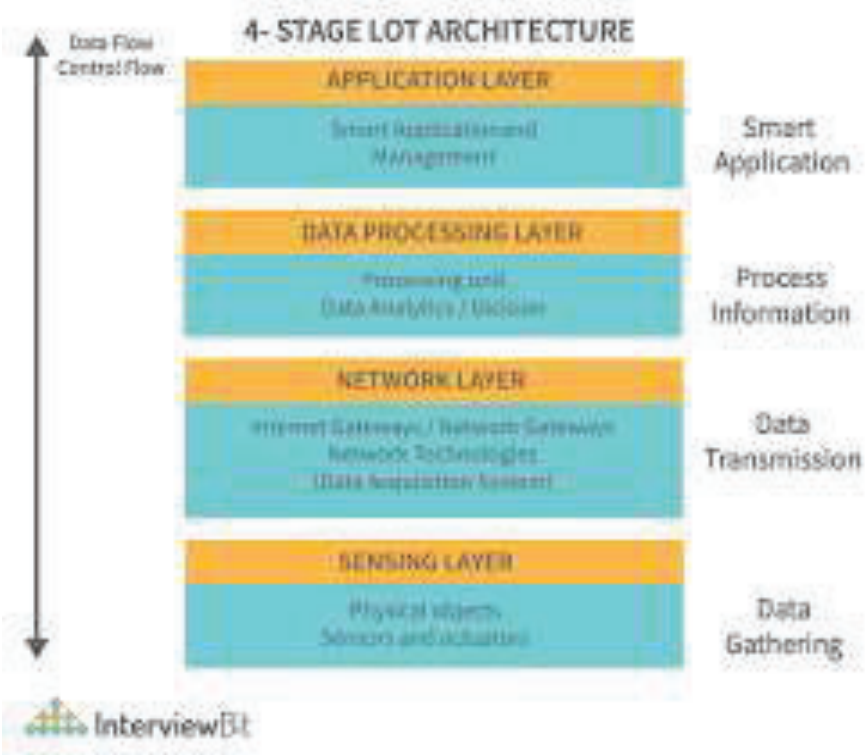

Figure: https://www.interviewbit.com/blog/wp-content/uploads/2022/06/Different-Layers-Of-IOT-550x467.png

6. Conclusion

All IoT applications need to have one or more sensors to collect data from the environment. Sensors are essential components of smart objects. One of the most important aspects of the Internet of Things is context awareness, which is not possible without sensor technology. IoT sensors are mostly small in size, have low cost, and consume less power. They are constrained by factors such as battery capacity and ease of deployment. Schmidt and Van Laerhoven provide an overview of various types of sensors used for building smart applications.

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Cryptography-Digital Signaturein ITRfiling

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Abstract-
Everydaynewtechnologiesarebroughtandprogressed very rapid in all fields. Now new generation giftedto tax payers for filing their income tax go back via on-line isE-submitting. The E-filing is the new effective method of filingincome tax return through online and make E-payment taxwith digitalsignature.Itsavesourgoldentime,strength,feeandalso reducesour anxiety.So,the tax payersare required touse E-filing centres.This present lookat examines that theexisting customers are satisfied with the E-filing facilities butmostofthepeopletaxpayersarenotawaretotheE-submittingprocedures so sufficient steps are required for create greaterawarenesswithinthemindsoftaxpayersregardingE-submittingofearningstaxwiththeaidofusingdigitalsignature.

Keywords—taxpayers, E-filing, digital signature, tax

I. INTRODUCTION(*HEADING1*)

Theadvancedtechnologyisseeneverywhere,frome-tickingtoe-filingthetaxreturn,everythingcanbedoneeasilyatthecomfortof yourhome.Whilefilinganincometaxreturnonlinearequirement thatyouhavetofurnishistoaffixyourdigitalsignaturewithyourta xreturndocumentstoauthenticatethesedocs.IntheITAct2000, adigitalsignatureenjoystheidenticalstatusasanormalsignatur e.It attests and verifies that the taxpayer has authenticated the taxreturn documents in secure surroundings, without fraud. Virtual orDigitalsignatures,thatareissuedbyCertificationauthorities,c ontain particulars just like the taxpayer's name, public key, nameof issuing Certification Authority, expiration date of public key(1-2years),thedigitalsignatureanditsserialwidevariety.Tamperin gwithdigitallysignedfilesandclaimingforgeryoverdigitalsignat ures isn't a viable option, especially since some assessmentsarenearingcompletiontoconfirmthesame.Chan gesandadditionstodigitallysignedfilesarealsoincludedinthesi gningprocess.

II. CRYPTOGRAPHY

Cryptography is a method of defensive facts and communicationsthroughthe usage ofcodes,sothatonlythose forwhomtheinformationisintendedcanreadandprocessit.Inc omputerscience,cryptographyreferstocomfydataandconvers ationtechniquesderivedfrommathematicalconceptsandafixe dofrule-based calculations called algorithms, to transform messages inways which might be difficult to decipher. these deterministicalgorithmsareusedforcryptographickeytechnol ogy,digital signing,verificationtodefenddataprivateness,websurfingattheinte rnet and private communications which includes credit cardtransactionsandemail.

A. Objectivesofcryptography

1.Confidentiality:Theinformationcannotbeunderstoodbyanyone forwhomitwasaccidental.
2.Integrity:Thestatisticscan'tbealteredinstorageortransitbetwe ensender and supposed receiver without the alteration being detected.3.Non-repudiation:Thecreator/senderoftheinformationcannotdenyata laterdegreetheirintentionsintheadventortransmission ofthefacts.
4.Authentication:Thesenderandreceivercanaffirmeveryother'side ntityandthestartingplace/vacationspotofthestatistics.

B. Typesofcryptography

i.Symmetric-keyencryptionalgorithmscreateafixedlengthofbitsknown as a block cipher with a secret key that the sender uses toencryptdata(encryption)andthereceiverusestodecryptit(de cryption). This only required a single key for both encryptionand decryption process. Block and Stream algorithms comprisesymmetric key cryptography, which is widely used on the Internettoday.TwopopularencryptionalgorithmsaretheAdvan cedEncryptionStandard(AES) and theDataEncryption Standard(DES). This method of encryption is often faster than symmetricencryption, but it allows both the sender and the data receiver tohaveaccesstothesecret key.

ii Asymmetric key algorithms: It use a pair of keys, a public keyassociated with the sender for encrypting messages and a privatekey that only the receiver knows for decrypting that information.This required two key one to encryption and the other one todecryption. When someone wants to send an encrypted message,theywillretrievetherecipient'spublickeyfromashare ddirectoryand use it to encrypt the message until it is sent. The receiver willnextusetheirassociatedprivatekeytodecryptthemessage. When the sender encrypts a message with their private key, themessagecanonlybedecryptedwiththesender'spublickey,al lowingthesendertobeauthenticated.Theseencryptionand

decryption operations are fully automated, so users do not have tomanually lockandunlock messages.

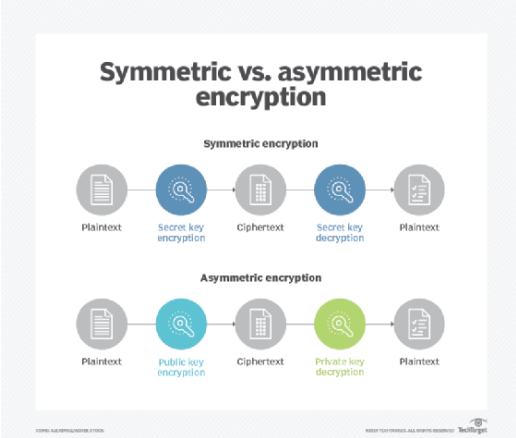


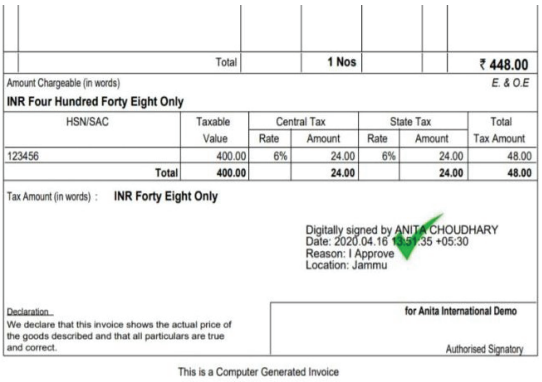
Fig.1Typesofcryptography

III. DIGITALSIGNATURE

A mathematical algorithm is routinely used to validate theauthenticity and integrity of a message using a digital signature,which is a type of electronic signature (e.g., an email, a credit cardtransaction, or a digital document). Digital signatures are used toidentify users and protect information in digital messagesanddocuments by creating a virtual fingerprint that is unique to them.The email content becomes part of the digital signature in emails.Electronic signatures such as digital signatures are far more securethanothertypesofelectronicsignatures.Digitalsignature scanofferproofoforigin,identityandstandingofdigitalfiles,transactionsordigitalmessages.Signersalsocanusethemtorenownedknowledgeable consent. In many countries, including the UnitedStates, digital signatures are considered legally binding inside theidenticalmannerasconventionalhandwrittenrecordsignatures..

A. HowDSCworks

Digital signatures are based on asymmetric key cryptography orpublickeycryptography.Usingapublickeyalgorithm,suchasRSAalgorithm,twokeysaregenerated,creatingalinkedpairofkeys, oneprivate key and one public key.Digitalsignaturesworkthroughasymmetrickeycryptography'stwomutually authenticating cryptographic keys. The individual whocreates the DS uses a private key to encrypt signature-related data,theonlywaytodecryptthatdataiswiththesigner'spublickey.If the recipient cannot open the document with the signer's publickey,that's asignthere's a problemwiththe document orthesignature.Thisishowdigitalsignaturesareauthenticated orvalid.



	Total		1 Nos				₹ 448.00

Amount Chargeable (in words) E. & O.E

INR Four Hundred Forty Eight Only

HSN/SAC	Taxable Value	Central Tax		State Tax		Total Tax Amount
		Rate	Amount	Rate	Amount	
123456	400.00	6%	24.00	6%	24.00	48.00
Total	**400.00**		**24.00**		**24.00**	**48.00**

Tax Amount (in words) : **INR Forty Eight Only**

Digitally signed by ANITA CHOUDHARY
Date: 2020.04.16 12:51:35 +05:30
Reason: I Approve
Location: Jammu

Declaration
We declare that this invoice shows the actual price of the goods described and that all particulars are true and correct.

for Anita International Demo

Authorised Signatory

This is a Computer Generated Invoice

Fig2DSCverification

B. DifferentclassesofDigitalsignature

- Class 1 Certificate: These are issued to individuals or privateusers.ThisCertificateconfirmsthattheuser'snameande-maillDarevalidandapprovedbytheCertifyingAuthoritiesontheirdatabase.
- Class2Certificate:Theseareissuedonlytobusinessperson neland individuals. They confirmed that the information in theapplicationprovidedbythesubscriberisthesameastheinformationinpopularconsumerdatabases.
- Class 3 Certificate: These are issued only to individuals andorganizations.Theyareveryhighassurancecertificates, mainlyfor the purpose of e-commerce applications. It is issued whentheindividualappearsin-personbeforethecertifyingauthorities.

C. Benefitsofdigitalsignature

1.Adigitalsignaturecan'tbeedited ortampered with.
2. Itissecuretotrack adigitallysigneddocument.
3. Itbringsdownthewastageofpaper andis aneco-friendly.
4. Helpstheefficiencyof theentiree-filingprocess.
5. Reducescost

TABLE 1DSC comparison

	DigitalSignature
Visible	No
Unobtrusive	Yes
Filechanges	NotAllowed
Virtuallyattachedtofile	Yes
Physically embedded infile	No
Dataauthenticity	Yes
Copyrightprotection	Yes
Globalidentification	partial

D. CertifyingauthoritiesforDigitalsignature

ThelicensedcertifyingauthoritieswhoauthorizedbygovernmentappointedControllerof CertifyingAuthority:

- 1.Safescrypt
- 2.CapricornCA
- 3.IDRBT
- 4.GNFC
- 5.eMudraCA
- 6.NSDL e-GovCA
- 7.IndianAirForce
- 8.VerasysCA

- 9. CDAC CA

.

E. Howtogetdigitalsignature

Thepurposeofobtaining adigitalcertificate, theuser willhavetosubmit certain documents to the certifying authority (CA). Itincludes an application form that has been duly signed, a passportsize photo an identification proof, Aadhaar card number, PANcard verification etc. The applicant may be asked to provide themobile number, email address and home or organization addressof the user. The different countries will have differentrequirements from the applicants for the issuance of digitalsignature certificate. The process of obtaining digital signaturecertificatesvariesdependingonthecertifyingauthorities.

F. MandatorytaxpayersforITRfilingusing DSC

Digital signature certificates is mandatory for some services / usercategoriessuchas e-Verification of returns filed bypolitical parties and companiesas well as other persons whoseaccounts are required to be audited under Section 44AB of theIncomeTaxAct.Inothercase,itisoptional.

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G. Stepsto createDSCin ITRfiling

1:Fill up the Income Tax Return form, generate the file asanXML (ExtensibleMark-upLanguage) fileandsaveit.
2:StepintotheIncomeTaxIndiawebsite.Logintoyouraccountusingyouruser passwordandID.
3:Afterlogin,clickonthetab"SubmitReturn"and thenselecttheassessment year.
4: Select the Income Tax Return Form Name from the drop-downmenulist.
5:Thenextfieldwillbe"DoYouWanttoDigitallySigntheFile?"Then select the "Yes" button.6: Select the type of digital signature you want to use, it can be"Sign withUSBToken"or"SignWith.PFXfile"
7: Upload the ITR with the help of digital signature certificate andverifyit.

Fig3USBtoken

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H.Currentproblemin takingDSC

As previously stated, the signature is signed with the USB tokenafter the digital signature certificate has been verified andapproved by certified authorities. The password will be includedin the DSc. There's a chance you'll lose your USB token. If it islost, other people or hackers can quickly track down the clientsDSc by targeting all of their authentication information. This is afairly rareprobleminthis field.

IV. PROPOSEDSYSTEM

The problem mentioned above is an example of a threat. We canuse an OTP password with the USB token to get around thissituation. If someone tried to access the USB Token, they couldeasily access the password that has been attached to it. It may alsorequest an OTP verification in addition to the password. Only theclient'smobilenumberwillreceivetheOTPpassword.Asaresult,this will provide a security mechanism whichuseful in futureattacks.

V. CONCLUSION

From the above study, the usage of ITR filing using DSC must befocusedtomakeabetterwayofusingonlinemethodinadeveloping country like India. Still the usage of DSC is increasingdaybydayamongthecitizensforitssecuretechniques.Thisstudyfocuses on the digital signature and its authentication process. Thebasic objective of research is to provide an awareness about DSCand its basic attacks. The majority of individuals are unaware ofthis problem.The paper aids them in raising awareness about theproblem.Thiscasestudywillbeimplementedinmyfutureresearch

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Visual Question Answering

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***Abstract*— Given an image and a natural language query regarding the picture, the system must produce a natural language answer to the inquiry in visual question answering. The goal of the proposed article is to employ convolutional neural networks to recognize and identify objects. Question answering is done via natural language processing. As a result, the paper's goal is to take a picture and a natural language query about it, and then have the system recognize the item and provide a suitable response to the question. The visual question-answering system can respond to inquiries such as how many, yes/no, and what the image includes.**

Keywords—visual question answering, convolutional neural networks, computer vision, natural language processing.

• Introduction

The purpose of this study is to make use of the features of visual question answering. The computer must offer an accurate answer to the query in Visual Inquiry Answering (VQA), where the input is a picture and an associated textual question (see Fig. 1). VQA is a multi-discipline Artificial Intelligence research challenge that combines Computer Vision, Natural Language Processing (NLP), and Knowledge Representation & Reasoning. The following is an example of how to use it. 1) Natural language processing (NLP) - to comprehend the query and provide a response. 2) Computer vision - extracting usable information from images and analyzing it. 3) Knowledge Representation - depicts data in a way that a computer system can understand and apply to solve problems. The suggested visual question-answering system can respond to inquiries such as how many, yes/no, and what does the image contain.

Visual question answering can aid blind and visually impaired users, summarize visual data for analysts, and be connected with image retrieval systems.

