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## About GTU

Gujarat Technological University is a premier academic and research institution which has driven new ways of thinking and working, since its inception in 2007, by Government of Gujarat vide Gujarat Act No. 20 of 2007. Today, GTU is an intellectual destination that draws inspired scholars to its campus, keeping GTU at the nexus of ideas that challenge and change the world. GTU is a State University with 435 affiliated colleges operating across the state of Gujarat through its five zones at Ahmedabad, Gandhinagar, Vallabh Vidyanagar, Rajkot and Surat. The University caters to the fields of Engineering, Architecture, Management, Pharmacy and Computer Science. The University has about 4, 00,000 students enrolled in a large number of Diploma, Under Graduate, Post Graduate programs along with the robust Doctoral program.

### **VISION:**

To be a global university for the creation and dissemination of knowledge and Innovation in Science & Technology, Humanities and Multidisciplinary domains for sustainable development and enrichment of human life.

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2. To build resources, facilities, proficiencies and other related infrastructure of global standard for the development of knowledge, skills, and competencies in the various educational domains.
3. To develop research-oriented pedagogy for flourishing ideas and to nurture innovators, entrepreneurs and professionals of tomorrow
4. To build and enhance collaborations with other academic, research, industry, and government organizations as well as NGOs across the globe so that education, training and research at university and its affiliated colleges become aligned with national and global level requirements.
5. To encourage multidisciplinary research and develop flexible learning ecosystem.

GTU has emerged as an International Innovative University in its pursuit of bringing innovation and internationalization in professional education. Within a really short span it has achieved several national accolades for its endeavor in bringing excellence in professional education. GTU is a pioneer in introducing some innovative learning methodology like “Active Learning”, a classroom created online. GTU has the largest International Experience Program in collaboration with the universities of US, Canada, Bulgaria and Germany, which offers a unique opportunity to the students to enhance their capabilities and capacities in a global perspective. GTU’s Research Week, a unique concept, is an evaluation process of dissertations of Master’s and Doctoral Program students involving experts from the Universities across the globe.

**From the Desk of Editor-in-Chief**

**MESSAGE**



I feel pride in publishing the seventh issue of ‘Multidisciplinary International Research Journal of Gujarat Technological University’.

This issue concentrates on Engineering, Pharmacy and Management disciplines in which articles are written in different areas such as Preplanned Disaster Management, Hybrid Intelligent Intrusion Detection System, Accidental Prevention Speed, Control System, Drone Based Imaging System for Waste Assessment, Impact of Covid-19 Pandemic on Online Banking Usage and Herbal Cosmetics prepared from Flaxseed etc.

I hope all these articles will be useful for their range of applications and will also open up new directions for further research.

I take this opportunity to thank the GTU editorial board members & international editorial board members for their efforts in upgrading the articles in this issue.

**Prof. (Dr.) Navin Sheth**  
**Vice Chancellor**  
**Gujarat Technological University, Ahmedabad**

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# **ELECTRONIC DESIGN AUTOMATION TOOLS: FUTURE OPPORTUNITIES FOR BEGINNERS**

**Mr. Priyank Bhupendrakumar Modi**  
L D College of Engineering, Ahmedabad

**Mr. Kinnar G. Vaghela**  
L D College of Engineering, Ahmedabad

## **ABSTRACT:**

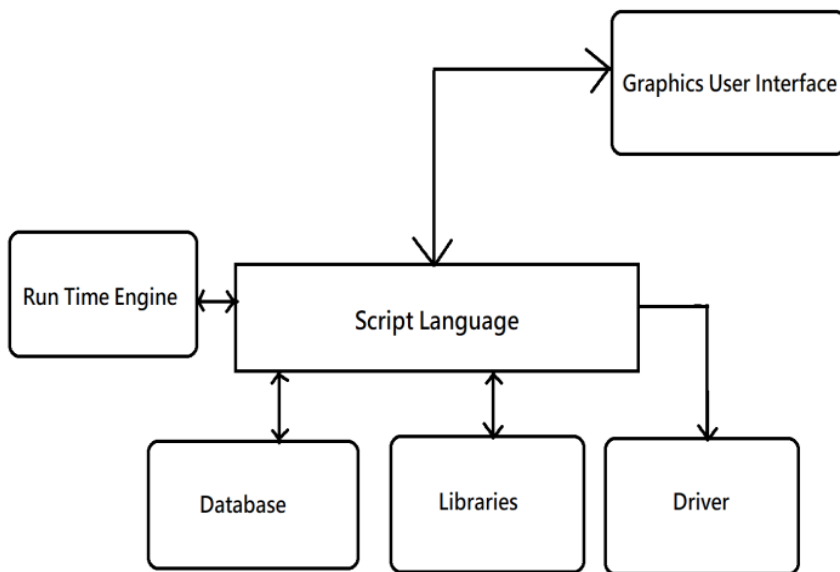
EDA tools transform the learning, experiment, and assessment environment of the electronics industry. In this review paper, we characterize the experimental analysis of EDA tools, as the electronics industry evolved, the insolubility of the circuit rises and the growth of integrated circuits accelerated. The main focus of this paper is providing many EDA tools for different platforms. We present an experimental analysis of the robust parameterization of Electronic Design Automation (EDA) tools concerning a different understanding of essential aspects offered to beginners. However, we display that most of the studied tools are critically useful here. The results of the EDA tool indicate that experiments conducted to evaluate the performance of the EDA tool should consider such behavior.

**KEYWORDS:** EDA Tool, Embedded, Design Process, Layout tool, Simulation, PCB Layout, Analog-Digital design, Patent trend

## **1. INTRODUCTION:**

According to experts, Electronic designing is one of the complex tasks for designers or engineers. A prototype created using hardware involves high costing or also at times high failure rates. The higher complexity of designing any system without logic or idea is not be considered at all. EDA is a tool that is defined help to engineers or students or electronic beginners to design any system. EDA is a term categorized in the software tool. Normally made of basic prototype concept as hardware form is very expensive and time wasting thing as well we face failure in most of the cases. Today it is possible to simulate the design of anything from a normal RC circuit to a microprocessor chip by using the proper methodology of EDA tools. It is an approach where it is used to simulate the circuit and allow proper electronics design methods. Software algorithms and applications are required for the design of complex next-generation semiconductor devices, electronic circuits, and embedded systems for future requirements and opportunities. Due to the elevated anfractuositities of current designs, In this paper, we will present an experimental evaluation of electronic design automation devices, which use precise logic synthesis and optimization algorithms, to illustrate that the tools are much more helpful. Today it is possible to simulate the design of an electronic blueprint using a computer and proper software tools. The use of software tools for the design and simulation of electronic circuits is one type of approach we can say is EDA. The EDA tools offer the design and development of electronic design with proper methodology, we can create a design, simulate it. It provides flexibility and reduces the workload of engineers or designers. As a result, we hope that this work will be useful for other beginners in identifying the strengths and weaknesses of different EDA tools.





(Fig 1 : EDA Tool basic understanding)

## 2. NECESSARILY OF EDA TOOL:

At that time, there was no EDA. There was only engineering by hand. Before EDA came into the scene, developing basic circuits to any integrated circuit was very difficult. The procedure takes a considerable amount of time and leads to several failures with various schematic errors at the end. The complexity of electronics shows us the necessity of automation. Currently, many EDA tools are available for design in accordance with an individual's intellectual property. The designing of electronics systems and their circuits has many deep histories. EDA was named for the first time in the 1960s when researchers created the CAD (Computer-Aided Design) tool for supporting engineers in the analysis and layout of circuits. In such a way we can reduce the amount of work, the duration of time, and the difficulty of analogical problems. In the 1970s SPICE, was an open source analog electronic circuit simulator developed by the University of California. At the ending of the 2000s, the need for EDA is increased due to its complexity and time reduction advantages. Today, there are many options available in the market when it comes to EDA tools. A few of them are open-source tools, but others require a confidential key. User applications determine how it works. The electronics industry is reevaluating engineering design tools.

There are basic features in tools:

1. Automated system that allows for automatic invocation and control of other systems through callbacks, for instance, so that they are notified of interacting events.
2. Using user requirements to determine whether additional computation is necessary and whether it can be deferred.
3. Other tools get notified when changes are made so they can make any required updates.
4. Data reversibility allows us to easily undo changes, save, and restore data.

A manufacturing facility uses a combination of digital and analog architectures to create an electronic chip or circuit. EDA tools have several advantages, including saving time spent developing complex circuits, eliminating manufacturing errors, lowering manufacturing costs, optimizing design, and ease of use.

### 3. DIFFERENT WAYS FOR CHOICE EDA TOOL:

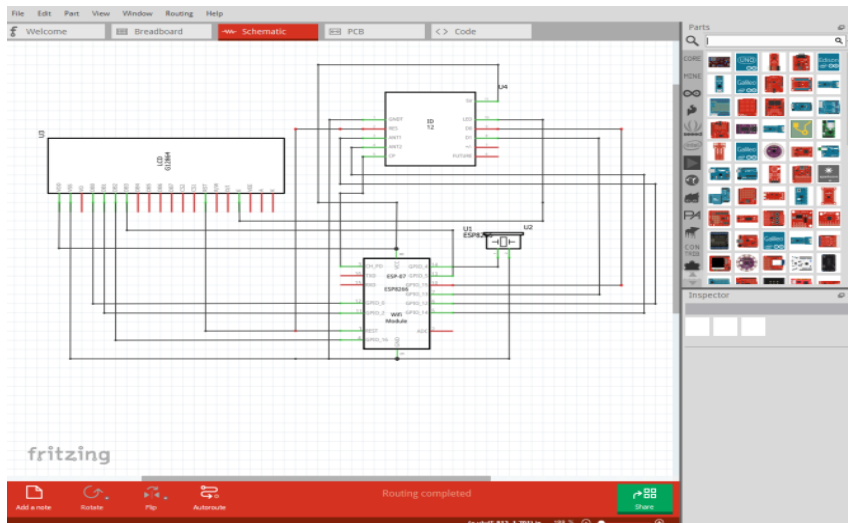
Before the revolution of technology or tools, to design a circuit, Circuits were traditionally drawn by hand or with geometric software. Circuit designers began utilizing software to automate the design process in 1970. The majority of EDA tools follow a flow diagram. There are two types of design flow: digital design and analog design. In digital design, the circuit is described with a hardware description language, and then simulated, synthesized, routed, and post-routed. A circuit is captured in analog design, there are then simulations, physical designs, layout extractions, and post-layout simulations. When producing electronics circuits or chips, a production facility uses digital and analog layouts combined. To design any devices or circuitry passes through many stages, from drawing an idea to determining the final layout. There are many lots of EDA tools available just for designing circuit boards and simulating any circuit. For example, OrCAD, Eagle, Fritzing, etc. If any designer wants to design an integrated circuit or chip there are several EDA tools available like Xilinx, Questa, Mentor graphics, Maxplus2, SPICE, etc. If we are going to make any embedded system there is Proteus Design Suite and many more EDA tools are available.

The EDA tools are categorized into three types:

- A. Design suit Tools
- B. Simulation And Layout Tools
- C. Verification and Q&A Tools

#### 3.1 Design Suit Tools:

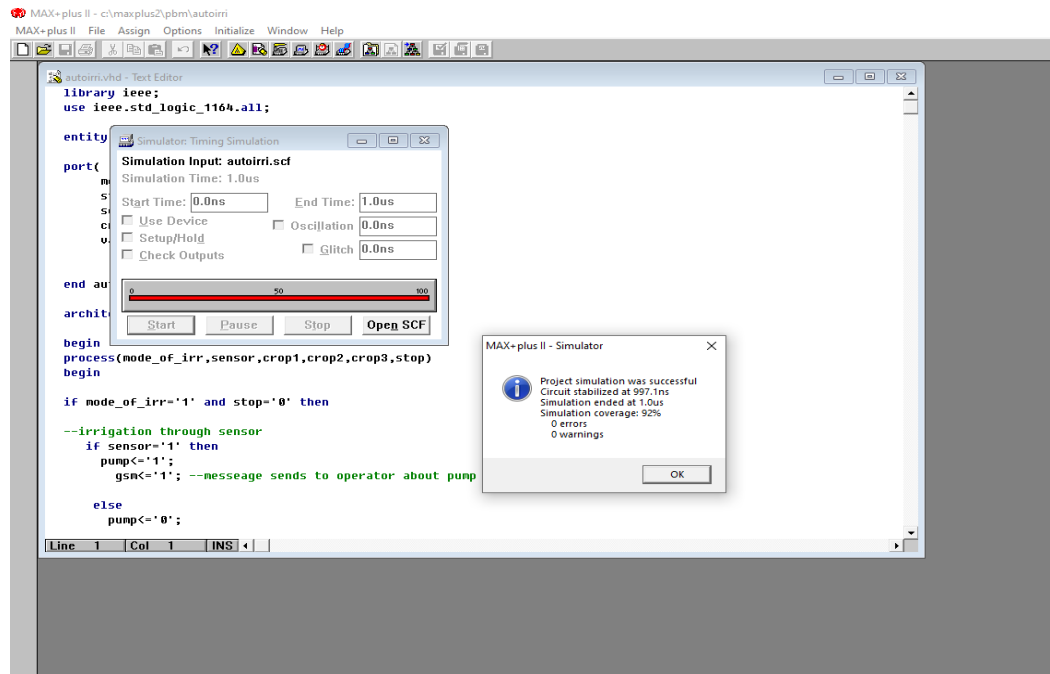
The starting of EDA tools as an industry happened in 1981, when Hewlett-Packard, Tektronix, and Intel started to use EDA tools internally. Several companies were founded at this time, such as Daisy Systems, Mentor Graphics, and Valid Logic Systems. It is a design process tool that is engineer required to design any circuit. For engineers and beginners, it is very time-consuming to design a circuit or system. For saving time and power we can design a user-defined application. It is prepared for designing simple circuits to schematic and PCB boards. With the help of the Design suit tool schematic designer have extensive components libraries, options to create their circuits and PCBs, they create their netlists as well as easily find and detect the error in the schematic.



(Image of 3.1: Microcontroller interfacing using the fritzing tool)

### 3.2 Simulation and Layout Tools:

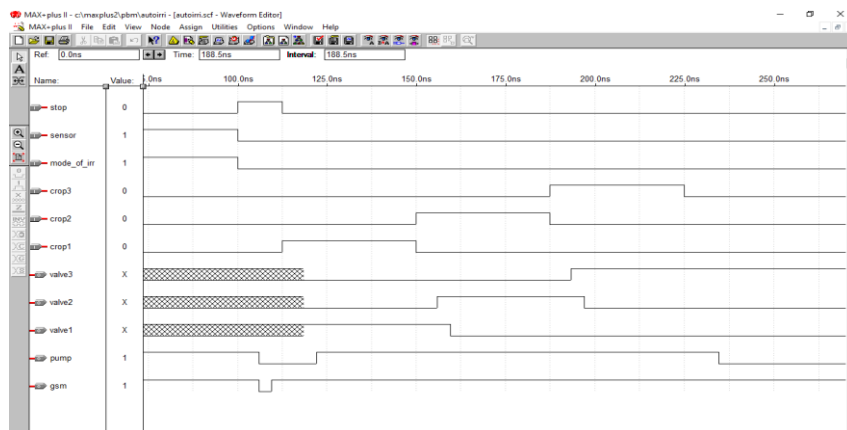
There was a hardware description language created in 1981 by the name of VHDL, followed by another one developed in 1986, called Verilog, which is similarly named. In a few years, back-ends for doing logic synthesis emerged along with simulators to support these languages. It is a functional verification tool of EDA. It checks the functionality of the designed circuit or system as user-defined. Sometimes it is a free and open-source EDA tool means a package of software we can use with a free license. In simulation there are mainly two major categories are included one is logical and the other one is timing-based. Simulation tools verify logic design VHDL simulation, Gate circuit design, any kind of automation tools. Where a timing-based simulator uses for multiple applications of design. Normally maintaining all features of EDA tools has been categorized. There are lots of free EDA tools with open source. Some of them are used as physical design tools.