- **Related Work**

Mateusz et al. [1] The machine must offer the correct answer to an image and an associated content query in Visual Question Answering (VQA). The response can be a yes/no response, a word, a sentence, a fill-in-the-blank response, or a selection from multiple options.

Mengye et al. [2] A unique method for eliminating huge items from digital images and replacing them with visually realistic backdrops is presented in this study. Exemplar-based texture synthesis duplicates both texture and structure, although it is extremely reliant on the filling sequence. They offer a best-first technique in which confidence in synthesized pixel values is conveyed similarly to information propagation in inpainting. The actual color values are computed via exemplar-based synthesis.

Aishwarya et al. [3] proposes Visual 7W a dataset for picture captioning, acknowledgment and division. It produces multiple-choice questions of the shape (Who, What, Why, How and Which, Where, When). The Visual Madlibs dataset may be a fill-in-the-blanks or numerous choice dataset.

How many cats are there ?
1

Is there any dog ?
Yes

Is there any person ?
No

What does the image contain ?
cat dog

Haoyuan et al. [4] describes calculation for the concurrent filling-in of surface and structure in locale of lost picture information is presented in this paper. The elemental thought is to initially deteriorate the picture into the complete of two capacities with diverse fundamental characteristics, and a while later reproduce each single one of these capacities independently with structure and surface filling-in calculations. The primary capacity utilized within the rot is of restricted assortment, talking to the elemental picture structure, whereas the moment capacity catches the surface and conceivable

clamor. The range of lost information within the constrained assortment picture is replicated utilizing picture inpainting calculations, whereas a comparative range within the surface picture is filled-in with surface union methods.

Shuhui[5] et al. implements VQA by means of four modules: include extraction, address understanding, reply era and include sifting. The primary three modules offer assistance to get it pictures and address and give adjust answers. The forward module is connected to move forward exactness. Methods like normalization, BOW, verbose memory arrange can be utilized.

Huijuan [6] et al. proposes to utilize LSTM for address encoding, and a profound remaining organize for picture highlights computation. A fragile thought component is utilized to compute looks of picture highlights from LSTM state.

Bolei [7] et al. presents a novel co-attention demonstrate for VQA that models visual consideration ("where to look"), in expansion to address consideration ("what words to tune in to"). They reasons approximately the address (and the picture subsequently through the co-attention thought) progressively through a novel 1D CNN. The questions "how many dogs are in this image?" and "how many dogs can you see in this picture?".

Kevin [8] et al. addresses double VQA on theoretical scenes. The issue is defined as visual confirmation of concepts inquired within the questions. The address is summarized to a tuple that summarizes the visual concept to be distinguished within the picture. In the event that the concept is found within the picture, the reply is "yes", else "no".

• Proposed method

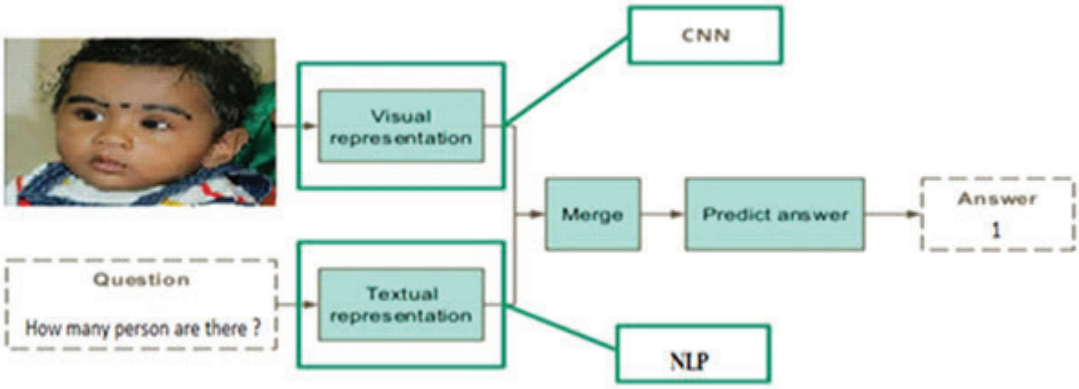
- *Visual Question Answering*

Text-based and visual question-answering systems are the two categories of question-answering systems. Consider the query "How many dogs are there?" in text-based question answering. The stages to answering a text-based question are as follows: 1. Classify or type the question: because this is a "how many" inquiry, the response must be a number. 2. Find the thing you want to count: dogs. To retrieve the response, the machine now creates a query and consults a knowledge base. The system under consideration is a visual question-answering system (see fig. 2).

Pre-processing, tokenization, and tagging of parts of speech (POS) are all phases in NLP. Stop words like a, an, and the like are eliminated during pre-processing. Tokenizing is the process of

dividing a text into tokens (words). Tags for nouns, verbs, adverbs, and other parts of speech are used to categorize each of these words. This is accomplished through the use of rule-based POS tagging. It makes advantage of information such as the preceding word, the following word, and whether the initial letter is capitalized, among others.

The following methods are used to determine if a sentence is a question or not: Check for terms like who, what, when, where, why, how, is, can, does, and do in the beginning of the phrase. If that's the case, look for a '?' at the conclusion of the text. We can categorize the text as a question if both requirements are met. We can now apply the following rule to see if the supplied token is a noun or not. 'Tag an unfamiliar word x as a noun if it is preceded by an article.' The suggested visual question answering system responds to inquiries such as how many, yes/no, and what the picture alone includes. As a result, the suggested system just needs to recognize the inquiry word and noun.[6]



To recognize objects in an image, we use Convolutional Neural Networks (CNN). It has 4 building blocks:

1) Convolution – identify and collect features from the given image.

2) Non-Linearity (ReLU) – helps to increase non-linearity in the image (because the majority of the knowledge the CNN would acquire in the real world would be non-linear)

$$ReLU = \max(x,0)$$

3) Pooling – decrement the spatial size of the representation and thus reduce computational cost

4) Fully-connected Layer - classifies images into various classes (bridge, people, dog, …)

The layers can be repeated several times.

This way, the CNN detects objects in an image.

• Results and analysis

- ***Results***

A sample image is fed to the visual question answering module in fig.4 (a). The task at hand is to identify the object in the image. The picture of a dog is recognized using a convolutional neural network. The proposed system uses Question from the Bag of Words: A bag-of-words representation is created using the top 1,000 words in the questions. We identify the top 10 first, second, and third words of the questions and generate a 30 dimensional bag-of-words representation since there is a high association between the words that start a question and the response. The question's 1,030-dim embedding is created by concatenating these characteristics.

- ***Evaluation Metric***

The suggested system's performance is rated on a scale of one to ten. The factors that were taken into account for qualitative evaluation are listed below.

1)Informativeness reflects the degree to which the system's responses are capable of giving relevant information.

2)Relevance assesses how well the responses are relevant to the topic and how well they fit into the right question category.

3)Semantic score is the degree to which the meaning of the question is taken into account or relates to the interpretation of the answer.

4)Correctness is a metric for determining the precision with which the system detects an object.

5)Overall score is a figure that determines the system's overall ranking based on its ease of use and dependability.

• Evaluation

For each group of questions, ten users were asked to assess the system based on the aforementioned qualitative aspects. Users were asked to rank on a scale of one to five, with five being the highest. For assessment, the average value is used. The following are the kind of queries that the system considers:

1) Questions with a two-part answer (yes/no)

2) Factual inquiries (What does image contain)

3) Quantitative questions (How many objects)

The assessment results for the various question categories are plotted in Fig.5 based on qualitative characteristics. On the basis of all qualitative characteristics, it can be seen that the system performs well for dichotomous problems. The performance of factual inquiries, on the other hand, shows a minor drop in informativeness. This is because the intention for factual queries is to include all facts and objects relevant to the image, which has not been fully achieved. Quantitative questions yielded good results as well. The drop in accuracy is due to the same reason: in some cases, the system does not completely cover all facts and objects. It can be observed that all three categories of semantic score and relevance factor were accomplished.

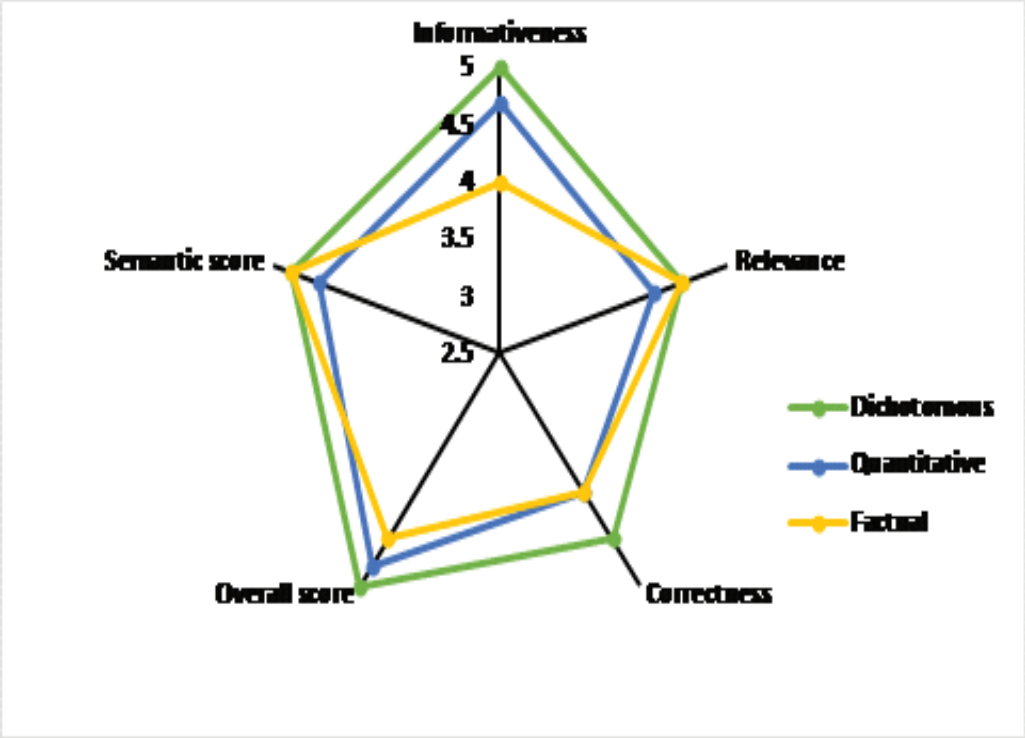


Fig 5. Evaluation on qualitative parameters for various question categories

- **Conclusion**

The goal of the research is to employ Convolutional neural networks and Natural language processing to answer visual questions. Object detection and identification are done with convolutional neural networks. Question answering is done via natural language processing. Qualitative analysis was carried out in order to identify an appropriate category of questions for the proposed system. To handle visual question answering difficulties, we created a model that learns to choose areas from an image. Learning to accomplish specific activities such as counting

or reading is one route for future career. Other options include incorporating and adapting pre-trained models for object and attribute detectors or geometric reasoning, as well as utilizing external information sources to assist in learning what is relevant to solve tough issues.

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Mathematical and Computational Applications

MDPI

Article

Odd Exponential-Logarithmic Family of Distributions: Features and Modeling

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Abstract: This paper introduces a general family of continuous distributions, based on the exponential-logarithmic distribution and the odd transformation. It is called the "odd exponential logarithmic family". We intend to create novel distributions with desired qualities for practical applications, using the unique properties of the exponential-logarithmic distribution as an initial inspiration. Thus, we present some special members of this family that stand out for the versatile shape properties of their corresponding functions. Then, a comprehensive mathematical treatment of the family is provided, including some asymptotic properties, the determination of the quantile function, a useful sum expression of the probability density function, tractable series expressions for the moments, moment generating function, Rényi entropy and Shannon entropy, as well as results on order statistics and stochastic ordering. We estimate the model parameters quite efficiently by the method of maximum likelihood, with discussions on the observed information matrix and a complete simulation study. As a major interest, the odd exponential logarithmic models reveal how to successfully accommodate various kinds of data. This aspect is demonstrated by using three practical data sets, showing that an odd exponential logarithmic model outperforms two strong competitors in terms of data fitting.

Keywords: exponential-logarithmic distribution; T-X transformation; moments; entropy; maximum likelihood estimation; simulation; data sciences

Citation: Chesneau, C.; Tomy, L.; Jose, M.; Jayamol, K.V. Odd Exponential-Logarithmic Family of Distributions: Features and Modeling. *Math. Comput. Appl.* **2022**, *27*, 68. https://doi.org/10.3390/mca27040068

Academic Editor: Sandra Ferreira

Received: 5 July 2022
Accepted: 4 August 2022
Published: 8 August 2022

1. Introduction

There has been a growing interest in defining new flexible distributions in the modern age, which has been submerged by the volume of data arriving from all disciplines. To define such mathematical objects, "thoroughly changing" a baseline (continuous) distribution is a straightforward and fast method. The addition of parameters has been shown to be useful in investigating tail properties as well as increasing the goodness-of-fit of the related models. Among the proposed distributions, the T-X family of continuous distributions (focds) by [1] is the most popular one. An exhaustive review of it can be found in [2]. Also, one of the most useful transformers for the T-X focds is the following odd transformation: $W[G(x;\Im)] = G(x;\Im)/[1-G(x;\Im)]$, where $G(x;\Im)$ denotes the cumulative density function (cdf) and $\Im$ the parameters of the cdf. That is, the focds defined by $G(x;\Im)$ is modified, defining a new focd based on a transformed cdf through the use of $W[G(x;\Im)]$. Such a transformed focds is generally called an "odd family" of distributions. Some odd families available in the modern literature are the odd log-logistic (OLL) focds by [3], odd-gamma generated type 3 (OGGT3) focds by [4], odd exponentiated generated (odd exp-G) focds by [5], odd Weibull generated (OW-G) focds by [6], odd generalized exponential (OGE) focds by [7], odd generalized exponential log-logistic (OGELL) focds by [8], odd log-logistic normal (OLLN) focds by [9], new generalized odd log-logistic (NGOLL) focds by [10], odd Fréchet generated (OF-G) focds by [11], generalized odd gamma generated (GOG-G)

focds by [12], generalized odd Lindley generated (GOL-G) focds by [13], Marshall-Olkin odd Lindley generated (MOOL-G) focds by [14], extended odd generated (EO-G) focds by [15], generalized odd inverted exponential generated (GOIE-G) focds by [16], odd flexible Weibull-H (OFW-H) family by [17], transmuted odd Fréchet generated (TOF-G) focds by [18], odd generalized gamma generated (OGG-G) focds by [19], modified odd Weibull generated (MOW-G) focds by [20], Topp-Leone odd Fréchet generated (TLOF-G) focds by [21], weighted odd Weibull generated (WOW-G) focds by [22], additive odd (AO) focds by [23], exponentiated odd Chen-G (EOC-G) focds by [24], generalized odd linear exponential (GOLE) focds by [25], and sine extended odd Fréchet generated (SEOF-G) focds by [26].

The new idea in this paper is centered around the notorious exponential-logarithmic (EL) distribution introduced by [27]. The EL distribution plays a fundamental role in reliability in several disciplines such as manufacturing, finance, biological sciences, and engineering. It is mathematically defined as follows. Let $p \in (0,1)$ and $\beta > 0$. Then, the EL distribution with parameters p and β is defined by the following cdf:

$$F_*(x;p,\beta) = 1 - \frac{1}{\log(p)} \log\left[1-(1-p)e^{-\beta x}\right], \quad x > 0. \tag{1}$$

Thus, it has the feature of combining exponential and logarithmic functions.
The related probability density function (pdf) is given by

$$f_*(x;p,\beta) = \left(\frac{1}{-\log(p)}\right) \frac{\beta(1-p)e^{-\beta x}}{1-(1-p)e^{-\beta x}}, \quad x > 0.$$

This pdf has the following notable properties: it is strictly decreasing with respect to x, it tends to zero as $x \to +\infty$, it is unimodal with a modal value at $x = 0$ and it is reduced to the pdf of the exponential distribution with rate parameter β as $p \to 1$. Also, as a complementary key function, the corresponding hazard rate function (hrf) is given by

$$h_*(x;p,\beta) = \frac{-\beta(1-p)e^{-\beta x}}{[1-(1-p)e^{-\beta x}]\log[1-(1-p)e^{-\beta x}]}, \quad x > 0.$$

It is proved to be decreasing (contrary to the former exponential distribution having a constant hrf). As an advantage for statistical analysis, the quantile function (qf) of the EL distribution has a closed-form expression; it is given by

$$Q_*(u;p,\beta) = \frac{1}{\beta} \log\left(\frac{1-p}{1-p^{1-u}}\right), \quad u \in [0,1).$$

Also, the EL distribution has a solid physical interpretation. Indeed, consider $T = (T_n)_{n\in\mathbb{N}^*}$ to be a sequence of independent and identically distributed random variables with an exponential distribution and a common parameter, β. Let N be a random variable following the discrete logarithmic distribution with parameter $1-p$, also independent of T. Then, the random variable $X = \inf(T_1, \ldots, T_N)$ follows the EL distribution with parameters p and β. As an example, such a random variable can model the lifetime of a system that failed when one of its components failed, assuming that it is dependent on a random number of independent components represented by N and that the lifetime of the i-th component is represented by T_i.