(Image of 3.2: VHDL simulation on Maxplus 2 tool)

### 3.3 Verification and Q&A Tools:

With the introduction of VLSI (Very Large Scale Integration) in 1980, programming languages entered the story to simplify the compilation of electronic designs. Later on, simulation and verification tools were developed to design more complex integrated circuits. Electronic engineers, designers, and students can design the logical representation of circuits, chipset, a microprocessor device, or any PCB board converting into a physical representation that allows for the manufacturing of that thing. After Completion of any simulation work of project designer can check the quality and analysis test by using EDA tools. Once creating the simulation or designing any chip or circuit user or designer can create a layout printing on a physical board. Sometimes procedure of layout is manual, but most steps for PCB layout creation are automatic in nowadays EDA tools. In VLSI, some functionality such as HDL turned into gate-level representation. The academic community makes wide use of EDA tools such as KiCAD, Logisim, OrCAD, PSPICE, NGSPICE, and many more for VLSI design.



(Image of 3.3: Output waveform of HDL Entity on Maxplus 2 tool)

#### 4. BENEFITS OF EDA TOOLS:

EDA tool helps students, engineers, and designers to manage high complexity in designing and simulation any project. A designer can explore different things in design approaches. EDA tools also help industries. Normally some EDA tools are likely to open and free source software where it can be used with the free license. EDA tools have much more features and most of them can fill up maximum demands of users or designers. EDA tools help to achieve more complex chips or circuits at a lower cost in a shorter time. It also helps layout designers to place millions of transistors on a single chip as well as micro semiconductors on a single board. EDA tools also check physical as well as electrical design rules for all semiconductors. EDA has a special program that allows the designers to estimate the value of system performance and life cycle. Normally every product from electronics toys to satellites all designers are use EDA tools and services. Electronics has become even more complex, as well EDA is more important worldwide in the educational sector, in industry, as well as for the world economy.

##### 4.1 Table 1 of comparison of EDA tools:

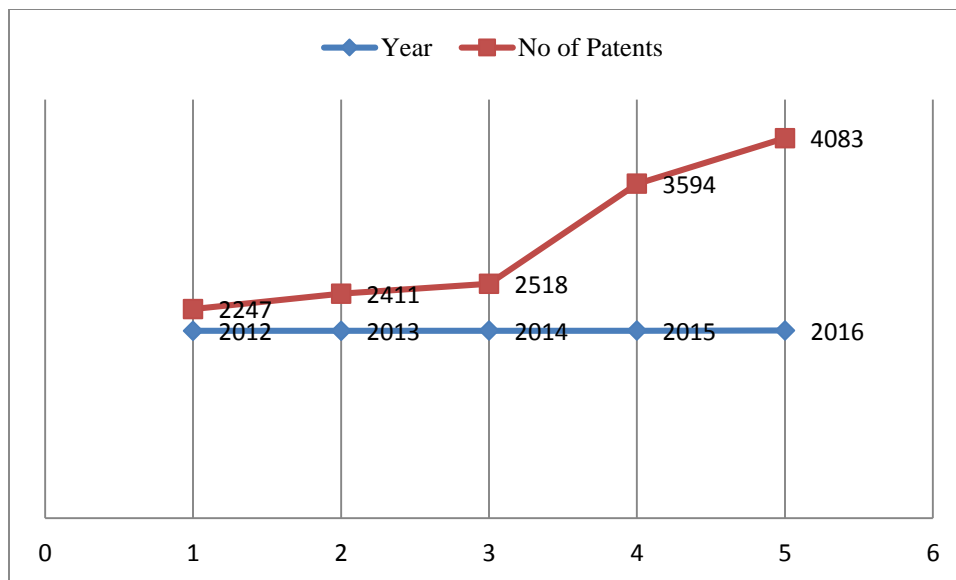
COMPONENT KINDS	QUCS	LTspice 1V	eSim (OSCAD)
Components with passive characteristics (e.g., Register, capacitor, inductor, etc.)	√	√	√
Devices that are active (such as transistors, diodes, and integrated circuits)	√	√	√
Power Sources (Voltage and Current)	√	√	√
<b>COMPONENTS OF THE DIGITAL WORLD</b>			
Gates like AND, OR, XOR, NOT	√	√	√
Gates like NAND, NOR, XNOR	√	X	√
SR, D Flip flop	√	√	√
JK, T Flipflop	√	X	√
VHDL Files	√	X	X
VERILOG Files	√	X	X
<b>ANATOMY TYPE</b>			
Transient	√	√	√

AC	√	√	√
DC	√	√	√
Digital	√	√	√
Equilibrium in harmonics	√	X	X
Parameter S	√	√	X
Sweep of parameters	√	X	X
Noise	√	√	X
Enhancement	√	X	X
Simulation of subcircuits	√	√	√
ALSO			
Is it compatible with Windows?	√	√	X
Tools available for free	√	X	√
Can we use another platform?	LINUX, SOLARIS, MAC	FOR LINUX WINE REQUIRED	LINUX
Format for spice netlists	X	√	√
Design of PCBs	X	X	√
Web app	X	X	√
Each step of the circuit equation	X	X	√
Check erc	X	X	√
Bom (bills of material)	X	√	√
It is possible to export the simulated data	√	√	√

Source: Electronic Design Automation Tool: a Comparative Study, March 2019, ResearchGate [2]

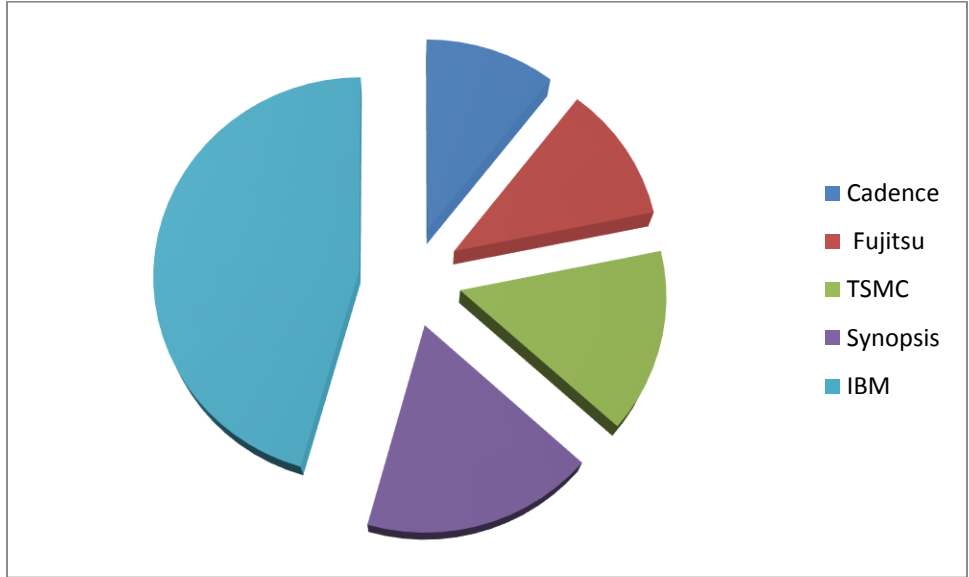
We can observe from the patent publication trend from the graph that the EDA tools industry is also growing rapidly all around. Among the major players, we see IBM and Cadence as well as Synopsys, Fujitsu, and TSMC.

**Graph 1: Trends in EDA, patent publication**



Source: Analysis data based on Legal Advantage's blog [6]

**Graph 2: Top patent assignees in the EDA domain**



Source: Analysis data based on Legal Advantage's blog [6]

## 5. CONCLUSION:

We have compared EDA tools using different parameters which are useful for beginners and students. Design and testing analog circuits can be done using tools with a proper GUI which are easily understood and easily used by students, engineers, and faculty members. From this paper, we can conclude that it is a good option to use testing, simulation techniques to design and test new analog and digital circuits. There is still much scope for a new EDA tool that can be performed more analysis as compared to the existing ones. However, the use of EDA tools offers a variety of possibilities for designing electronic circuits or chips, although they also have their downsides. In addition to being expensive, many EDA tools are difficult to install on a computer. Almost every EDA tool can be learned easily, and many EDA experts are available to help you achieve proficiency. Even though colleges have excellent tools to use, a lack of skilled instructors means that students aren't learning EDA, but moving into other domains, like software. In the early stages of education regarding EDA tools, if the costs of the EDA tools are kept at a reasonable level, more students can engage in the EDA domain, increasing expertise and accelerating growth in the EDA domain for Accelerating Growth of New India's Innovations.

## REFERENCES:

Md. Mydul Islam\*, Faysal Al Mahmud, Md.Haswan Maruf, and Md. Atiqul Islam, (June 2017). Survey on Electronics Design Automation Tools and Software, Dept of Electrical & Electronics Engineering, Green University of Bangladesh, Dhaka, Bangladesh. SEU Journal of Science and Engineering, Vol. 11, No.1

Poonam Dang, Harshal Arolkar, (Mar 2019). Electronic Design Automation Tool: a Comparative Study" International Journal for Research in Applied Science & Engineering Technology (IJRASET) Volume 7, Issue III.

T. Bhanu Praksah Reddy, (Aug 2019). Role of Electronic Design Automation in Circuit Design, Velagapudi Ramakrishna Siddhartha Engineering College, Vijaywada. Vol 6 Issue 3. ISSN: 2349-6002

Pinhong Chen, Desmond A. Kirkpatrick, Kurt Keutzer, (Feb 2001). Scripting for EDA Tools: A Case Study, Conference Paper, IEEE explore. INSPEC Accession Number: 6971045, DOI: 10.1109/ISQED.2001.915211

Fritzing Simulator and Layout Tool, (September 2021). Online Source tool, Retrieved from <https://fritzing.org/learning/tutorials/building-circuit>

Legal Advantage Blog, (April 24, 2017). EDA Tools. Retrieved from Online Source: <https://www.legaladvantage.net/blog/eda-tools/>

Max plus II compiler and simulator Tool, (2020). Retrieved from: <https://max-plus-ii-baseline.software.informer.com/10.2/>

S. Hassoun and T. Sasao, (2002). Logic Synthesis and Verification, Boston, MA, Kluwer Academic Publishers, 454 p.

W. Shum and J. H. Anderson, (Feb 2012). Analyzing and predicting the impact of CAD algorithm noise on FPGA speed performance and power, in Proceedings of the ACM/SIGDA international symposium on Field Programmable Gate Arrays (FPGA'12), pp. 107-110.

Dewey, A. (2000). Digital & Analog Electronic Design Automation, The electrical engineering handbook, CRC Press LLC, 2000.

Petr Fišer, Jan Schmidt, Jiří Balcárek, Faculty of Information Technology, Czech Technical University in Prague, (April 2014). Sources of bias in EDA tools and its influence, Prague, Czech Republic, Conference Paper. ResearchGate, DOI: 10.1109/DDECS.2014.6868803

Luciano Lavagno, Politecnico di Torino, Torino, Italy, Igor L. Markov, University of Michigan, Ann Arbor, Michigan, USA, Grant Martin, Cadence Design Systems, Inc, ( Feb 2016). Electronic Design Automation for IC Implementation, Circuit Design, and Process Technology. San Jose, California, USA, Louis K. Scheffer, Howard Hughes, Medical Institute, Ashburn, Virginia, USA. Version Date: 20160224. International Standard Book Number-13: 978-1-4822-5461-7.

## **INEVITABILITY OF CIVIL ENGINEERING IN A PERFECTLY PREPLANNED DISASTER MANAGEMENT**

**Mr. Prit Alkeshkumar Gandhi**  
**L.E. College, Morbi, Gujarat**

### **ABSTRACT**

A disaster is an unexpected extreme event, which results in the loss of property and life. This article is presented to describe the necessity of perfectly pre-planned disaster management. Here, various types of disasters are described with an explicit focus on hydro-meteorological disasters with their impact and influence zone. The historical data of the disaster occurrences in the world, India, and Gujarat state are discussed in brief. The influence of the disasters in terms of population affected and damaged to the properties is presented.

The disaster, natural or manmade, is responsible for the severe disturbance of the functioning of a society, causing widespread (human, material and environmental) damages, losses of property and lives, which exceeds the ability of the affected society to deal with using only its resources. This much description reveals why perfectly planned and fool-proof disaster management is inevitable. What are the roles of different fields of civil engineering in disaster management is also described in detail.

**KEYWORDS: Natural and Manmade disasters, Vulnerability, Disaster management**

### **1. INTRODUCTION**

There are two types of disasters: natural disasters and man-made disasters. Natural disasters include earthquake produced by sudden tectonic movements, volcanic eruptions, continued drought conditions, heavy floods, cyclones, etc. Man-made disasters include fire accident, road accident, terrorism, nuclear disasters, chemical accidents, biological disasters etc. A disaster of any kind, manmade or natural, is a combined effect of threats and hazards like floods, cyclone, drought, etc. and vulnerabilities of society, cities or villages. There are no disasters without vulnerability or hazard. A hazard is defined as a phenomenon that poses a risk to the community or system which may cause disaster. Vulnerability is the ability of a society or a system to resist the forces and impacts of hazard [1]. The disaster is a product of hazards and vulnerability. The major categories of disasters are as follows.

1. Hydro-meteorological disasters like flood, cyclone, and drought.
2. Geological disasters like earthquake, landslide, and volcanoes.
3. Technological disasters like nuclear and chemical accidents.
4. The word 'disaster' originated from the Old Italian word disaster. In Latin and Greek meaning of disaster is "bad star" which means the destruction of the star.

The geo-climatic conditions, a high scale of socioeconomic vulnerability, large population below the poverty line (BPL) etc. altogether make India one of the most disasters facing nation in the world. Every year, India is facing destructive effects of the cyclone, flood, drought, cloudburst, which results in the damage of the properties and losses of life.



## 2. DEFINITIONS OF DISASTERS

Certain definition of disaster or calamity is given hereunder.

- A sudden occurrence of an accident that causes an enormous loss of life and property is called a calamity or a disaster.
- An unexpected natural or man-made catastrophe of substantial extent causing significant physical damage or destruction, loss of life or sometimes permanent change to the natural environment is known to be a disaster.
- Disaster is also sometimes described as a catastrophic situation in which the usual pattern of life or ecosystem is disrupted and extraordinary emergency interventions are required to save and preserve lives and the environment [2].
- A catastrophe, mishap, calamity or grave occurrence in any area, arising from natural or man-made causes, or by accident or negligence which results in substantial loss of life or human suffering or damage and destruction of property, or degradation of the environment, and is of such a nature or magnitude as to be beyond the coping capacity of the community of the affected area [3].
- The occurrence of sudden or significant misfortune event which disrupts the basic fabric and normal functioning of the society or community [4].

## 3. NATURAL DISASTERS

The number of deaths from natural disasters has been varying from year to year; some years pass with very few deaths before a large disaster event takes many lives away. For many decades, ~60,000 people globally died from natural disasters each year, i.e. only ~0.1% of global deaths. In many years, the number of deaths can be very low, often less than 10,000, and accounting for as low as ~0.01% of total deaths. But we also see some distressing impact of shock events: famine and drought (Ethiopia, 1983-85), Gujarat Earthquake (Katchchh, Saurashtra and Gujarat, 2001), Indian Ocean earthquake and tsunami (2004); Nargis Cyclone (Myanmar 2008), Port-au-Prince earthquake (Haiti, 2010). These and many such events pushed global disasters deaths to over ~200,000 lives which is more than ~0.4% of deaths in these years. Low-frequency, high-impact events (earthquakes or tsunamis) are unpreventable. The world has seen a significant reduction in disaster deaths through earlier prediction, more robustly resistant infrastructure, emergency preparedness and response systems with proper tactfully predesigned disaster management [5].