We leverage these characteristics of the EL distribution to create a new odd focds based on it. We present three special four-parameter distributions of the family that have very desirable statistical properties, such as versatile hazard rate shapes; increasing, decreasing, J, reversed-J, and bathtub shapes. Then, a complete mathematical treatment of the focds is derived, with several results on the pdf, moments, entropy (Rényi and Shannon entropy), order statistics, and stochastic ordering. By turning out some special distributions as models, we prove that they are more adequate to fit some data sets than

notable competitors, with the same or more numbers of parameters, and the same baseline distribution as well. We explain this success by the original exponential-logarithmic definitions of the corresponding functions, offering some ability in the modeling that can be reached by other families.

The paper is composed of the following sections. In Section 2, we introduce the odd exponential-logarithmic focds. We present some special distributions in Section 3. The mathematical properties of the focds are derived in Section 4. For the inferential aspect, the maximum likelihood method is discussed in Section 5. The analysis of two real data sets is presented to illustrate the modeling potential of the focds in Section 6. Finally, the conclusion of the paper appears in Section 7.

2. The New Family

The proposed focds, called the odd EL generated (OEL-G) focds, is characterized by the cdf given by

$$F(x;p,\beta,\Im) = 1 - \frac{1}{\log(p)}\log\left[1-(1-p)e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}\right], \quad x\in\mathbb{R}, \tag{2}$$

where $G(x;\Im)$ denotes the cdf of an absolutely continuous distribution based on a parameter vector denoted by $\Im$. We recall that $p \in (0,1)$. Its definition is based on the T-X transformation introduced by [1], the EL distribution previously presented and the odd transformation, i.e., we can write $F(x;p,\beta,\Im)$ as $F(x;p,\beta,\Im) = F_*(W[G(x;\Im)];p,\beta)$, where $F_*(y;p,\beta)$ is the cdf of the EL distribution given by (1) and $W(y)$ is the following odd transformation: $W(y) = y/(1-y)$. One can also notice some compounding relations between the OEL-G and the OW-G and Pappas and Loukas generated (PAL-G) families by [6,28], respectively. Indeed, we can write $F(x;p,\beta,\Im)$ as

$$F(x;p,\beta,\Im) = 1 - \frac{1}{\log(p)}\log[1-(1-p)S_o(x;\beta,\Im)],$$

where $S_o(x;\beta,\Im)$ denotes the survival function (sf) of the OW-G focds with parameters β and $\Im$, which also corresponds to the cdf of the PAL-G focds, with parameter p and the cdf of the OW-G focds as a baseline. However, to the best of our knowledge, the OEL-G focds as defined by (2) is new in the literature.

The sf of the OEL-G focds is given by $S(x;p,\beta,\Im) = 1 - F(x;p,\beta,\Im)$, hence

$$S(x;p,\beta,\Im) = \frac{1}{\log(p)}\log\left[1-(1-p)e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}\right], \quad x\in\mathbb{R},$$

The appropriate pdf is given by deriving $F(x;p,\beta,\Im)$ from x; we get

$$f(x;p,\beta,\Im) = \left(\frac{1}{-\log(p)}\right)\frac{g(x;\Im)}{[1-G(x;\Im)]^2}\frac{(1-p)\beta e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}}{1-(1-p)e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}}, \quad x\in\mathbb{R}, \tag{3}$$

where $g(x;\Im)$ refers to the pdf related to $G(x;\Im)$.

Also, the hrf of the OEL-G focds is specified by $h(x;p,\beta,\Im) = f(x;p,\beta,\Im)/S(x;p,\beta,\Im)$, hence

$$h(x;p,\beta,\Im) = \frac{g(x;\Im)}{[1-G(x;\Im)]^2}\frac{-(1-p)\beta e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}}{\left[1-(1-p)e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}\right]\log\left[1-(1-p)e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}\right]}, \quad x\in\mathbb{R}.$$

These two last functions are crucial to handling some statistical features of the OEL-G focds, such as the possible adequateness of the related models to various kinds of data.

3. Special Distributions

Three special four-parameter distributions of the OEL-G focds are described in this section, all defined with well-established baseline distributions, namely: the Weibull, gamma, and Fréchet distributions.

3.1. The OELW Distribution

The OEL Weibull (OELW) distribution is now introduced. It is defined by the cdf given by (2) with the Weibull distribution as baseline distribution, i.e., with the cdf given by $G(x;a,b) = 1 - e^{-(x/b)^a}$ and the pdf given by $g(x;a,b) = (a/b)(x/b)^{a-1}e^{-(x/b)^a}$, $a,b,x > 0$. When $x \leq 0$, the cdf and pdf are equal to 0. Thus, the cdf of the OELW distribution is given by

$$F(x;p,\beta,a,b) = 1 - \frac{1}{\log(p)} \log\left[1 - (1-p)e^{-\beta\left\{e^{(\frac{x}{b})^a}-1\right\}}\right], \quad x > 0.$$

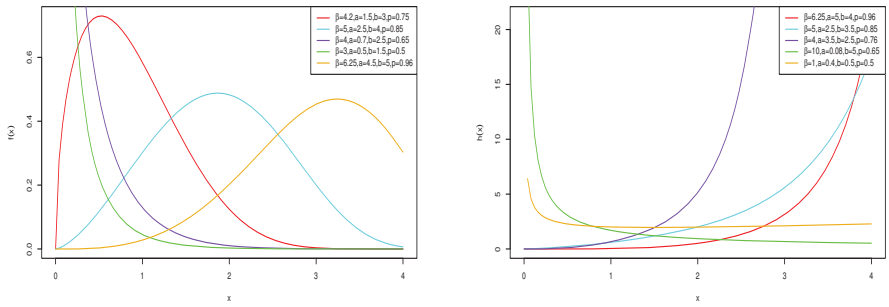
In this setting, the pdf is expressed as

$$f(x;p,\beta,a,b) = \left(\frac{1}{-\log(p)}\right)\frac{a}{b}\left(\frac{x}{b}\right)^{a-1} e^{(\frac{x}{b})^a} \frac{(1-p)\beta e^{-\beta\left\{e^{(\frac{x}{b})^a}-1\right\}}}{1-(1-p)e^{-\beta\left\{e^{(\frac{x}{b})^a}-1\right\}}}, \quad x > 0.$$

The hrf is obtained as

$$h(x;p,\beta,a,b) = \frac{a}{b}\left(\frac{x}{b}\right)^{a-1} e^{(\frac{x}{b})^a} \frac{-(1-p)\beta e^{-\beta\left\{e^{(\frac{x}{b})^a}-1\right\}}}{\left[1-(1-p)e^{-\beta\left\{e^{(\frac{x}{b})^a}-1\right\}}\right]\log\left[1-(1-p)e^{-\beta\left\{e^{(\frac{x}{b})^a}-1\right\}}\right]}, \quad x > 0.$$

The functions above are equal to 0 when $x \leq 0$. As graphical illustrations, Figure 1 shows some plots of $f(x;p,\beta,a,b)$ and $h(x;p,\beta,a,b)$, for selected values of the parameters p, β, a and b. These plots show that the pdf of the OELW distribution has a great shape flexibility. It can be left skewed, right skewed, J-shaped, reversed J-shape, and symmetric. Furthermore, the corresponding hrf can be increasing, decreasing, J, or bathtub in shape.



(**a**) (**b**)

Figure 1. Examples of plots of the (**a**) pdf and (**b**) hrf of the OELW distribution for various values of p, β, a and b.

The applicability of the OLEW distribution will be highlighted in the application part of the paper (see Section 6).

3.2. Two Other Examples

To show other perspectives of lifetime modeling, two other special cases are briefly described below.

3.2.1. The OELGa Distribution

We now introduce the OEL gamma (OELGa) distribution. It is defined by the cdf given by (2) with the gamma distribution as baseline distribution, i.e., with the cdf given by $G(x;a,b) = (1/\Gamma(a))\gamma(a,bx)$ and the pdf given by $g(x;a,b) = (b^a/\Gamma(a))x^{\alpha-1}e^{-bx}$, $a,b,x>0$, where $\Gamma(a) = \int_0^{+\infty} t^{a-1}e^{-t}dt$ and $\gamma(a,bx) = \int_0^{bx} t^{a-1}e^{-t}dt$. When $x \leq 0$, the cdf and pdf are equal to 0. So, the cdf of the OELGa distribution is given by

$$F(x;p,\beta,a,b) = 1 - \frac{1}{\log(p)}\log\left[1-(1-p)e^{-\beta\frac{\gamma(a,bx)}{\Gamma(a)-\gamma(a,bx)}}\right], \quad x>0.$$

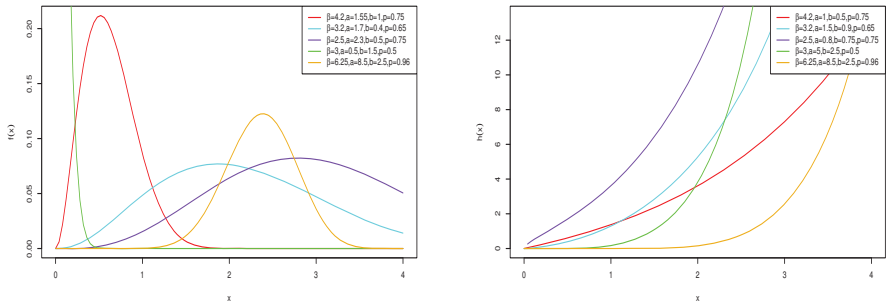
The related pdf is given as

$$f(x;p,\beta,a,b) = \left(\frac{1}{-\log(p)}\right)b^a x^{\alpha-1}e^{-bx}\frac{\gamma(a,bx)}{[\Gamma(a)-\gamma(a,bx)]^2}\frac{(1-p)\beta e^{-\beta\frac{\gamma(a,bx)}{\Gamma(a)-\gamma(a,bx)}}}{1-(1-p)e^{-\beta\frac{\gamma(a,bx)}{\Gamma(a)-\gamma(a,bx)}}}, \quad x>0.$$

The hrf is given by

$$h(x;p,\beta,a,b) = b^a x^{\alpha-1}e^{-bx}\frac{\gamma(a,bx)}{[\Gamma(a)-\gamma(a,bx)]^2}\times \frac{-(1-p)\beta e^{-\beta\frac{\gamma(a,bx)}{\Gamma(a)-\gamma(a,bx)}}}{\left[1-(1-p)e^{-\beta\frac{\gamma(a,bx)}{\Gamma(a)-\gamma(a,bx)}}\right]\log\left[1-(1-p)e^{-\beta\frac{\gamma(a,bx)}{\Gamma(a)-\gamma(a,bx)}}\right]}, \quad x>0.$$

The functions above are equal to 0 when $x \leq 0$. Figure 2 shows some plots of $f(x;p,\beta,a,b)$ and $h(x;p,\beta,a,b)$, for selected values of the parameters p, β, a and b. The plots indicate that the pdf of the OELGa distribution can be reverse J-shaped, symmetric, right skewed, left-skewed, and unimodal, whereas the hrf of the OELGa has J and increasing shapes.



(**a**) (**b**)

Figure 2. Examples of plots of the (**a**) pdf and (**b**) hrf of the OELGa distribution for various values of p, β, a and b.

3.2.2. The OELF Distribution

We now introduce the OEL Fréchet (OELF) distribution. It is defined by the cdf given by (2) with the Fréchet distribution as baseline distribution, i.e., with the cdf given by $G(x;a,b) = e^{-(x/b)^{-a}}$ and the pdf given by $g(x;a,b) = (a/b)(x/b)^{-a-1}e^{-(x/b)^{-a}}$, $a,b,x>0$. When $x \leq 0$, the cdf and pdf are equal to 0. Hence, the cdf of the OELF distribution is given by

$$F(x;p,\beta,a,b) = 1 - \frac{1}{\log(p)}\log\left[1-(1-p)e^{-\beta\frac{e^{-(\frac{x}{b})^{-a}}}{1-e^{-(\frac{x}{b})^{-a}}}}\right], \quad x>0.$$

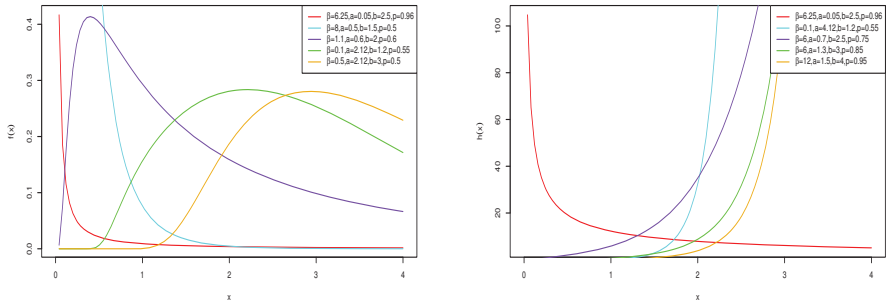
The pdf can be deduced as

$$f(x;p,\beta,a,b)=\left(\frac{1}{-\log(p)}\right)\frac{a}{b}\left(\frac{x}{b}\right)^{-a-1}\frac{e^{-\left(\frac{x}{b}\right)^{-a}}}{[1-e^{-\left(\frac{x}{b}\right)^{-a}}]^2}\frac{(1-p)\beta e^{-\beta\frac{e^{-\left(\frac{x}{b}\right)^{-a}}}{1-e^{-\left(\frac{x}{b}\right)^{-a}}}}}{1-(1-p)e^{-\beta\frac{e^{-\left(\frac{x}{b}\right)^{-a}}}{1-e^{-\left(\frac{x}{b}\right)^{-a}}}}},\quad x>0.$$

The hrf is expressed as

$$h(x;p,\beta,a,b)=\frac{a}{b}\left(\frac{x}{b}\right)^{-a-1}\frac{e^{-\left(\frac{x}{b}\right)^{-a}}}{[1-e^{-\left(\frac{x}{b}\right)^{-a}}]^2}\times$$
$$\frac{-(1-p)\beta e^{-\beta\frac{e^{-\left(\frac{x}{b}\right)^{-a}}}{1-e^{-\left(\frac{x}{b}\right)^{-a}}}}}{\left[1-(1-p)e^{-\beta\frac{e^{-\left(\frac{x}{b}\right)^{-a}}}{1-e^{-\left(\frac{x}{b}\right)^{-a}}}}\right]\log\left[1-(1-p)e^{-\beta\frac{e^{-\left(\frac{x}{b}\right)^{-a}}}{1-e^{-\left(\frac{x}{b}\right)^{-a}}}}\right]},\quad x>0.$$

The functions above are equal to 0 when $x \leq 0$. Figure 3 shows some plots of $f(x;p,\beta,a,b)$ and $h(x;p,\beta,a,b)$, for selected values of the parameters p, β, a and b. The plots indicate that the OELF distribution can be reverse J-shaped, right skewed, left-skewed, and unimodal. On the other hand, the corresponding hrf has decreasing, increasing, J, reverse J- shapes.



(**a**) (**b**)

Figure 3. Examples of plots of the (**a**) pdf and (**b**) hrf of the OELF distribution for various values of p, β, a and b.

4. Mathematical Features

This section is devoted to some mathematical properties of the OEL-G focds. In the following, it is assumed that the criterion for interchanging summation and integration and the criterion for interchanging summation and differentiation are satisfied. Also, let us mention that most of the presented formulas can be handled in standard mathematical software (Mathematica, Maple, ...).

4.1. Asymptotic Results

Here, we investigate some asymptotic results of the pdf and hrf of the OEL-G focds. First of all, as $x \to -\infty$ (or $G(x;\Im) \to 0$), we have

$$f(x;p,\beta,\Im)\sim\left(\frac{1-p}{-p\log(p)}\right)\beta g(x;\Im),\quad h(x;p,\beta,\Im)\sim\left(\frac{1-p}{-p\log(p)}\right)\beta g(x;\Im).$$

When $x \to +\infty$ (or $G(x;\Im) \to 1$), we have

$$f(x;p,\beta,\Im) \sim \left(\frac{1-p}{-\log(p)}\right)\beta\frac{g(x;\Im)}{[1-G(x;\Im)]^2}e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}, \quad h(x;p,\beta,\Im) \sim \beta\frac{g(x;\Im)}{[1-G(x;\Im)]^2}.$$

We thus see the role of the parameters β and p in the possible asymptotes for these functions. In particular, when $x \to +\infty$, we see that β has large impact on the convergence of $f(x;p,\beta,\Im)$ due to the exponential term, whereas p has no effect on the limit of $h(x;p,\beta,\Im)$. Also, the function $u(p) = (1-p)/[-p\log(p)]$ appearing multiple times is decreasing in p and convex, with $\lim_{p\to 0} u(p) = +\infty$ and $\lim_{p\to 1} u(p) = 0$.

4.2. Shapes of the pdf and hrf

The shapes of the pdf and hrf of the OEL-G focds can be described analytically. The critical point(s) of the pdf (also called mode(s)) of the OEL-G focds is(are) the root(s) of the following equation: $d[\log(f(x;p,\beta,\Im))]/dx = 0$, i.e.,

$$\frac{dg(x;\Im)/dx}{g(x;\Im)} + 2\frac{g(x;\Im)}{1-G(x;\Im)} - \beta\frac{g(x;\Im)}{[1-G(x;\Im)]^2}\frac{1}{\left[1-(1-p)e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}\right]} = 0.$$

Similarly, the critical point(s) of the hrf of the OEL-G focds is(are) the root(s) of the following equation: $d[\log(h(x;p,\beta,\Im))]/dx = 0$, i.e.,

$$\frac{dg(x;\Im)/dx}{g(x;\Im)} + 2\frac{g(x;\Im)}{1-G(x;\Im)} - \beta\frac{g(x;\Im)}{[1-G(x;\Im)]^2}\frac{1}{\left[1-(1-p)e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}\right]} \times$$
$$\left(1 + (1-p)\frac{e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}}{\log\left[1-(1-p)e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}\right]}\right) = 0.$$

Mathematical software (R, Python, Mathematica, ...) can be used to solve these two equations and determine whether the critical points are local maximums, minimums, or inflexion points for a given cdf $G(x;\Im)$. It is the case for the proposed OELW, OELGa, and OELF distributions, where the equations above have no analytical solutions. For them, Figures 1–3, are informative on their global mode properties; these special distributions can be unimodal, with various hrf shapes.

4.3. Quantile Function

The qf of the OEL-G focds, say $Q(u;p,\beta,\Im)$, satisfies the following functional equation: $F(Q(u;p,\beta,\Im);p,\beta,\Im)) = Q(F(u;p,\beta,\Im);p,\beta,\Im)) = u$, $u \in (0,1)$. After some algebraic manipulations, we get

$$Q(u;p,\beta,\Im) = Q_G\left(\frac{\log\left(\frac{1-p}{1-p^{1-u}}\right)}{\beta + \log\left(\frac{1-p}{1-p^{1-u}}\right)};\Im\right) \quad u \in (0,1), \tag{4}$$

where $Q_G(u;\Im)$ denotes the qf related to $G(x;\Im)$. As a result, with appropriate values of u, quantiles of interest can be obtained. In particular, the median is reduced to

$$M = Q(0.5;p,\beta,\Im) = Q_G\left(\frac{\log(1+\sqrt{p})}{\beta + \log(1+\sqrt{p})};\Im\right).$$

One can also use the quantile function for simulating values for a special OEL-G distribution. For any random variable U with the standard uniform distribution, $X = Q(U; p, \beta, \Im)$ has the cdf given by (2).

4.4. Expansions of the cdf and pdf

The cdf and pdf of the OEL-G focds are expressed here using exp-G cdfs and pdfs as defined by [29]. Then, the structural properties of the exp-G focds can be used to derive those of the OEL-G focds.

The following result is about the series expansion of the cdf.

Proposition 1. *Let $F(x; p, \beta, \Im)$ be the cdf given by (2). Then, assuming that $G(x; \Im) \in (0, 1)$, the following series expansion is valid:*

$$F(x; p, \beta, \Im) = \sum_{k,\ell=1}^{+\infty} \sum_{m=0}^{+\infty} a_{k,\ell,m} G(x; \Im)^{\ell+m},$$

where

$$a_{k,\ell,m} = \frac{1}{\log(p)} (-1)^{\ell+m} \binom{-\ell}{m} \frac{1}{k} \frac{1}{\ell!} (1-p)^k \beta^\ell k^\ell. \tag{5}$$

Proof. It follows from the Taylor theorem applied to the logarithmic function that $\log(1-x) = -\sum_{k=1}^{+\infty} \frac{1}{k} x^k$, $x \in (-1, 1)$, and some sum manipulations, that

$$\begin{aligned} F(x; p, \beta, \Im) &= 1 + \frac{1}{\log(p)} \sum_{k=1}^{+\infty} \frac{1}{k} (1-p)^k e^{-\beta k \frac{G(x;\Im)}{1-G(x;\Im)}} \\ &= \frac{1}{\log(p)} \sum_{k=1}^{+\infty} \frac{1}{k} (1-p)^k \left[e^{-\beta k \frac{G(x;\Im)}{1-G(x;\Im)}} - 1 \right]. \end{aligned}$$

For the term in brackets, the Taylor theorem applied to the exponential function, i.e., $e^x = \sum_{k=0}^{+\infty} \frac{1}{k!} x^k$, $x \in \mathbb{R}$, gives

$$e^{-\beta k \frac{G(x;\Im)}{1-G(x;\Im)}} - 1 = \sum_{\ell=1}^{+\infty} \frac{1}{\ell!} (-1)^\ell \beta^\ell k^\ell G(x; \Im)^\ell [1 - G(x; \Im)]^{-\ell}.$$

Now, the generalized binomial theorem, i.e., $(1-x)^v = \sum_{k=0}^{+\infty} \binom{v}{k} (-1)^k x^k$, $x \in (-1, 1)$, $v \in \mathbb{R}$, gives

$$[1 - G(x; \Im)]^{-\ell} = \sum_{m=0}^{+\infty} \binom{-\ell}{m} (-1)^m G(x; \Im)^m.$$

By combining all of the foregoing equalities, we get the desired result. The proof of Proposition 1 is now complete. □

Corollary 1. *Owing to Proposition 1, upon differentiation of the involved functions, a series expansion for $f(x; p, \beta, \Im)$ is given by*

$$f(x; p, \beta, \Im) = \sum_{k,\ell=1}^{+\infty} \sum_{m=0}^{+\infty} b_{k,\ell,m} g(x; \Im) G(x; \Im)^{\ell+m-1},$$

where $b_{k,\ell,m} = (\ell + m) a_{k,\ell,m}$.

In comparison to the former analytical definition, for practical purposes (integration…), the expression of $f(x;p,\beta,\Im)$ in Corollary 1 can be more easy to handle through the following approximation:

$$f(x;p,\beta,\Im) \approx \sum_{k,\ell=1}^{M}\sum_{m=0}^{M} b_{k,\ell,m}\, g(x;\Im)G(x;\Im)^{\ell+m-1},$$

where M is a carefully chosen number.

4.5. Moments

Hereafter, we denote by X a random variable having the cdf of the OEL-G focds given by (2). Corollary 1 can be used to have a tractable expression for the moments of X, among other things. Indeed, for any integer r, the rth moment of X is given by

$$\mu'_r = E(X^r) = \int_{-\infty}^{+\infty} x^r f(x;p,\beta,\Im)dx = \sum_{k,\ell=1}^{+\infty}\sum_{m=0}^{+\infty} b_{k,\ell,m}\,\tau_{\ell,m,r},$$

where $\tau_{\ell,m,r} = \int_{-\infty}^{+\infty} x^r g(x;\Im)G(x;\Im)^{\ell+m-1}dx = \int_0^1 u^{\ell+m-1}[Q_G(u;\Im)]^r du$. For a given $G(x;\Im)$, this integral can be calculated or computed numerically. We refer to [30], where $\tau_{\ell,m,r}$ has been determined for some standard distributions (normal, beta, Weibull …). For practical purposes, another remark concerns the infinity limit in the sums; as mentioned before, it can be substituted by a large positive integer.

As usual, the mean of X is obtained directly by $\mu = \mu'_1$. Also, the variance of X can be calculated using the following formula: $\sigma^2 = \mu'_2 - \mu^2$.

In a similar vein, for $y \in \mathbb{R}$, the rth incomplete moment of X is given by

$$\mu'_r(y) = E(X^r 1_{\{X\le y\}}) = \int_{-\infty}^{y} x^r f(x;p,\beta,\Im)dx = \sum_{k,\ell=1}^{+\infty}\sum_{m=0}^{+\infty} b_{k,\ell,m}\,\tau_{\ell,m,r}(y),$$

where $\tau_{\ell,m,r}(y) = \int_{-\infty}^{y} x^r g(x;\Im)G(x;\Im)^{\ell+m-1}dx = \int_0^{G(y;\Im)} u^{\ell+m-1}[Q_G(u;\Im)]^r du$. Then, one can express the mean deviations about the mean and about the median, as well as Bonferroni and Lorenz curves, which play a central role in life testing, reliability, and renewal theory.

Similarly, the moment generating function of X is given by

$$M(t) = E(e^{tX}) = \int_{-\infty}^{+\infty} e^{tx} f(x;p,\beta,\Im)dx = \sum_{k,\ell=1}^{+\infty}\sum_{m=0}^{+\infty} b_{k,\ell,m}\,\upsilon_{\ell,m}(t),$$

where $\upsilon_{\ell,m}(t) = \int_{-\infty}^{+\infty} e^{tx} g(x;\Im)G(x;\Im)^{\ell+m-1}dx = \int_0^1 u^{\ell+m-1}e^{tQ_G(u;\Im)}du$.

4.6. Skewness and Kurtosis

The skewness and kurtosis properties of the OEL-G focds can be explored via the four first moments or the use of the qf given by (4). The main measures defined by moments are the skewness and kurtosis parameters defined by

$$S = E\left[\left(\frac{X-\mu}{\sigma}\right)^3\right] = \frac{\mu'_3 - 3\mu'_2\mu + 2\mu^3}{\sigma^3}$$

and

$$K = E\left[\left(\frac{X-\mu}{\sigma}\right)^4\right] = \frac{\mu'_4 - 4\mu'_3\mu + 6\mu'_2\mu^2 - 3\mu^4}{\sigma^4}.$$

They can be expressed for a given baseline cdf $G(x;\Im)$.

Alternatively, if the moments do not exist (or in full generality), one can consider the measures defined with the qf. Examples are the Bowley skewness and the Moors kurtosis defined by, respectively,

$$S_* = \frac{Q(\frac{1}{4}; p, \beta, \Im) + Q(\frac{3}{4}; p, \beta, \Im) - 2Q(\frac{1}{2}; p, \beta, \Im)}{Q(\frac{3}{4}; p, \beta, \Im) - Q(\frac{1}{4}; p, \beta, \Im)},$$

and

$$K_* = \frac{Q(\frac{7}{8}; p, \beta, \Im) - Q(\frac{5}{8}; p, \beta, \Im) + Q(\frac{3}{8}; p, \beta, \Im) - Q(\frac{1}{8}; p, \beta, \Im)}{Q(\frac{6}{8}; p, \beta, \Im) - Q(\frac{2}{8}; p, \beta, \Im)}.$$

We refer to [31,32] for more information on these quantile measures.

Table 1 provides the mean, variance, skewness S and kurtosis K (defined with the moments) of one of the members of the OEL-G focds, the OELW distribution, for different choices of parameter values.

Table 1. Moment measures of the OELW distribution for various choices of parameters.

Parameter	Mean	Variance	Skewness	Kurtosis
$a = 0.5$ $b = 1.5$ $\beta = 3$ $p = 0.5$	0.1375667	0.05076667	12.77926	21.5475
$a = 0.5$ $b = 1.5$ $\beta = 3$ $p = 0.05$	0.06894464	0.03067229	27.02119	42.1311
$a = 0.5$ $b = 1.5$ $\beta = 3$ $p = 0.012$	0.04940314	0.02260463	38.03328	57.77719
$a = 0.5$ $b = 2$ $\beta = 0.3$ $p = 0.2$	1.324836	6.267231	8.523013	13.13688
$a = 0.5$ $b = 0.02$ $\beta = 30$ $p = 0.012$	7.938928×10^{-8}	1.69951×10^{-10}	26,964.99	26,960.99
$a = 0.5$ $b = 5$ $\beta = 6.25$ $p = 0.96$	0.1737497	0.09645452	15.83522	27.64176

Table 1 indicates that, for fixed a, b and β, the mean and variance of the OELW distribution are decreasing functions with respect to p. Also, the OELW distribution tends to be skewed more to the right as p decreases.

4.7. Entropy

Entropy is a measure of the variation of uncertainty that finds numerous applications in various areas such as engineering, mathematical physics, and probability. One of the most famous useful entropy measures is the Rényi entropy, introduced by [33] and the

Shannon entropy by [34]. In the context of the OEL-G focds, the Rényi entropy of X is defined by

$$I_\delta(X) = \frac{1}{1-\delta}\log\left[\int_{-\infty}^{+\infty} f(x;p,\beta,\Im)^\delta dx\right],$$

where $\delta > 0$ and $\delta \neq 1$. As an alternative to direct computation, we now present an expression that depends on a tractable series expansion. In this regard, let us present and prove the following proposition, which can be viewed as an extension of Corollary 1.

Proposition 2. *Let $\delta \in \mathbb{R}$ and $f(x;p,\beta,\Im)$ be the pdf given by (3). Then, the following series expansion is valid:*

$$f(x;p,\beta,\Im)^\delta = \sum_{k,\ell,m=0}^{+\infty} c_{k,\ell,m}(\delta)\, g(x;\Im)^\delta G(x;\Im)^{\ell+m},$$

where

$$c_{k,\ell,m}(\delta) = \left(\frac{1}{-\log(p)}\right)^\delta \binom{-\delta}{k}\binom{-(2\delta+\ell)}{m}(-1)^{k+\ell+m}\frac{1}{\ell!}(1-p)^{\delta+k}\beta^{\delta+\ell}(\delta+k)^\ell.$$

Proof. We have

$$f(x;p,\beta,\Im)^\delta = \left(\frac{1}{-\log(p)}\right)^\delta \frac{g(x;\Im)^\delta}{[1-G(x;\Im)]^{2\delta}} \frac{(1-p)^\delta\beta^\delta e^{-\delta\beta\frac{G(x;\Im)}{1-G(x;\Im)}}}{\left[1-(1-p)e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}\right]^\delta}.$$

The generalized binomial formula demonstrates that

$$\left[1-(1-p)e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}\right]^{-\delta} = \sum_{k=0}^{+\infty}\binom{-\delta}{k}(-1)^k(1-p)^k e^{-k\beta\frac{G(x;\Im)}{1-G(x;\Im)}}.$$

By the Taylor series of the exponential function, we get

$$e^{-(\delta+k)\beta\frac{G(x;\Im)}{1-G(x;\Im)}} = \sum_{\ell=0}^{+\infty}\frac{1}{\ell!}(-1)^\ell(\delta+k)^\ell\beta^\ell G(x;\Im)^\ell[1-G(x;\Im)]^{-\ell}.$$

Furthermore, the generalized binomial formula gives

$$[1-G(x;\Im)]^{-(2\delta+\ell)} = \sum_{m=0}^{+\infty}\binom{-(2\delta+\ell)}{m}(-1)^m G(x;\Im)^m.$$

By combining all of the aforementioned equality, we get the desired result. □

As a direct application of Proposition 2, the Rényi entropy is given by

$$I_\delta(X) = \frac{1}{1-\delta}\log\left[\sum_{k,\ell,m=0}^{+\infty} c_{k,\ell,m}(\delta)\int_{-\infty}^{+\infty} g(x;\Im)^\delta G(x;\Im)^{\ell+m}dx\right].$$

On the other side, the Shannon entropy of X is defined by

$$\eta(X) = -E\{\log[f(X;p,\beta,\Im)]\}.$$

It can be determined via the limit result: $\eta(X) = \lim_{\delta\to 1} I_\delta(X)$. However, this limit is not easy to handle. Some sum expressions can also be proved as an alternative. Indeed, we have

$$\eta(X) = -\log\left[\frac{1}{-\log(p)}\right] - \log(1-p) - \log(\beta) - E\{\log[g(X;\Im)]\} + 2E\{\log[1-G(X;\Im)]\}$$
$$+ \beta E\left[\frac{G(X;\Im)}{1-G(X;\Im)}\right] - \log(p)\{E[F(X;p,\beta,\Im)] - 1\}.$$

Now, by using Corollary 1, we have

$$E\{\log[g(X;\Im)]\} = \sum_{k,\ell=1}^{+\infty}\sum_{m=0}^{+\infty} b_{k,\ell,m}\kappa_{\ell,m},$$

where $\kappa_{\ell,m} = \int_{-\infty}^{+\infty} \log[g(x;\Im)]g(x;\Im)G(x;\Im)^{\ell+m-1}dx = \int_0^1 \log[g(Q_G(u;\Im);\Im)]u^{\ell+m-1}dx$.