Those low-income groups (LIGs) are often the most vulnerable to disaster happenings, so improving living standards, infrastructure and response systems in these regions is the key to preventing deaths from natural disasters in the upcoming decades. Globally, over the past decade, natural disasters accounted for an average of  $\cong 0.1\%$  of total deaths. This was, however, highly variable to high-impact events and ranged from  $\cong 0.01\%$  to  $0.4\%$  of total deaths. What we see is that in the early-to-mid 20<sup>th</sup> century, the annual death toll from disasters was high, often reaching over one million per year. In recent decades we have seen a substantial decline in deaths. In most years fewer than ~20,000 dies (and in the most recent decade, this has often been  $\leq 10,000$ ). Even in peak years with high-impact disasters, the death toll has not exceeded ~500,000 since the mid-1960s. This decline is even more significant when the population growth rate over this period is considered. When it is corrected for population, showing this data in terms of death rates (per 100,000 people), even more decline over the past century is seen. A significant decline in deaths from almost all types of disasters with exception of earthquakes and extreme weather is also observed [5].

The reduction in the death rate is even more impressive. When the world population has grown rapidly over this period; one of the major successes over the past century has been the dramatic decline in global deaths from natural disasters. Behind this improvement has been the improvement in living standards; access to and growth of strong infrastructure; and effective response systems. These factors have been driven by an upsurge in incomes across the world. Today, the populations in low-income countries, those where a large percentage of the population is still in extreme poverty and mark low on the social or Human Development Index, have been more vulnerable to the effects of natural disasters.

Highly developed countries are much more resilient to disasters and so have a consistently low death rate from natural disasters. This does not mean that low-income countries have high death rates by disasters every year. In most years they also have very low death rates. But in the low-frequency, high-impact disasters, they are particularly vulnerable to its effects. Overall development, poverty lessening, and knowledge-sharing of how to increase resilience to natural disasters will therefore be the key to reducing the disasters-toll in the years to come [5].

#### 4. TYPES OF DISASTERS

The disasters identified by the high power committee on disaster management constituted in 1999 under National Disaster Management Authority (NMDA) [3, 6] is identified in **Table 1**.

*Table 1: Different Types of Disasters [6].*

Sr.	Type Of Disasters	Examples
01	Climatical Disasters	Floods, Cyclones, Tornadoes, Cloud Burst, Droughts, Heat Wave and Cold Wave
02	Geological Disasters	Earthquakes, Landslides and Mudflows, Dam Break/Dam Bursts, Minor Fires
03	Chemical, Industrial and Nuclear Disasters	Chemical Disasters, Industrial Disasters, Nuclear Reactor Disasters
04	Accidental Disasters	Forest Fires, Oil Spills, Mine Flooding, Urban Fires, Village Fire, Electrical Disasters, Road/Rail/Air Accidents, Boat Capsizing, Bomb Blasts.
05	Biological Disasters	Epidemics, Pandemics, Pest Attacks, Food Poisoning, Cattle Epidemics

#### 5. DISASTERS WORLDWIDE

During the 2<sup>nd</sup> half of the 20<sup>th</sup> century, more than 200 horrific natural disasters were happened in different countries of the world and caused a loss of lives of ~1.4 million. Losses due to natural disasters are ~20 times more in developing countries. Asia is having a topmost in causalities and loss of lives due to natural disasters.

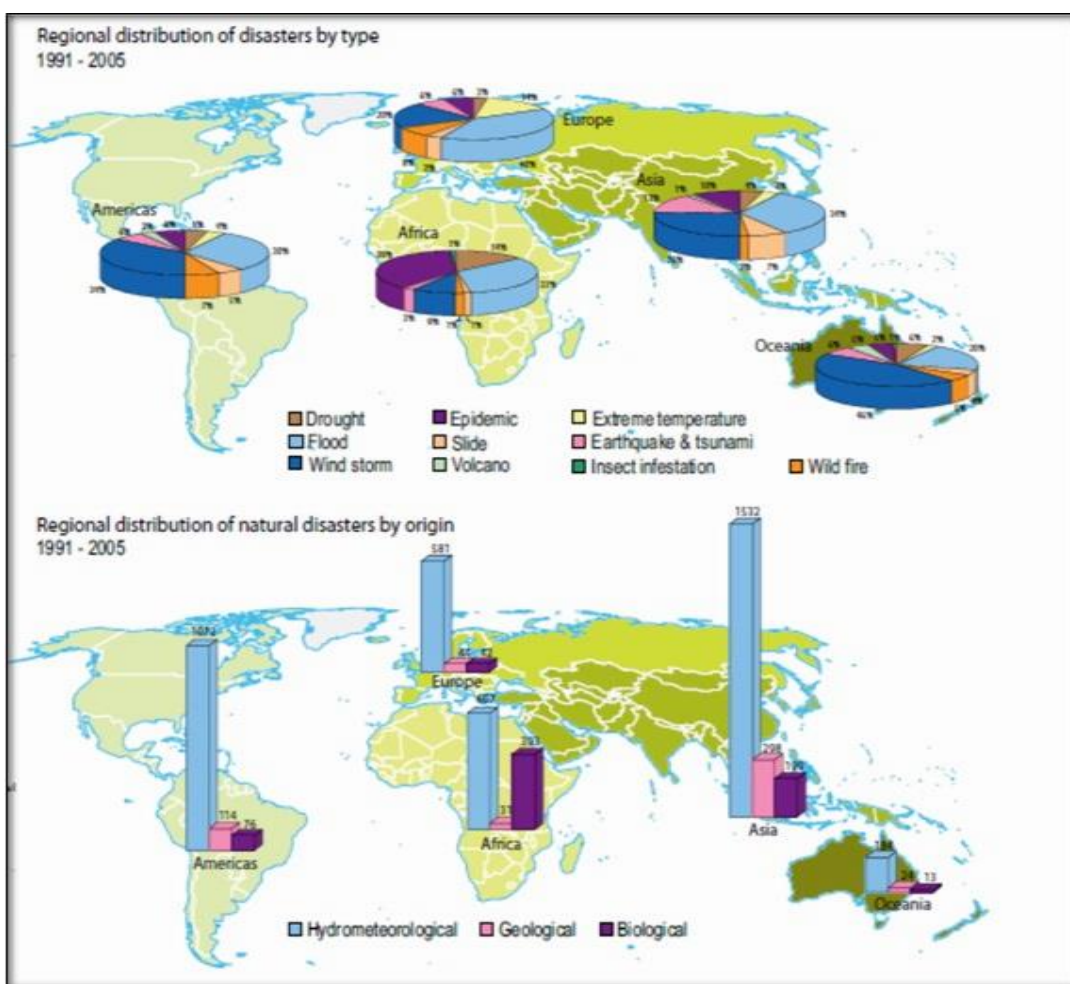
##### 5.1 Major Disasters Worldwide

During 1991-2005, the world was heavily affected by natural disasters like flood, windstorm, epidemic, earthquake, tsunami, drought, wildfires, high temperatures, landslides, volcano, etc. According to the centre for research on the epidemiology of disaster (CRED)[7], the contribution of different factors is given in **table 2**.

**Table 2: Different Elements / Factors Responsible for Disasters Worldwide[7].**

No	Disaster Type	World (~%)	Africa (~%)	Asia (~%)	Europe (~%)	U.S.A. (~%)	Lands of Pacific Ocean
1	Flood	32	33	34	40	30	20
2	Wind Storm	25	09	26	20	34	46
3	Epidemic	13	38	10	06	06	05
4	Earthquake/ Tsunami	08	03	13	06	06	06
5	Drought	06	14	04	03	05	06
6	Land Slide	05	01	07	03	05	04
7	Wild Fire	04	01	02	08	07	05
8	Extreme Temperature	04	*	03	14	04	02
9	Volcanic Irruption	02	*	01	*	03	05
10	Insect Infestation	01	01	*	*	*	01

Results\* < ~ 0.5% are not shown and the box left blank.