By using the Taylor series of the logarithmic function, we have

$$E\{\log[1-G(X;\Im)]\} = -\sum_{i=1}^{+\infty}\frac{1}{i}E\Big[G(X;\Im)^i\Big].$$

By using the geometric series, it comes

$$E\left[\frac{G(X;\Im)}{1-G(X;\Im)}\right] = \sum_{i=0}^{+\infty} E\Big[G(X;\Im)^{i+1}\Big].$$

By using Proposition 1, we have

$$E[F(X;p,\beta,\Im)] = \sum_{k,\ell=1}^{+\infty}\sum_{m=0}^{+\infty} a_{k,\ell,m}E\Big[G(X;\Im)^{\ell+m}\Big].$$

All the terms involving the expectation of exponentiated $G(X;\Im)$ are expressible by using the following results. For any $\zeta \geq 0$, by Corollary 1, we have

$$E\Big[G(X;\Im)^{\zeta}\Big] = \sum_{k,\ell=1}^{+\infty}\sum_{m=0}^{+\infty} b_{k,\ell,m}\int_{-\infty}^{+\infty} g(x;\Im)G(x;\Im)^{\zeta+\ell+m-1}dx$$
$$= \sum_{k,\ell=1}^{+\infty}\sum_{m=0}^{+\infty} b_{k,\ell,m}\frac{1}{\zeta+\ell+m}.$$

By putting all the above equalities together, we get a tractable expression for the Shannon entropy, and possible approximations can be derived for practical purposes.

4.8. Order Statistics

The following result concerns a distributional property of a mth order statistic related to the OEL-G focds.

Proposition 3. *Let $X_1, \ldots, X_n$ be a random sample of size n from X and $X_{m:n}$ be the corresponding mth order statistic, i.e., the mth random variable satisfying the inequalities $X_{1:n} \leq X_{2:n} \leq \ldots X_{m:n} \leq \ldots \leq X_{n:n}$, almost surely. The pdf of $X_{m:n}$ is then linearly represented in terms of pdfs of the exp-G focds.*

Proof. By definition, the pdf of $X_{m:n}$ is given by

$$f_{m:n}(x;p,\beta,\Im) = \frac{n!}{(m-1)!(n-m)!}F(x;p,\beta,\Im)^{m-1}[1-F(x;p,\beta,\Im)]^{n-m}f(x;p,\beta,\Im).$$

Owing to the binomial formula, we can write

$$f_{m:n}(x;p,\beta,\Im) = \frac{n!}{(m-1)!(n-m)!}\sum_{d=0}^{m-1}\binom{m-1}{d}(-1)^d[1-F(x;p,\beta,\Im)]^{d+n-m}f(x;p,\beta,\Im).$$

It follows from Corollary 1 that $f(x;p,\beta,\Im)$ can be expressed as a sum of pdfs of the exp-G focds. As a result, the proof concludes by demonstrating that $[1-F(x;p,\beta,\Im)]^{d+n-m}$ can be expressed as a sum of cdfs of the exp-G focds, by exploiting the fact that the multiplication of a pdf and a cdf of the exp-G focds is a pdf of the exp-G focds, up to a constant factor. We have

$$[1-F(x;p,\beta,\Im)]^{d+n-m} = \left(\frac{1}{-\log(p)}\right)^{d+n-m}\left\{-\log\left[1-(1-p)e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}\right]\right\}^{d+n-m}.$$

By the Taylor series of the integer power of the logarithmic function (see, for instance, http://functions.wolfram.com/ElementaryFunctions/Log/06/01/04/03/, accessed on 4 July 2022), we have

$$\begin{aligned}&\left\{-\log\left[1-(1-p)e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}\right]\right\}^{d+n-m}\\ &= (d+n-m)\sum_{k=0}^{+\infty}\sum_{j=0}^{k}\binom{k-(d+n-m)}{k}\binom{k}{j}(-1)^{j+k}\frac{1}{d+n-m-j}\times\\ &u_{j,k}(1-p)^{d+n-m+k}e^{-(d+n-m+k)\beta\frac{G(x;\Im)}{1-G(x;\Im)}},\end{aligned}$$

where $u_{j,k}$ can be determined recursively by $u_{j,0}=1$ and, for $k\in\mathbb{N}^*$,

$$u_{j,k} = \frac{1}{k}\sum_{s=1}^{k}[k-s(j+1)]\frac{(-1)^{s+1}}{s+1}u_{j,k-s}.$$

We will now proceed in the same manner that we did in the proof of Proposition 1. The Taylor theorem applied to the exponential function gives

$$e^{-(d+n-m+k)\beta\frac{G(x;\Im)}{1-G(x;\Im)}} = \sum_{\ell=0}^{+\infty}\frac{1}{\ell!}(-1)^\ell\beta^\ell(d+n-m+k)^\ell G(x;\Im)^\ell[1-G(x;\Im)]^{-\ell}.$$

It follows from the general binomial theorem that

$$[1-G(x;\Im)]^{-\ell} = \sum_{m=0}^{+\infty}\binom{-\ell}{m}(-1)^m G(x;\Im)^m.$$

By combining the aforementioned equalities, we arrive at

$$[1-F(x;p,\beta,\Im)]^{d+n-m} = \sum_{k,\ell,m=0}^{+\infty}w_{k,\ell,m}G(x;\Im)^{\ell+m},$$

where

$$\begin{aligned}w_{k,\ell,m} = &\left(\frac{1}{-\log(p)}\right)^{d+n-m}(d+n-m)\sum_{j=0}^{k}\binom{k-(d+n-m)}{k}\binom{k}{j}\binom{-\ell}{m}(-1)^{j+k+\ell+m}\times\\ &\frac{1}{d+n-m-j}u_{j,k}(1-p)^{d+n-m+k}\frac{1}{\ell!}\beta^\ell(d+n-m+k)^\ell.\end{aligned}$$

We thus have a linear representation of $[1-F(x;p,\beta,\Im)]^{d+n-m}$ in terms of cdfs of the exp-G focds, ending the proof of Proposition 3. □

Thanks to Proposition 3, one can determine various mathematical properties for the mth order statistic, such as moments, incomplete moments, entropy, and so on.

4.9. Stochastic Ordering

Here, a stochastic ordering result involving the OEL-G focds is investigated. First of all, some elementary relations are presented below. The complete theory can be found in [35]. Let X_1 and X_2 be two random variables having the sfs and pdfs given by $S_1(x)$ and $S_2(x)$, and $f_1(x)$ and $f_2(x)$, respectively. Then, X_1 is said to be "smaller than X_2" in the following senses:

1. stochastic order, denoted by $X_1 \leq_{st} X_2$, if $S_1(x) \leq S_2(x)$ for all x,
2. hazard rate order, denoted by $X_1 \leq_{hr} X_2$, if $S_1(x)/S_2(x)$ is decreasing in x,
3. likelihood ratio order, denoted by $X_1 \leq_{lr} X_2$, if $f_1(x)/f_2(x)$ is decreasing in x.

Then, we have the following implications:

$$(X_1 \leq_{lr} X_2) \Rightarrow (X_1 \leq_{hr} X_2) \Rightarrow (X_1 \leq_{st} X_2).$$

A stochastic ordering result on the OEL-G focds is presented below.

Proposition 4. *Let X_1 having the cdf given by (2) with $p = p_1$ and X_2 having the cdf given by (2) with $p = p_2$. Then, if $p_1 \leq p_2$, we have $X_1 \leq_{lr} X_2$ (implying $X_1 \leq_{hr} X_2$ and $X_1 \leq_{st} X_2$). The equality in the likelihood ratio order is satisfied if and only if $p_1 = p_2$.*

Proof. Let $f(x; p_1, \beta, \Im)$ and $f(x; p_2, \beta, \Im)$ be the pdfs of X_1 and X_2, respectively. Then, by using (3), we have

$$\frac{f(x; p_1, \beta, \Im)}{f(x; p_2, \beta, \Im)} = \left(\frac{\log(p_2)}{\log(p_1)}\right)\left(\frac{1-p_1}{1-p_2}\right)\frac{1-(1-p_2)e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}}{1-(1-p_1)e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}}.$$

Hence, by differentiation, we obtain

$$\frac{d}{dx}\frac{f(x; p_1, \beta, \Im)}{f(x; p_2, \beta, \Im)} = \left(\frac{\log(p_2)}{\log(p_1)}\right)\left(\frac{1-p_1}{1-p_2}\right)\beta(p_1-p_2)\frac{g(x;\Im)}{[1-G(x;\Im)]^2}\frac{e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}}{\left[1-(1-p_1)e^{-\beta\frac{G(x;\Im)}{1-G(x;\Im)}}\right]^2}.$$

Now, observe that the sign of $d[f(x; p_1, \beta, \Im)/f(x; p_2, \beta, \Im)]/dx$ is the same to the sign of $p_1 - p_2$. So, if $p_1 \leq p_2$, $f(x; p_1, \beta, \Im)/f(x; p_2, \beta, \Im)$ is decreasing with respect to x, implying the desired result. The proof of Proposition 4 is now complete. □

5. Maximum Likelihood Estimation

In this section, we examine the statistical practice of the OEL-G model.

5.1. Method

To begin, we determine the (standard) maximum likelihood estimates (MLEs) of the parameters p, β, and $\Im$.

Let $x_1, \ldots, x_n$ be observed values from X. Then, the log-likelihood function for $\Theta = (p, \beta, \Im)$ is given by

$$\ell_n = n\log\left[\frac{1}{-\log(p)}\right] + n\log(1-p) + n\log(\beta) + \sum_{i=1}^{n}\log[g(x_i;\Im)] - 2\sum_{i=1}^{n}\log[1-G(x_i;\Im)]$$
$$-\beta\sum_{i=1}^{n}\frac{G(x_i;\Im)}{1-G(x_i;\Im)} - \sum_{i=1}^{n}\log\left[1-(1-p)e^{-\beta\frac{G(x_i;\Im)}{1-G(x_i;\Im)}}\right].$$

The first derivatives of ℓ_n with respect to p, β and $\Im$ are

$$\frac{\partial \ell_n}{\partial p} = -\frac{n}{p\log(p)} - \frac{n}{1-p} - \sum_{i=1}^{n} \frac{e^{-\beta \frac{G(x_i;\Im)}{1-G(x_i;\Im)}}}{1-(1-p)e^{-\beta \frac{G(x_i;\Im)}{1-G(x_i;\Im)}}},$$

$$\frac{\partial \ell_n}{\partial \beta} = \frac{n}{\beta} - \sum_{i=1}^{n} \frac{G(x_i;\Im)}{1-G(x_i;\Im)} \frac{1}{1-(1-p)e^{-\beta \frac{G(x_i;\Im)}{1-G(x_i;\Im)}}}$$

and

$$\frac{\partial \ell_n}{\partial \Im} = \sum_{i=1}^{n} \frac{g^{(\Im)}(x_i;\Im)}{g(x_i;\Im)} + 2\sum_{i=1}^{n} \frac{G^{(\Im)}(x_i;\Im)}{1-G(x_i;\Im)} - \beta \sum_{i=1}^{n} \frac{G^{(\Im)}(x_i;\Im)}{[1-G(x_i;\Im)]^2} \frac{1}{1-(1-p)e^{-\beta \frac{G(x_i;\Im)}{1-G(x_i;\Im)}}},$$

where $g^{(\Im)}(x_i;\Im) = \partial g(x_i;\Im)/\partial \Im$ and $G^{(\Im)}(x_i;\Im) = \partial G(x_i;\Im)/\partial \Im$.

The MLEs of Θ, say $\hat{\Theta} = (\hat{p}, \hat{\beta}, \hat{\Im})$, are the simultaneous solutions of the following equations: $\partial \ell_n/\partial p = 0$, $\partial \ell_n/\partial \beta = 0$ and $\partial \ell_n/\partial \Im = 0$. These MLEs do not have analytical expressions, but they can be computed numerically using well-established algorithms available in mathematical software. Moreover, assuming that there are r components in $\Im$, with $\Im = (\Im_1, \ldots, \Im_r)$, the corresponding observed information matrix at $\Theta = \Theta_*$ is given by

$$J(\Theta_*) = -\left(\begin{array}{ccccc} \frac{\partial^2 \ell_n}{\partial p^2} & \frac{\partial^2 \ell_n}{\partial p \partial \beta} & \frac{\partial^2 \ell_n}{\partial p \partial \Im_1} & \cdots & \frac{\partial^2 \ell_n}{\partial p \partial \Im_r} \\ \cdot & \frac{\partial^2 \ell_n}{\partial \beta^2} & \frac{\partial^2 \ell_n}{\partial \beta \partial \Im_1} & \cdots & \frac{\partial^2 \ell_n}{\partial \beta \partial \Im_r} \\ \cdot & \cdot & \frac{\partial^2 \ell_n}{\partial \Im_1^2} & \cdots & \frac{\partial^2 \ell_n}{\partial \Im_1 \partial \Im_r} \\ \cdot & \cdot & \cdot & \cdots & \cdot \\ \cdot & \cdot & \cdot & \cdots & \cdot \\ \cdot & \cdot & \cdot & \cdots & \frac{\partial^2 \ell_n}{\partial \Im_r^2} \end{array} \right)\Bigg|_{\Theta=\Theta_*}.$$

Under some standard conditions of regularity, when n is large, the sub-jacent distribution of $\hat{\Theta}$ can be assimilated to the following Gaussian distribution: $\mathcal{N}_{r+2}(\Theta, J(\hat{\Theta})^{-1})$, where $J(\hat{\Theta})$ is the observed information matrix at $\Theta = \hat{\Theta}$. Confidence intervals and statistical tests for the model parameters can be constructed from this result. Further details on the maximum likelihood estimation in the setting of odd focds can be found in [16,36].

5.2. Simulation

Here, we perform a simulation study evaluating the performance of the MLEs presented above for the OELW distribution for selected values of the parameters a, b, p, and β. The simulation experiment was repeated 1000 times each with sample sizes of 30, 60, and 100, and parameter combinations are

(I) $a = 0.5$, $b = 0.2$, $p = 0.05$ and $\beta = 0.01$
(II) $a = 0.55$, $b = 0.3$, $p = 0.04$ and $\beta = 0.01$
(III) $a = 0.5$, $b = 0.4$, p = 0.8 and $\beta = 0.1$

Table 2 presents the average estimates (AEs), average bias (Bias), and mean square error (MSE) values of parameters for different sample sizes.

Table 2. AEs, Bias, and MSE of parameters based on 1000 simulations of the OELW distribution.

	n	Parameter	AEs	Bias	MSE
I	30	a	0.4917	−0.0083	0.0138
		b	0.2122	0.0122	0.0032
		p	0.1716	0.1216	0.4697
		β	0.0174	0.0074	0.0315
	60	a	0.4983	−0.0017	0.0003
		b	0.2015	0.0015	0.0002
		p	0.0614	0.0114	0.0108
		β	0.0121	0.0021	0.0004
	100	a	0.5002	0.0002	3.9531×10^{-5}
		b	0.1998	−0.0002	3.9531×10^{-5}
		p	0.0487	−0.0013	0.0017
		β	0.0094	−0.0006	0.0004
II	30	a	0.0373	−0.5127	0.2823
		b	0.0211	−0.2789	0.0840
		p	0.0075	−0.0324	0.0174
		β	0.0007	−0.0092	0.0012
	60	a	0.5481	−0.0019	0.0020
		b	0.3002	0.0002	0.0009
		p	0.0460	0.0060	0.0751
		β	0.0106	0.0006	0.0028
	100	a	0.5498	−0.0002	3.3018×10^{-5}
		b	0.3001	8.4933×10^{-6}	3.9531×10^{-5}
		p	0.0410	0.0010	0.0009
		β	0.0102	0.0002	4.8256×10^{-5}
III	30	a	0.0327	−0.4673	0.2377
		b	0.0230	−0.3770	0.1507
		p	0.0467	−0.7532	0.3422
		β	0.0044	−0.0956	0.0105
	60	a	0.3342	−0.1658	0.0930
		b	0.2598	−0.1402	0.0559
		p	0.5333	−0.2666	0.2138
		β	0.0621	−0.0379	0.0058
	100	a	0.5013	0.0013	0.0017
		b	0.3998	−0.0002	4.2791×10^{-5}
		p	0.8053	0.0053	0.0703
		β	0.0995	−0.0005	0.0003

It can be noted that as the sample size increases, the bias decays towards zero and the MSE decreases. That is, the random versions of the MLEs are asymptotically unbiased and consistent. Therefore, the maximum likelihood method works quite well to estimate the parameters of the OELW distribution.

6. Applications

In this section, we show how the OELW model can be used in real-world data analysis applications. We fit the OELW distribution to two data sets and compare the results with those of the fitted four or five-parameter distributions also based on the Weibull distribution, namely the log-logistic Weibull (LLoGW) distribution by [37] and exponentiated generalized modified Weibull (EGMW) distribution by [38]. The Akaike information criterion (AIC), Bayesian information criterion (BIC), Anderson-Darling (A^*), Cramér-von Mises (W^*) and the values of the Kolmogorov-Smirnov (K-S) statistic and the corresponding p-values (p-Vs) are used to compare the three models after we estimate the unknown parameters of each model using the maximum likelihood method of estimation. In addition, for three data sets, the observed Fisher information matrix for the OELW distribution is provided.

6.1. The Survival Data Sets

The first real data set is a subset of the findings of [39]. It is based on the survival periods (in years) of 46 patients who received just chemotherapy. The data are provided below.

{0.047; 0.115; 0.121; 0.132; 0.164; 0.197; 0.203; 0.260; 0.282; 0.296; 0.334; 0.395; 0.458; 0.466; 0.501; 0.507; 0.529; 0.534; 0.540; 0.641; 0.644; 0.696; 0.841; 0.863; 1.099; 1.219; 1.271; 1.326; 1.447; 1.485; 1.553; 1.581; 1.589; 2.178; 2.343; 2.416; 2.444; 2.825; 2.830; 3.578; 3.658; 3.743; 3.978; 4.003; 4.033}

A summary of measures of descriptive statistics is provided in Table 3.

Table 3. Descriptive statistics of the survival data set.

Minimum	Mean	Median	Variance	Skewness	Kurtosis	Maximum
0.047	1.341	0.841	1.5540	0.9721	2.6638	4.033

Table 4 gives the relevant numerical summaries for the three fits based on the survival data set.

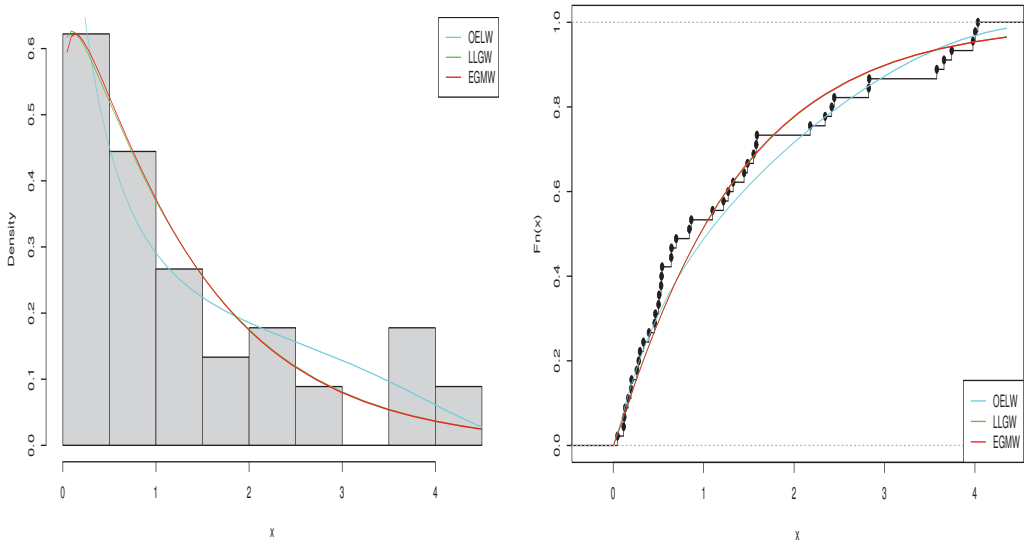
Table 4. Estimated values, log-likelihood, AIC, and BIC for the survival data set.

Distribution	Estimates	$-\log(L)$	AIC	BIC	A^*	W^*	K-S	p-V
OELW	$\hat{a} = 1.2911$ $\hat{b} = 1.8757$ $\hat{p} = 0.0086$ $\hat{\beta} = 0.1485$	55.6795	119.3589	126.5856	0.5029	0.0794	0.1000	0.7213
LLoGW	$\hat{s} = 5.4074$ $\hat{c} = 0.9984$ $\hat{\beta} = 1.0963$ $\hat{\alpha} = 0.5519$	58.1248	124.2497	131.4763	0.5297	0.0802	0.1086	0.6245
EGMW	$\hat{\alpha} = 0.0262$ $\hat{\theta} = 23.6778$ $\hat{\beta} = 1.1346$ $\hat{\mu} = 7.4771$ $\hat{\lambda} = 0.9329$	58.0787	126.1574	135.1907	0.5339	0.0813	0.109	0.6197

Figure 4 gives the graphs of the estimated pdfs and cdfs of the considered distributions. Figure 5 gives the probability-probability (PP) plot of the OELW distribution.

The observed Fisher information matrix for the OELW distribution is given by

$$J(\Theta_*) = \begin{pmatrix} 46614.05 & -4027.669 & 1022.565 & 460.6903 \\ . & 715.1325 & 49.82654 & -149.2407 \\ . & . & 80.76499 & -136.9867 \\ . & . & . & 33.75663 \end{pmatrix}.$$



(**a**) (**b**)

Figure 4. Obtained plots of the (**a**) estimated pdfs and (**b**) estimated cdfs of the considered distributions for the survival data set.

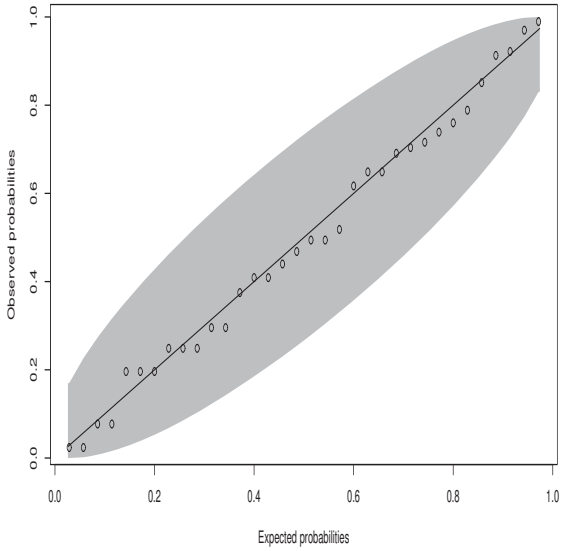


Figure 5. PP plot of the survival data set.

6.2. The Vinyl Chloride Data Set

The second data set represents 34 observations of the vinyl chloride data (in mg/L) that was obtained from clean-up gradient groundwater monitoring wells. The data are obtained from by [40] and are given below.

{5.1; 1.2; 1.3; 0.6; 0.5; 2.4; 0.5; 1.1; 8; 0.8; 0.4; 0.6; 0.9; 0.4; 2; 0.5; 5.3; 3.2; 2.7; 2.9; 2.5; 2.3; 1; 0.2; 0.1; 0.1; 1.8; 0.9; 2; 4; 6.8; 1.2; 0.4; 0.2}

A summary of measures of descriptive statistics is provided in Table 5.

Table 5. Descriptive statistics of the vinyl chloride data set.

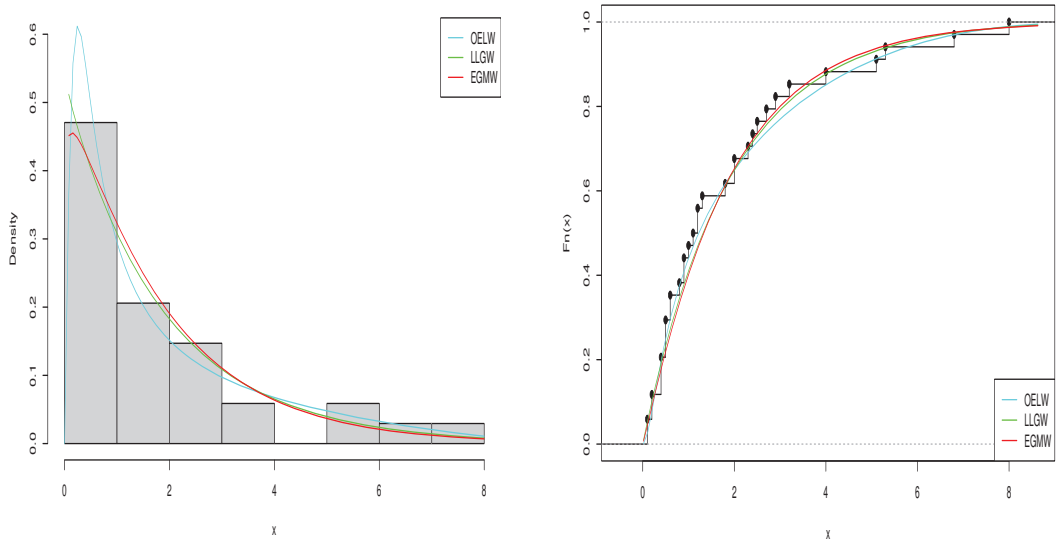
Minimum	Mean	Median	Variance	Skewness	Kurtosis	Maximum
0.100	1.879	1.150	3.8126	1.6037	5.0054	8.000

Table 6 gives the relevant numerical summaries for the three fits based on the vinyl chloride data set.

Table 6. Estimated values, log-likelihood, AIC, and BIC for the vinyl chloride data set.

Distribution	Estimates	$-\log(L)$	AIC	BIC	A^*	W^*	K-S	p-V
OELW	$\hat{a} = 1.9409$ $\hat{b} = 8.7259$ $\hat{p} = 0.0023$ $\hat{\beta} = 2.0977$	54.2109	116.4218	122.5273	0.2002	0.0289	0.0785	0.9849
LLoGW	$\hat{s} = 9.7787$ $\hat{c} = 5.0155$ $\hat{\beta} = 0.9910$ $\hat{\alpha} = 0.5270$	55.354	118.708	124.8134	0.2881	0.0438	0.0931	0.9301
EGMW	$\hat{\alpha} = 0.0158$ $\hat{\theta} = 33.6386$ $\hat{\beta} = 1.0908$ $\hat{\mu} = 2.2873$ $\hat{\lambda} = 0.8806$	55.3950	120.79	128.4218	0.3159	0.0517	0.0973	0.9043

Figure 6 gives the graph of the estimated pdfs and cdfs of the considered distributions. Figure 7 gives the PP plot of the OELW distribution.



(**a**) (**b**)

Figure 6. Obtained plots of the (**a**) estimated pdfs and (**b**) estimated cdfs of the considered distributions for the vinyl chloride data set.

The observed Fisher information matrix for the OELW distribution is

$$J(\Theta_*) = \begin{pmatrix} 357010.6 & -570.5293 & 3586.215 & 267.4771 \\ . & 2.083823 & -5.523455 & -1.17793 \\ . & . & 37.51406 & 432.3013 \\ . & . & . & 0.3955599 \end{pmatrix}.$$

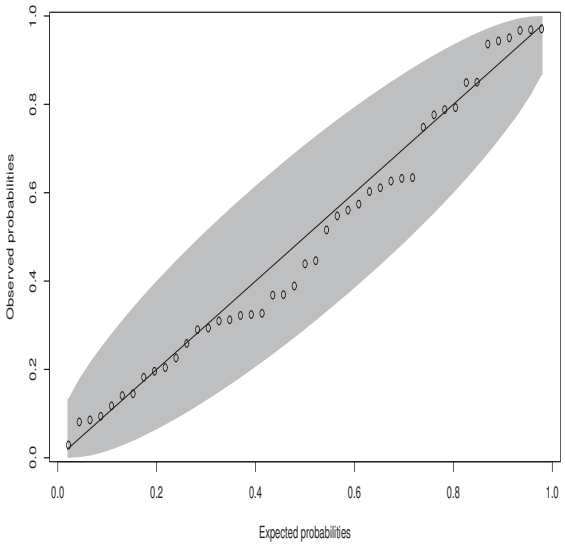


Figure 7. PP plot of the vinyl chloride data set.

6.3. Carbon Dioxide Data Sets

The third data set contains the annual mean growth rate of carbon dioxide during the period of 1959 to 2016 in Mauna Loa, Hawaii. The measurements are given in parts per million by year (ppm/yr). These data are taken from the given website https://www.esrl.noaa.gov/gmd/ccgg/trends/gr.html/, accessed on 4 July 2022. They are given below.

{0.94; 0.50; 0.96; 0.64; 0.71; 0.32; 1.06; 1.28; 0.70; 1.06; 1.35; 1.00; 0.81; 1.74; 1.18; 0.95; 1.06; 0.83; 2.15; 1.31; 1.82; 1.68; 1.43; 0.86; 2.36; 1.51; 1.21; 1.47; 2.06; 2.24; 1.24; 1.20; 1.05; 0.49; 1.36; 1.95; 2.01; 1.24; 1.91; 2.97; 0.92; 1.62; 1.62; 2.51; 2.27; 1.59; 2.57; 1.69; 2.31; 1.54; 2.00; 2.30; 1.92; 2.65; 1.99; 2.17; 2.95; 3.03}

A summary of measures of descriptive statistics is provided in Table 7.

Table 7. Descriptive statistics of the carbon dioxide data set.

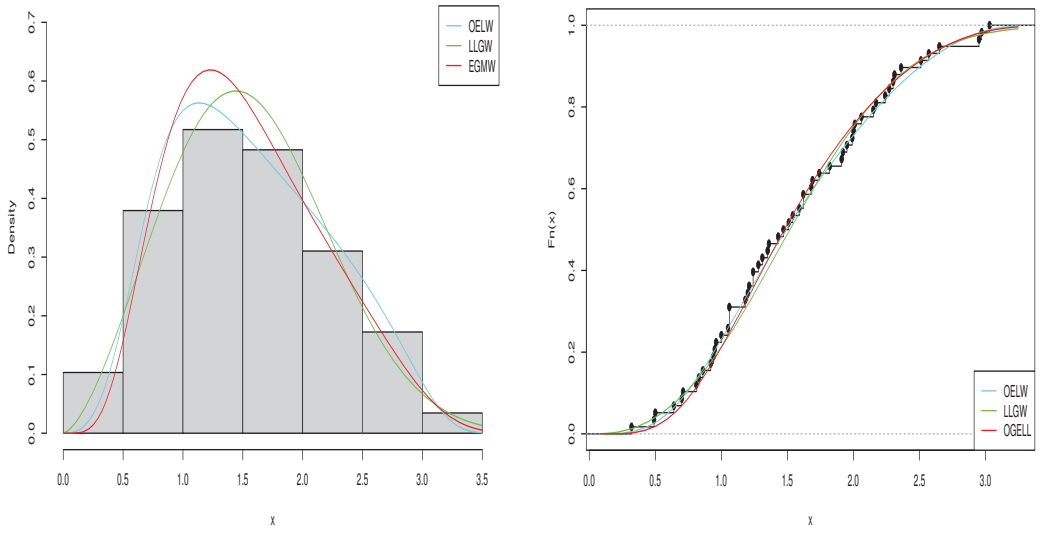
Minimum	Mean	Median	Variance	Skewness	Kurtosis	Maximum
0.320	1.556	1.490	0.4457	0.3413	2.3618	3.030

Table 8 gives the relevant numerical summaries for the three fits based on the carbon dioxide data set.