**Figure 1: Regional Distributions of Disasters [8].**

A close look at **figure 1** reveals the regional distributions of the disasters worldwide [8]. **Figure 2** to **15**[9-10] show different graphs and charts presenting global data concerning disasters. **Figure 2** shows an Annual number of weather and non-weather types of natural disaster events globally from 2000 to the recent time, categorized by type. Due to the natural disaster from 1990-2017, **figure 3** shows the global estimates of the number of deaths from the natural disasters differentiated by the disaster type. **Figure 4** describes the global estimates of the number of deaths from natural disasters differentiated by disaster type. **Figure 5** provides an insight into the weather and nonweather related global disaster losses in economic terms expressed as a share of global gross domestic product (G-GDP). **Figure 6** brings awareness about the year wise total economic cost of damages as a result of global natural disasters, and the same due to flood only is shown in **figure 7**. **Figure 8** describes the absolute or annual number of deaths or death rate from all forms of natural disasters and the same due to the flood only is shown in **figure 9**. **Figure 10** shows the global natural disaster death rates due to all-natural disasters, while the same due to flood is given in **figure 11**. **Figure 12** is the graph of the number of natural disaster events from 1900 to 2019 and the same for flood is shown in **figure 13**. **Figure 14** describes the total number of deaths due to natural disasters worldwide. **Figure 15** shows global economic losses from disasters as a share of GDP. All figures [9-10] comprise the data of all types of natural disasters including drought, flood, extreme weather, extreme temperature, landslides, dry mass movement, wildfires, volcanic activities and earthquakes; except where specifically flood is not considered.

**Table 3** [11] describes the world's deadliest disasters in the last century. According to the presented statistics, the Asian countries profoundly affected by the natural disaster than USA and other regions. China is profoundly affected by flood in the last century, while Bangladesh is affected by the cyclone. Heavy earthquake is affected by Japan, China, and Turkey. If individual disasters are considered, then the world has been heavily affected by flood and windstorm compared to other disasters [7].

*Table 3: World Deadliest Disasters in the Last Century [11].*

Sr.	Name of Event	Year	Country and Area
1	China Floods	1931	China
2	China Floods	1954	China
3	Bangladesh Cyclone	1970	Bangladesh, Chittagong, Khulna
4	Bangladesh Cyclone	1991	Bangladesh
5	Earthquake	1999	Turkey
6	Tsunami	2004	Indonesia, Srilanka, Malaysia, Somalia, Bangladesh, Thailand
7	Hurricane Katrina	2005	United States of America
8	Sichuan Earthquake	2008	China
10	Cyclone Nargis	2008	Myanmar
11	Haiti Earthquake	2010	Haiti

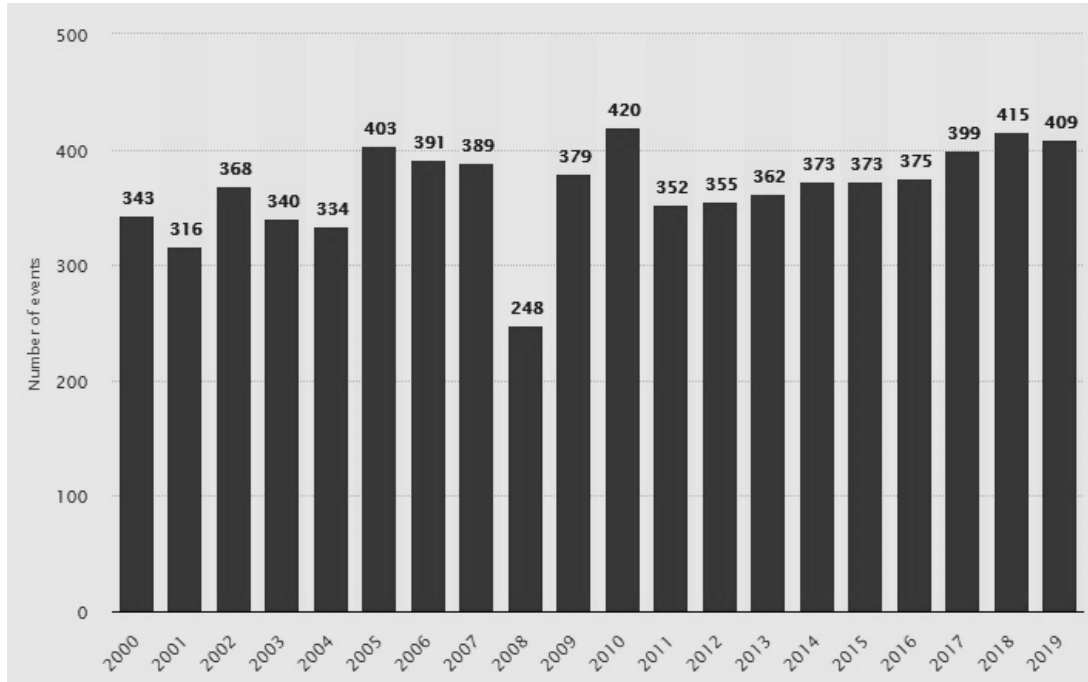


Figure 2: Global Data of Annual Number of Natural Disasters [9, 10].

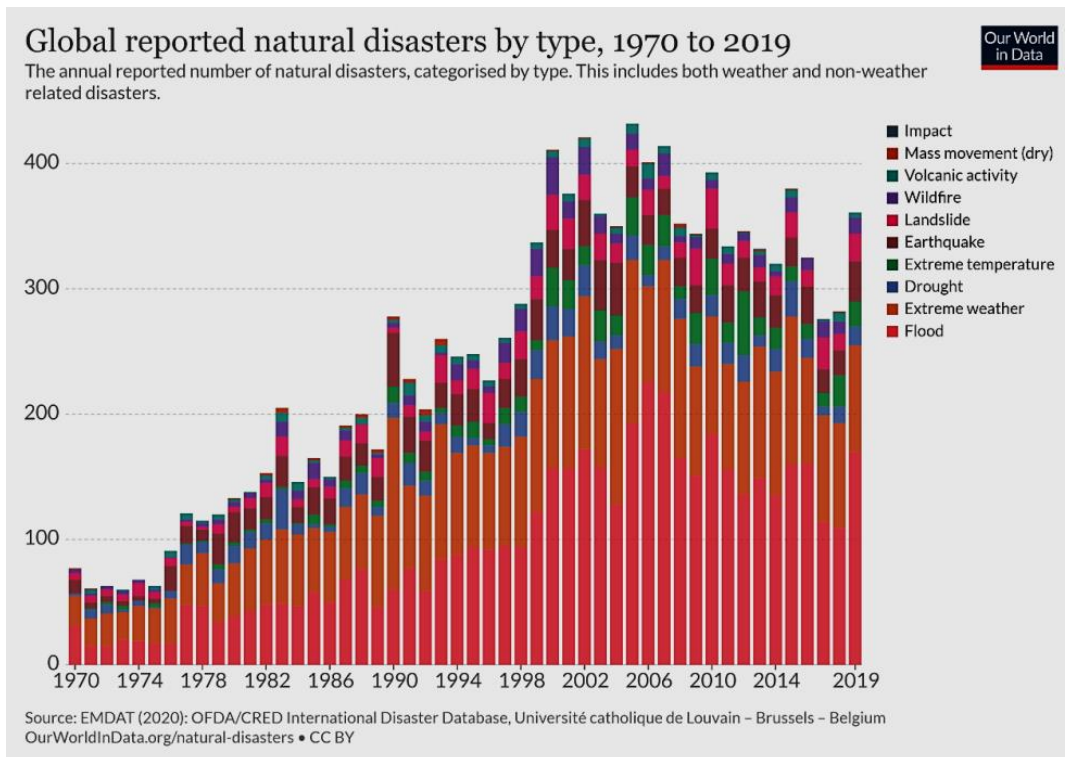


Figure 3: Globally Reported Worldwide Natural Disasters by Type [9, 10].