Figure 8 gives the graph of the estimated pdfs and cdfs of the considered distributions. Figure 9 gives the PP plot of the OELW distribution.

Table 8. Estimated values, log-likelihood, AIC, BIC, A^*, W^*, K-S and p-V for the carbon dioxide data set.

Distribution	Estimates	$-\log(L)$	AIC	BIC	A^*	W^*	K-S	p-V
OELW	$\hat{a} = 3.7419$ $\hat{b} = 2.8634$ $\hat{p} = 0.0143$ $\hat{\beta} = 1.2442$	55.6190	119.2381	127.4798	0.1204	0.0132	0.0461	0.9997
LLoGW	$\hat{s} = 5.7793$ $\hat{c} = 2.5283$ $\hat{\beta} = 2.5456$ $\hat{\alpha} = 0.2272$	56.68579	121.3716	129.6134	0.2053	0.0339	0.0682	0.9499
EGMW	$\hat{\alpha} = 0.0601$ $\hat{\theta} = 25.4632$ $\hat{\beta} = 6.3678$ $\hat{\mu} = 0.0151$ $\hat{\lambda} = 6.6891$	56.16804	122.3361	132.6383	0.2144	0.0271	0.0650	0.967



(**a**) (**b**)

Figure 8. Obtained plots of the (**a**) estimated pdfs and (**b**) estimated cdfs of the considered distributions for the carbon dioxide data set.

The observed Fisher information matrix for the OELW distribution is

$$J(\Theta_*) = \begin{pmatrix} 18811.95 & -362.08 & 444.2855 & 606.4949 \\ . & 13.93288 & -6.794833 & -30.04717 \\ . & . & 11.62585 & 626.3218 \\ . & . & . & 25.90807 \end{pmatrix}.$$

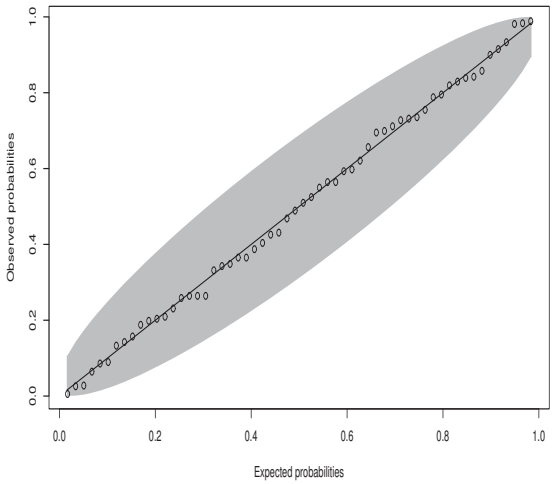


Figure 9. PP plot of the carbon dioxide data set.

In Tables 4, 6 and 8, the MLEs of the parameters for the fitted distributions, along with log-likelihood, AIC, BIC, A^*, (W^*) and K-S with p-V values are presented for three different data sets, respectively. From these tables, it is quite obvious that for the three data sets, the OELW distribution is the best model with the lowest values of AIC, BIC, A^*, W^*, K-S, and highest p-V of the K-S statistics. Hence, the OELW distribution turns out to be a better model than the LLoGW and EGMW models. A visual comparison of the closeness of the fitted pdfs with the observed histogram of the data, fitted cdfs with empirical cdfs, and PP plots for different data is presented in Figures 4–9, respectively. These plots indicate that the proposed distributions provide a closer fit to these data.

7. Conclusions

The OEL-G family of continuous distributions is a new family that we introduced and analyzed in this research. It has the feature of combining the functionalities of the logarithmic and odd transformations, of the EL distributions, and odd transformations, respectively. We gave explicit formulations for the moments, generating function, skewness, kurtosis, entropies, and order statistics, as well as a convenient linear representation for the probability density function. The OELW distribution, which is a subset of the OEL-G family, has been given special attention. Then there are statistical applications. The OELW model parameters are estimated using the maximum likelihood method, and the observed Fisher information matrix is explained. When compared to the famous LLoGW and EGMW distributions, three examples of real-life data fitting demonstrate good results in favor of the suggested distribution. Based on the findings, the proposed family might be regarded as a valuable addition to the field's existing knowledge.

Author Contributions: Conceptualization, C.C., L.T., M.J. and K.V.J.; methodology, C.C., L.T., M.J. and K.V.J.; software, C.C., L.T., M.J. and K.V.J.; validation, C.C., L.T., M.J. and K.V.J.; formal analysis, C.C., L.T., M.J. and K.V.J.; investigation, C.C., L.T., M.J. and K.V.J.; resources, C.C., L.T., M.J. and K.V.J.; data curation, C.C., L.T., M.J. and K.V.J.; writing—original draft preparation, C.C., L.T., M.J. and K.V.J.; writing—review and editing, C.C., L.T., M.J. and K.V.J.; visualization, C.C., L.T., M.J. and K.V.J. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Acknowledgments: The authors would like to thank the three reviewers for the constructive comments on the first version of the paper.

Conflicts of Interest: The authors declare no conflict of interest.

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JOURNAL OF MANAGEMENT & ENTREPRENEURSHIP
ISSN : 2229-5348
UGC Care Group 1 Journal

IMPACT OF SOCIO-ECONOMIC STATUS ON ACADEMIC – ACHIEVEMENTS OF STUDENTS WITH SPECIAL REFERENCE TO GOVERNMENT COLLEGES IN KEARLA

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Abstract:

This study examined the ways in which Muslim engineering students' academic achievements are effected by their socio-economic status. Participants were 200 Muslim engineering college students taken as randomly selected from Government colleges in Kerala. Data is collected from participants through questionnaire which contains three basic variables. Personal profile, Socio-economic status are independent variables and student's achievement is dependent variable. Ordinary Least Square Analysis, t-test and f-test were used for data analysis. Analysis of data indicates that students belonging to strong financial status perform better than those who face problems in finance. Similarly, parental education boosts up their children's performance.

Keywords: *Socio-Economic Status, Academic Performance, Academic Achievements, Muslim/Islamic Students*

Introduction:

If we talk about Muslim population, India is the second largest country after Indonesia. Why we call India's population a diverse indigenous one because here are many religions like Hinduism, Islam, Buddhism, Jainism, Sikhism and Christianity. All these religions are prevailing in India since time immemorial (Moinuddin). If we consider census of 2011 then the Muslim constitutes 14.2 percent of this country. In the same way the decadal growth rate is also the highest among them i.e 24.6 percent (if we see at the end of census 2011). Muslim community is considered the largest one as well. In all the states and union territories their presence can be seen easily. The socio-economic conditions of Muslims are not fairly significant even though they are considered the largest minority community in the country. Muslims face a lot of struggle to settle themselves safely in the society. In large parts of the country Muslims are still backward and this all is due to discrimination which they have to face, along with discrimination social stagnation and educational marginalization.

Scholastic achievement of the students and human resource development at the macro level can be progressed through academic achievement which plays a vital role in the context of an education system. In today's era children are being judged on the basis of academic achievement. To achieve educational growth academic achievement is very important without which educational growth cannot be achieved. We cannot overemphasize the importance of academic achievement in our life. It is like a tonic which make us emotionally strong. Whole future deposition stands on sound academic records which act like a pillar. Educational research has always proved that a good achievement in academics has always been the centre. No matter how many goals an education has but the most important goal of education is the academic development of the child. Students face huge competition in their lives. Everyone talks about the bright students no one is interested in mediocre student. Only the best one is being fitted on the top room. Personality, learning and development of the individual are totally effected by the role of socioeconomic status on one person and his academic achievement as well. What is the most important factor that effects a student life and the answer is family background and its socioeconomic status.

Promotion of one child's achievements is being done by the involvement of families not only this they should also focus on the improvement of school and democratization of the school governance. Student's educational achievements are also effected by their parent's education and their socio economic factors. Parents are the only one who can provide financial and mental confidence to the students. Different financial status and different parental educational level leads to explicit difference which can be easily seen among the students. In this era of globalization education is the one factor which is the primary need for everyone. All the essential qualities like personality, moral values, knowledge and skills are being groomed by education. Not only this education also gives

insight. If one has to survive in the atmosphere of competition he or she must be educated. Highly qualified people are demanded everywhere. According to Battle and Lewis, "In this era of globalization and technological revolution, education is the one factor that has been considered as the core factor for human activity. Human capital can only be developed with the help of education not only this it also results in an individual's well being and better living.

Many factors play a vital role in the academic performance of the students but if we consider the most important one then that is socio economic status. The effect of socio economic status on the quality of the student's academic performance is the most important topic of argument. Academic performance of the students are being negatively effected by the low socio economic status because they do not get the basic needs and this is one of the hot topic among experts to argue upon(Adams 1996). Those students who face financial problems they have to suffer from various hurdles. These students are not able to concentrate on their studies which results in low grades and consequently finding a job becomes a very difficult task for them. As per US Department of Education, 2003 environmental deficiencies are there due to low socio economic status that also effects self esteem of the students in negative way.

Scope of this study:

Socio-Economic factors plays a vital role in effecting students' educational achievements. Education is a primary need in this era of globalization. Education not only gives insight, it also grooms the personality, inculcates moral values, add knowledge and gives skill. Education is necessary owing to the atmosphere of competition .In every field highly qualified people are needed. Muslims are the minority category. So that they have to face so many challenges to come forward to the society. Besides education, access to media, socio-cultural norms of the community, job of women and household participation rate, a variable about the knowledge of an Islamic Concept of women empowerment has an effect upon women empowerment. So this paper discussing about the impact of socio-economic status on academic – achievements of students in engineering department of self financing colleges.

Review of literature:

In a rural sub-district in Bangladesh, Hamid (2011) examined the relationships between the socioeconomic characteristics of the family of secondary school students and their academic achievement in English. The academic achievement in English of these rural students was of low level. This overall low level of achievement was directly correlating to the family income of the students and education of the parents of such students. The performance of few students was above the average. These were the students whose parents were well learned and educated and their family income was quite high too. Such students are more likely to acquire higher grades in English in their Secondary School Certificate examination.

A research was conducted by Davis (1998) examining the relation between the number of family members and the performance of students in their academics. He also studied the correlation between college students from single parent and two parent homes and deducting the academic differences in the two groups. Statistical analysis proved that there is no relationship between such variables and the academic performance of the students. The study also supported the fact that people adapt to all changes and adjust to any shortcomings brought upon them from being in a single parent home or in a lower SES environment.

Otula (2007) stated that collaboration among students, teachers and parents will ensure effective learning. He also observed that students get more motivated if the families involve in the emotional and material benefit ensuring higher education interest in them. The students' academic achievement is definitely affected by the socio-economic status of the family.

The fact that all children have certain needs both physical and sociological was noted by Omoraka (2001). When these needs are satisfied the academic achievement increases positively. These needs mainly include good infrastructure of the school like a good library, canteen facilities, sporting

activities, various media of study material, etc. All these enable students to effectively learn and achieve good scores in schools. In order to provide the appropriate human resources to all the sectors, quality education is a must. This also helps in increasing our material wealth and in improving the living standards.

The fact that the most unavoidable impact on a student's progress is the socio-economic factor was clearly brought out by G.R Memon, Department of Education Karachi University, Pakistan (2009).These factors are electric facilities, involvement of the parents in children's home assignments and the relationship between the parent and the teacher,etc.

The increase in the performance of high school students in Anamba, Nigeria was explained by Kainuwa& Yusuf (2013). They claimed that the educational success of Nigerian you is based on the socioeconomic background. To evaluate the school performance of students ,the socio economic background, students' self-concept and school performance were used as variables in this study.

A study among the intermediate students was conducted by Trivedi, Vineeta (1988)to prove the relationship between socio economic background and academic achievement. The sample consisted of 523 girls students from 11 institutions. The study inferred that there is a significant relationship between socio economic status and academic achievement. The better the socio-economic status the better the performance of the students.

In Kamrup District Assam, children belonging to the lower SES group were studied by Rupa Das Barbora (2001) to find out the causes of their low academic achievements. The children of educated parents performed better than those of the uneducated parents and also the girls performed better than boys.

Objectives:

1. To analyses the academic achievement scores between male and female Muslim engineering students having high, medium and low socio economic status
2. To analyse Impact of socio-economic factors on the academic performance of Muslim engineering students

Research methodology:

The process used to collect information and data for the purpose of makingbusinessdecisions. The methodology may include publicationresearch, interviews, surveys and other research techniques, and could include both present and historical information. There are several important aspects to research methodology. This is a summary of the key concepts in scientific research and an attempt to erase some common misconceptions in science. Methodology is the systematic, theoretical analysis of the methods applied to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge. Typically, it encompasses concepts such as paradigm, theoretical model, phases and quantitative or qualitative techniques. The Methodology is the general research strategy that outlines the way in which a research project is to be undertaken and, among other things, identifies the methods to be used in it.

Descriptive type of research is followed by this study. Convenient sampling method is adopted. The primary data is used for this study which is collected through questionnaire.Sample size is 200 Muslim Engineering students from different Government colleges in Kerala. T test, F test and Ordinary Least Square Analysis are used for data analysis.

Data analysis:

Objective 1: To analyses the academic achievement scores between male and female Muslim engineering students having high, medium and low socio-economic status

Categorized all the Muslim engineering students in Kerala into three categories on the basis of socioeconomic status a) high SES b) middle SES c) low SES respectively. t' test is used to compare Academic Achievement of male and female Muslim engineering students. In order to find out the difference in the Academic Achievement of students having high, middle and low socioeconomic

status, their respective scores were taken into considerations and significance of difference in the mean values of these three levels of scores have been calculated by means of adopting by one way analysis of variance or F- test.

Table 1: Comparison of Academic -Achievement scores between male and female Muslim Engineering students

Gender	N	Mean	S D	t value
Male	100	78.071	46.79	**1.997**
Female	100	71.482	16.09	

*Significant at 0.05 level

The above table no.1 represents the mean scores of male and female Muslim Engineering students. This is based on their Academic Achievement. It is estimated that the tabulated values of 't' with degree of freedom 448 are 1.96 with 0.05 level of significance and 2.58 at 0.01 level of significance. The calculated value of 't' is 1.997. This value is higher than the table value at 0.05 levels and it shows that there is a significant difference in the Academic - Achievement of male and female Muslim Engineering students.

Table 2: Comparison of academic achievement scores between male and female Muslim engineering students having high socioeconomic status

Gender	N	Mean	S D	t value
Male	33	78.13	14.46	**1.270 NS**
Female	29	81.59	8.056	

NS- Not Significant

From the table no.2, we can get to know that the mean academic achievement scores of respondents, both male and female Muslim engineering students have high socio-economic status. The Mean values here are 78.13 and 81.59 respectively. The calculated t-ratio of the means is estimated to be 1.270. The tabulated values of 't' where the degree of freedom (N-2) 60 are 2.00 and 2.65 corresponding to 0.05 level and 0.01 level of significance. The 't' value here is 1.270 which reveals that the t value is less than the table value, thus, there is no significant difference in academic achievement of male and female Muslim engineering students who have high socioeconomic status. Based on the above calculations, we can come to a conclusion that there is no significant difference in academic achievement of male and female Muslim engineering having high socioeconomic status and this pertains to the null hypothesis.

Table 3: Comparison of academic achievement scores between male and female Muslim engineering students having middle socioeconomic status

Gender	N	Mean	S D	t value
Male	38	85.181	60.92	**1.564 NS**
Female	33	75. 070	15.01	

NS- Not Significant

Table-3 exhibits the mean academic achievement scores of male and female Muslim engineering students. The respondents here belong to the middle socioeconomic status where the values are 85.18 and 75.07 with 't' value of 1.564. The tabulated value of 't' with degree of freedom (N-2) 69 are 1.97 and 2.60 at 0.05 and 0.01 level of significance. Here the calculated value of 't' which is 1.564 is lesser than the table value at both the levels. This shows that there is no significant difference in academic achievement of male and female Muslim engineering students who have middle socio-economic status. The null hypothesis that there is no significant difference in academic achievement of male and female Muslim engineering having middle socioeconomic status is proved.

Table 4: Comparison of academic achievement scores between male and female Muslim engineering students having low socioeconomic status

Gender	N	Mean	S D	t value
Male	29	65.370	14.197	**.627 NS**
Female	94	63.884	16. 165	

NS- Not Significant

The table no. 4 is of the respondents having low socioeconomic status. This shows the mean academic achievement scores of male and female Muslim engineering students which are 65.37 and 63.84 respectively. The tabulated values of 't' is .627 with degree of freedom (N-2) 121 are 1.98 and 2.61 at 0.05 and 0.01 level of significance. The value of 't' is lesser than the table value which means there is no significant difference in academic achievement of respondents in low socioeconomic status, thus, there is no significant difference in academic achievement of male and female Muslim engineering having low socio-economic status is accepted.

Table 5: Comparison of academic achievement scores among three categories of Socioeconomic status (High, Middle and Low) – Duncan's Mean Test

Low SES (N=123)		*Middle SES (N=71)*		*High SES(62)*		*Low/ Middle*	*Middle/ high*	*High /Low*	*F value*
Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*				
64.49	*15.34*	*80.83*	*47.19*	*79.99*	*11.53*	*	-	*	*11.50*

* Significant at 0.05 level ** Significant at 0.01 level

Table no. 5 reveals the comparison of academic achievement scores. The respondents here belong to the three categories of socio-economic status viz, high, middle and low. This study was based on the analysis of variance where the F-value is equal to11.50 at 0.01 level of significance. The null hypothesis where there is no significant difference in academic achievement of Muslim engineering having high socioeconomic status, middle socioeconomic status and low socio-economic status seems to be failed. As a result, there is a difference in Academic Achievement scores of respondents belonging to all three categories.

Objective 2: To analyse Impact of socio-economic factors on the academic performance of Muslim engineering students

Table 6: Ordinary Least Square Analysis

IMPACT OF SOCIO-ECONOMIC FACTORS ON THE ACADEMIC PERFORMANCE OF STUDENTS			
Variables	***Standardized coefficient beta***	***T stat.***	***P Value***
Constant	1.244	9.811	**0.000**
Family Background	0.065	0.776	0.439
Students Satisfied with University Environment	0.046	0.666	0.506
No of Children in Family	0.093	1.3300	0.085*
Mother Education	0.346	4.307	0.000*
Father Education	0.146	1.745	0.083 ***
Perception of Parents about the Future Career of Kids	0.037	0.489	0.626
Father income	0.019	0.219	0.087***
Availability of Government Facilities for Education	0.084	1.108	0.069*
Personal Interest of Students in Education	0.127	1.378	0.706
R-Square		0.382	
Total Observations		200	

Note:***Significant at 1%, **Significant at 5%, *Significant at 10%

The table above shows that the academic performance of the students has proved to have a positive impact especially at the university level where their parents are educated. Study reveals that a year increase in father's year of schooling has an impact where there is a 14% increase in the GPA of the students, whereas, a year increase in mother's education gears up to a 34% increase in student's average performance. From this, we can get to know that mother's education has a significant influence on the performance of students than that of father. Father's income has proved to have a positive impact

on the academic performance of the students, where fathers with higher incomes are found to have a higher GPA of their children. Parents thought about their kid's future have also had a positive impact where the kids put in more effort in studies and bring better grades. Child's personal interest in studies, dream about their future, their career perception has a positive impact on their academic performance. Family background also plays a vital role in determining this factor. T-value checks for the significance of the β's where β's are significant when its value is greater than 2. The measure of fit of the regression equation is determined by the R-square where the proportion of the variation in the dependent variable is explained by the explanatory variable. The 33% variation in the dependent variable which is the academic record of the students is due to independent variables. Here the value of adjusted R square is estimated to be .100. The F statistics is applied to check the overall significance of the model.

Findings:

- No significant difference was found in Academic Achievement scores of male and female Muslim engineering students having high socioeconomic status.
- No significant difference was observed in Academic Achievement scores of male and female Muslim engineering students who have a middle socioeconomic status.
- No significant difference was found in Academic Achievement scores of male and female Muslim engineering students having low socioeconomic status.
- A significant difference was found in Academic Achievement scores of male and female Muslim engineering students. Male students showed better academic achievement than female students

Conclusion:

This study throws adequate light on the effect of socio economic status on academic achievement of Muslim engineering students in self finance engineering colleges in Kerala having High and middle socio economic status have better academic achievement than low socioeconomic status. The Muslim engineering students belonging to low socioeconomic status should be financially helped and adequate scholarship should be given to them. They may have inferiority complex to come forward, so that the students of low status should be encouraged to participate in different activities. This study could find one more aspect on Muslim engineering students. Their family background also effect their academic achievements. So that this study concluded that there is a relation between socioeconomic status on academic – achievements of Muslim engineering students.

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IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 3, November 2022
Impact Factor: 6.252

Adoption of E-Kanikka in Kerala

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Assistant Professor[1,2,3,4]
Carmel College, Mala, Kerala, India

Abstract: *Kanikka means something in Hinduism, Sanskrit, the history of ancient India, Jainism, Prakrit. So many as 22 QR codes have been displayed at various locations in the temple complex and nearby areas through which the devotees can offer the kannikka. As the annual pilgrimage is progressing at the famed Lord Ayyappa temple in Kerala, the Travancore Devaswom Board (TDB), the apex temple body, has made arrangements for devotees to offer 'e-kanikka' at the electronic hundi collection in the temple complex and nearby areas. As in the previous years, the arrangements for the digital payment was made in association with the Dhanlaxmi Bank, who are the official bankers of the TDB this year as well.*

Keywords: E-Kanikka, Kerala, Pilgrims, Adoption.

I. INTRODUCTION

Devotees can make the payment through Google Pay and the QR code for this has been displayed at several places including the Sannidhanam, the temple complex and Nilakkal on the foothills. "As many as 22 QR codes have been put on display in various points. Devotees can also remit the kanikka amount through the dedicated Google Pay number," TDB executive officer V Krishnakumar Warrier said.

Steps would be taken to display more QR codes at various places along the Sabarimala pilgrimage route, the TDB said.

Meanwhile, a new batch of police personnel took charge at the temple complex to ensure the safety and security of devotees and the management of crowds at the Sannidhanam. A total of 265 officers are deployed for crowd management alone at the hill shrine complex, besides another batch of 300 personnel which comprises intelligence officers, commandos, bomb squad experts, quick response team members and the rapid response and disaster management teams from the neighbouring Tamil Nadu and Andhra Pradesh, a TDB statement added.

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1.1 Scope of the Study

E-kanikka is a new concept arise due to covid-19 pandemic. Everything got in electronic system after demonetization. But due to covid situation electronic system has been pull up. So in temples also adopted the E-kanikka or virtual kanikka system. Nowadays most of the temples are forced to use this system. This is the convenient method also. This study analysing the relation between the demographical profile and the adoption of e-kanikka system. And analysing why the people are adopting the e-kanikka system.

1.2 Objectives

1. To analysing the relation between the demographical profile and the adoption of e-kanikka system.
2. To analysing the factors to influence people for the adopting of e-kanikka system.

II. RESEARCH METHODOLOGY

2.1 Data Analysis

Objective 1:

- To find out the relation between the demographical profile and the adoption of e-kanikka system.

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Table 1: Data and results of coefficient of Correlation between the demographical profile and the adoption of e-kanikka system and t- Test for Significance

Variable	N	r	t value	Significance level
Gender Age	208 208	0.966	53.62	P < 0.01

The table depicts the 'r' value as 0.966 and it can be interpreted as positive very high correlation between the variables. The t-value calculated is 53.62, which is significant at 0.01 level. Hence, we can conclude that there is a significant relationship between the demographical profile and the adoption of e-kanikka system. So that the null hypothesis is rejected.

Objective 2

- To identify the factors to influence people for the adopting of e-kanikka system.

Table 2: Ranking of various factors to influence people for the adopting of e-kanikka system

Factors	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Weighted Average
Safety	46	50	4	-	-	29.47
Social Distance	48	47	5	-	-	29.53
Convenience	37	43	20	-	-	27.8
Currency exchange issues	29	46	25	-	-	26.93
Difficulty to carry the notes or coins	19	22	43	13	3	22.73
Transaction records	17	29	33	20	1	22.73

Source: Primary Data

Table 2 reveals the personal opinion of the respondents regarding the various factors influencing people to adopt e-kanikka system .In order to analyse the opinion of the respondents regarding various factors influencing the adoption of e-kanikka system . And for that weighted average for each statement is calculated and the same is arranged in ascending order. So it is identified that the statement Social Distance occupied first rank, Safety got second rank, Convenience occupied the third rank, the Currency exchange issues occupied fourth rank, difficulty to carry the notes or coins and Transaction records got fifth rank.

III. FINDINGS

There is a significant relationship between the demographical profile and the adoption of e-kanikka system. Social Distance occupied first rank, Safety got second rank, Convenience occupied the third rank, the Currency exchange issues occupied fourth rank, difficulty to carry the notes or coins and Transaction records got fifth rank.

IV. CONCLUSION

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SOUTH INDIA JOURNAL OF SOCIAL SCIENCES
ISSN: 0972 – 8945

ERGONOMICS IN THE WORK PRACTICE OF EMPLOYEES

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Abstract:
The purpose of ergonomics is to suit the task to the individual rather than the other way around. Increased productivity, enhanced worker health and safety, higher job satisfaction, and better compliance with government requirements are all benefits of effective ergonomics. Aiming for dynamic versus static labour, optimising work surface heights, preventing muscle overload, avoiding unnatural postures, and training individuals to use the workplace, facility, and equipment effectively are all broad ergonomics principles that should be applied to the workplace. The impact of workstation and work posture ergonomics on librarian job satisfaction in libraries was explored in this study. this study conducted in Kerala. The survey research design was used in this study. "Ergonomics is the science of matching job tasks to workers' capabilities. Through the principles of ergonomics, jobs can be redesigned and improved to be within reasonable limits of human capabilities" (1). The purpose of the ergonomic workplace assessment is to assess employee at work, identify potential problem/risks related to the work and then find a suitable modification to prevent the injuries. The workplace assessment is done based on the fundamental ergonomic principles that improve the performance and efficiency of the work and enhance the safety of the employee. The assessment also allows injured worker to return to the work by minimizing the discomfort while they recover from the injury.

Keyword: Ergonomics, Work Place, Employees, Librarians, Job Satisfaction, Work Posture

Introduction:

As indicated by work and organisational literature, job satisfaction is a widely researched topic. This is due to the fact that analysts believe work happiness has an impact on labour market behaviour. According to Flanagan and Flanagan (2002), a low rate or lack of job satisfaction is one of the most crucial indicators of an organization's poor and deteriorating work circumstances because it might lead to job quitting (Gazioglu and Tansel, 2002).

Ergonomics is a branch of science concerned with the study of interactions between humans and other components of a system. It improves human well-being and total system performance by applying theory, concepts, data, and methodologies to design (International Ergonomics Association (IEA)) (2000). Instead of physically forcing the worker's body to match the job, ergonomics seeks to create the workplace to fit the demands and physical capabilities of employees (Ghosh et al, 2011). Ergonomic considerations that can lead to job satisfaction might come from a variety of workplace difficulties. For example, a badly constructed work environment might impede or slow down an employee's effectiveness in the workplace, leading to irritation and, as a result, lowering job satisfaction.

The goal of ergonomics is to improve the human's safety, health, comfort, and efficiency in the workplace. Reaching, bending, carrying large objects, utilising continuous force, working with vibrating machinery, and repetitive motion are all physiological activities in foundries. To protect workers, it is critical to create a safety and health policy and programme. Ergonomics improves human performance, such as worker health, safety, and productivity.

Review of Literature:

Workstation design, according to De Croon et al. (2005), can cause physiological and psychological reactions either directly or indirectly. A multitude of issues arise as a result of incorrect and bad computer workstation setups. For example, people may experience feelings of lack of space, low job satisfaction, induced stress weariness, and potentially an increase in blood pressure. Second, poor performance and negative health consequences such as chronic fatigue, burnout, and musculoskeletal issues. The appropriate design, modification, and use of computer workstations, according to Fraser

(2009), are significant considerations for the avoidance of musculoskeletal injury. The goal should be to establish a workplace where people may work in a neutral state, which will reduce the amount of wear and tear on their bodies. In her study, Adeyemi (2010) found that Nigerian academic library personnel encounter a wide range of ergonomic issues, including headaches, tension, and stress. She went on to say that poor sitting and computer monitor positioning, as well as lifting and carrying, are some of the issues they face. Occupational health statistics from the United Kingdom estimate that hundreds of thousands of workers have been injured as a result of extended standing, resulting in over two million days of sick leave every year, according to O'Neil (2005).

Objectives:

1. To determine the link between the adequacy of workstation and equipment designs and employee job satisfaction.
2.To determine the association between librarians' work posture (sitting or standing) and job satisfaction.

Research Methodology:

A structured questionnaire was used as part of the survey study strategy. Sample collected from arts and science self financing college librarians. Sample size is 352. Both primary and secondary data were used for this study. The information gathered was analysed with descriptive statistics such as frequency count, percentage, mean, and standard deviation. Hypotheses one and two were tested using Pearson Product Moment Correlation (PPMC) analysis. At a significance threshold of 0.05, the hypotheses were tested. Area of the study is Kerala. Cluster sampling method used as sample method.

Data Analysis and Interpretation:

Table 1: Demographic catechistic of respondents.

Character	Information	Frequency	Percentage
Gender	Male	163	46.3
	Female	189	53.7
	Total	352	100%
Qualification	Degree	127	36%
	PG	183	52%
	Phd	42	12%
	Total	352	100%

Table 1 shows that 53.7% of respondents are female. 46.3% of respondents are male. 52 % of them are post graduated. 36 % of respondents hold degree qualification. Only 12% of them have PhD.

Objective1: . To determine the link between the adequacy of workstation and equipment designs and employee job satisfaction.

H_0: There is no significant relationship between workstation and equipment designs and job satisfaction of librarians.

Table : 2 workstation and equipment designs and job satisfaction

Variables	N	Mean	S.D	R	Sig
Job Satisfaction	352	2.70	0.43	0.46	0.00
Suitability of workstation and equipment designs	352	2.48	0.56		

A summary of data on the test of relationship between job satisfaction and workstation and equipment designs is presented in table 1. As is revealed in the table, there is a significant positive relationship between job satisfaction and workstation and equipment ($r = 0.46$, $P < 0.05$). The null hypothesis is therefore rejected as there is no sufficient evidence to accept it. This positive relationship implied that the more workstation and equipment design are suitable, the more the librarians will achieve job satisfaction.

Objective 2: To determine the association between librarians' work posture (sitting or standing) and job satisfaction.

H_0 : There is no significant relationship between the condition of work posture (sitting or standing) designs of librarians and the job satisfaction of librarians.

Table 3: condition of work posture designs and the job satisfaction

Variable	N	Mean	S.D	R	Sig
Job satisfaction	352	2.70	0.43		
Work posture condition	352	2.64	0.38	0.15	0.005

There is a substantial positive link between librarians' job happiness and their work posture (sitting or standing) (r = 0.15, P 0.05). As a result, the null hypothesis is rejected because there is insufficient evidence to support it. The conclusion here is that proper work posture could improve library workers' job happiness.

Findings:

Females make up the majority of the respondents. PG is held by 52 percent of them. Workstation and equipment have a considerable positive link with job satisfaction. This positive link showed that the more suited the workstation and equipment design, the more job satisfaction librarians will experience. The library personnel may be more satisfied with their jobs if they have good posture.

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Conclusion:

The purpose of this study was to see how the adequacy of workstation and equipment designs, as well as work posture ergonomics, influenced employee job satisfaction. The importance of job satisfaction cannot be overstated, according to this study, because it has a significant impact on organisational behaviour and goal fulfilment. This study discovered that ergonomic elements such as appropriate workstation and equipment designs, as well as the state of employees' work posture, played a significant role in achieving a greater degree of job satisfaction among employees. In light of the negative impact of ignoring ergonomic principles in the design of working workstations and equipment on job satisfaction, the resulting decline in performance and productivity, and the severe health repercussions that could emerge from inadequate ergonomics.

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