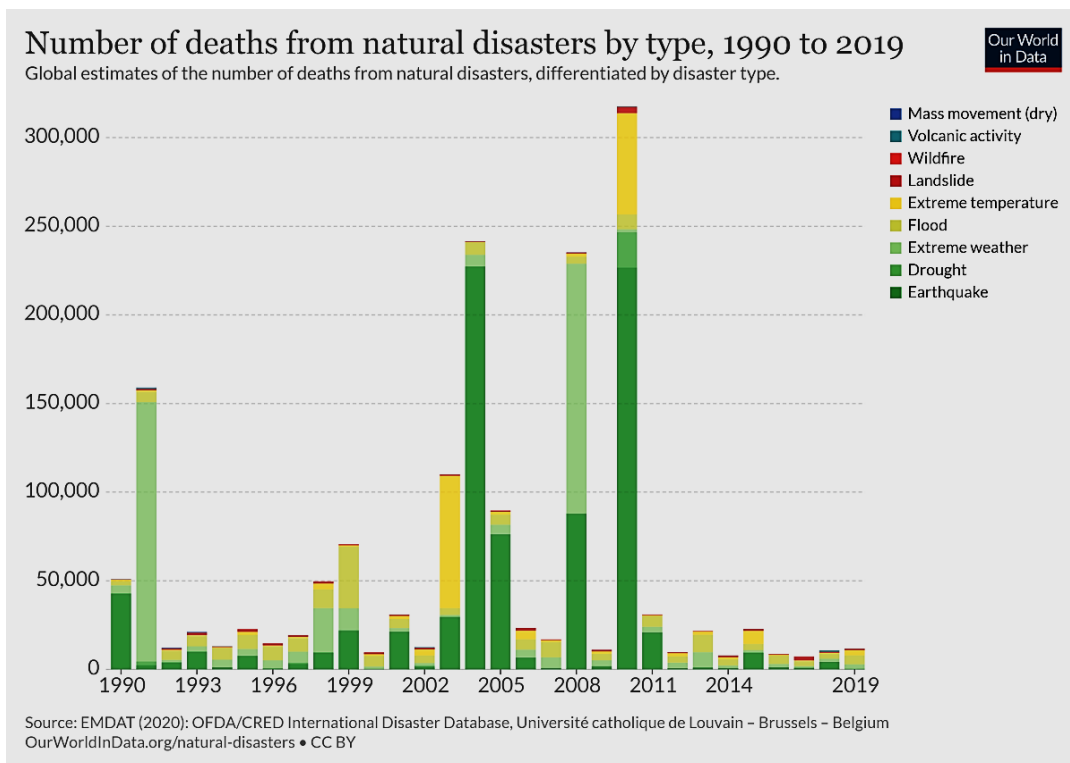


Figure 4: Number of Deaths from the Natural Disasters by Type World –Wide [9, 10].

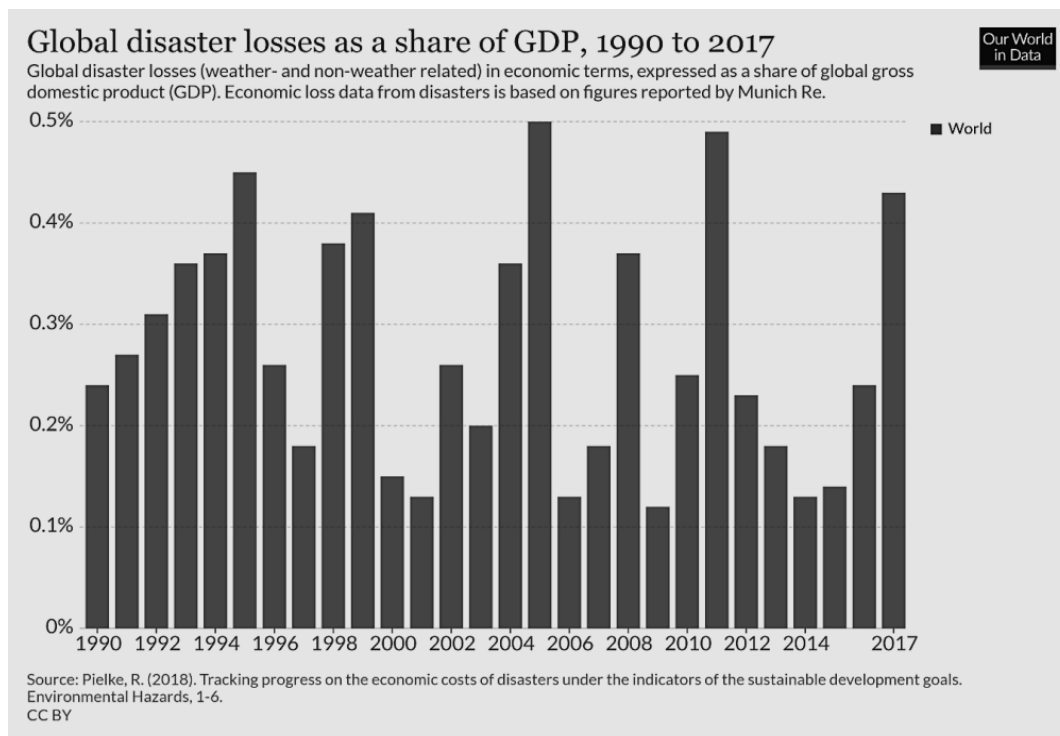


Figure 5: Global Disaster Losses as a Share of GDP [9, 10].

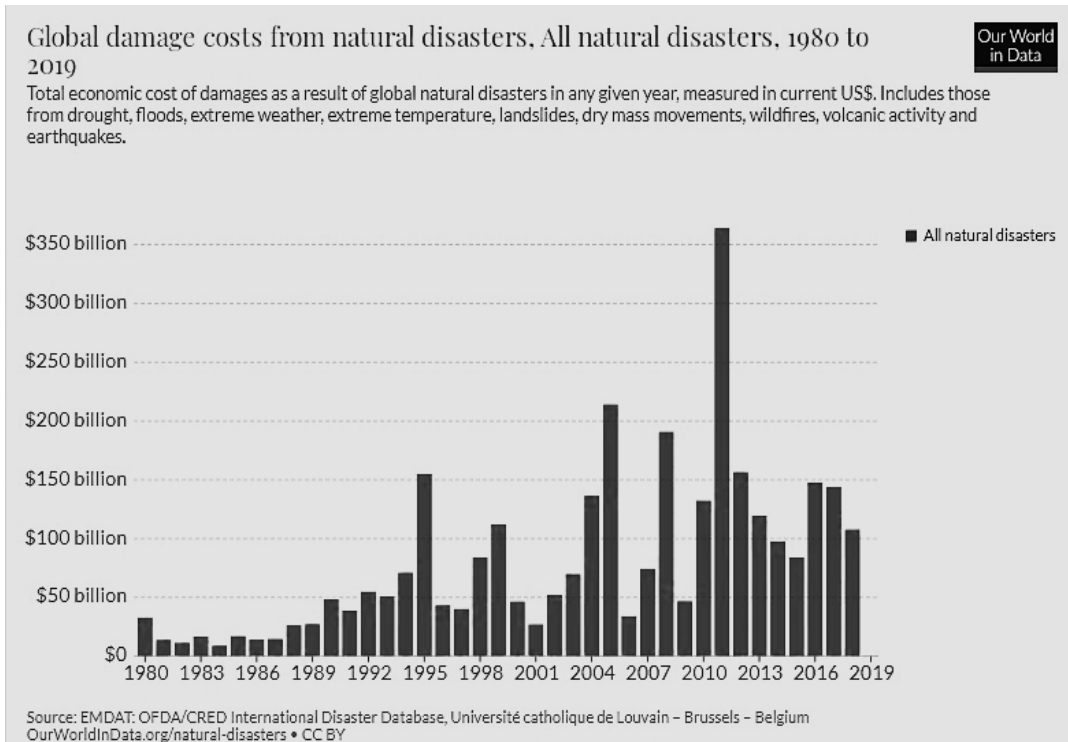


Figure 6: Global Damage Costs from All Natural Disasters [9, 10].

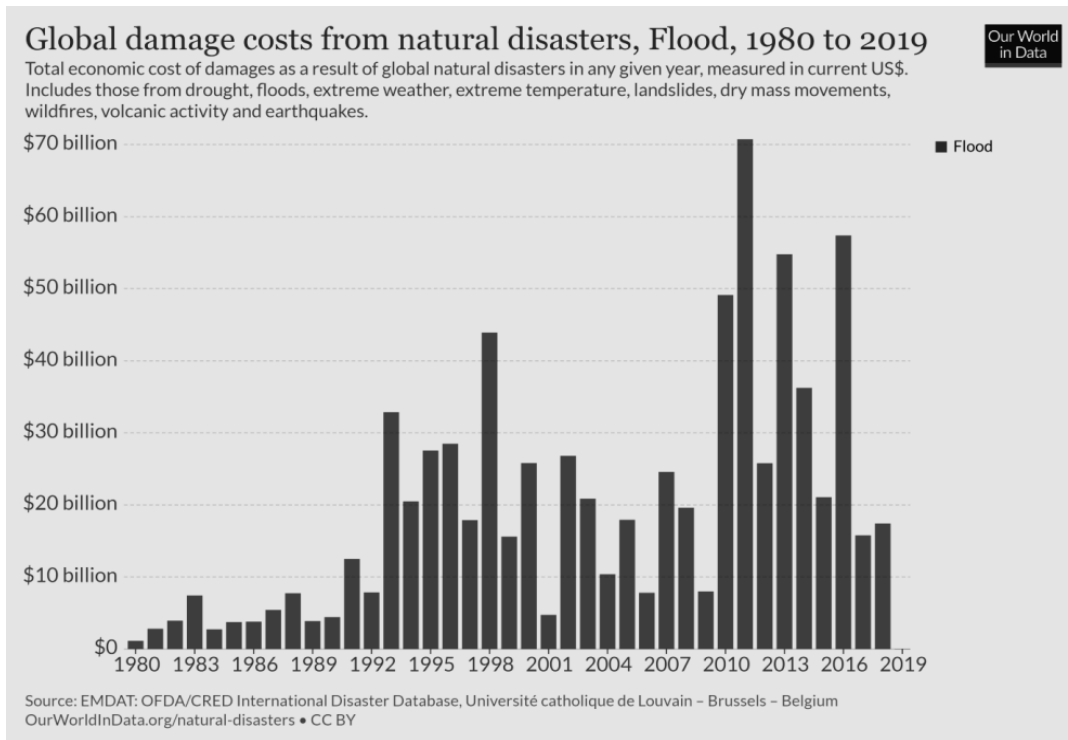


Figure 7: Global Damage Costs from the Flood [9, 10].

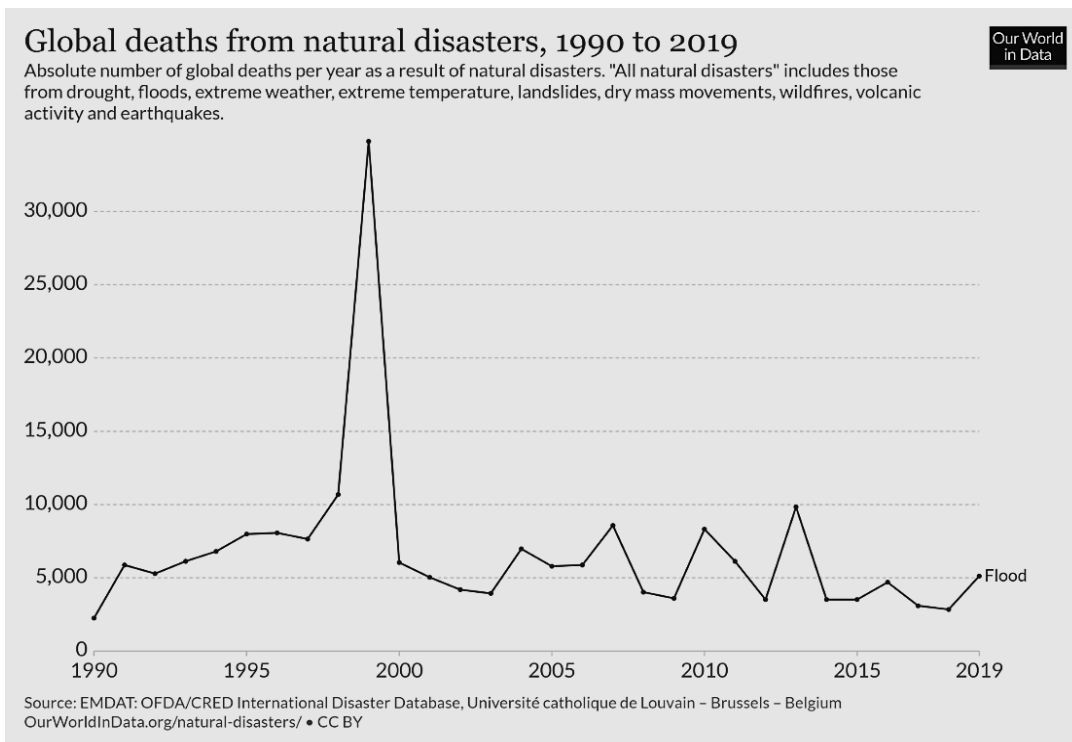


Figure 8: Deaths from the Natural Disasters Worldwide [9, 10].

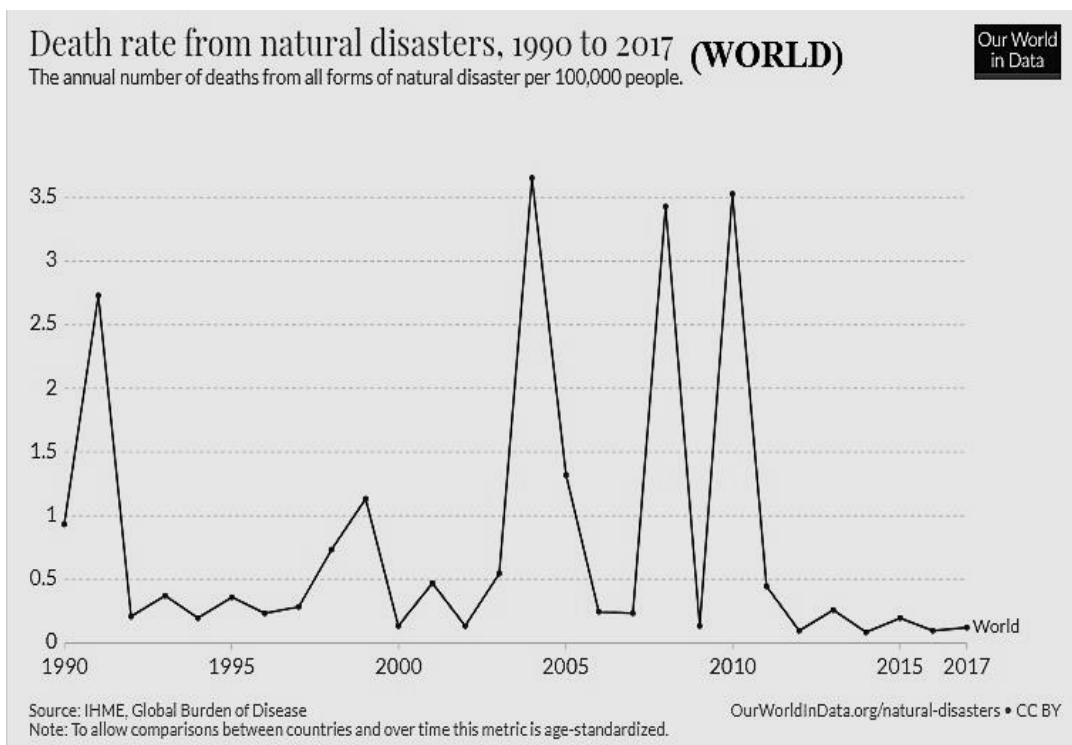
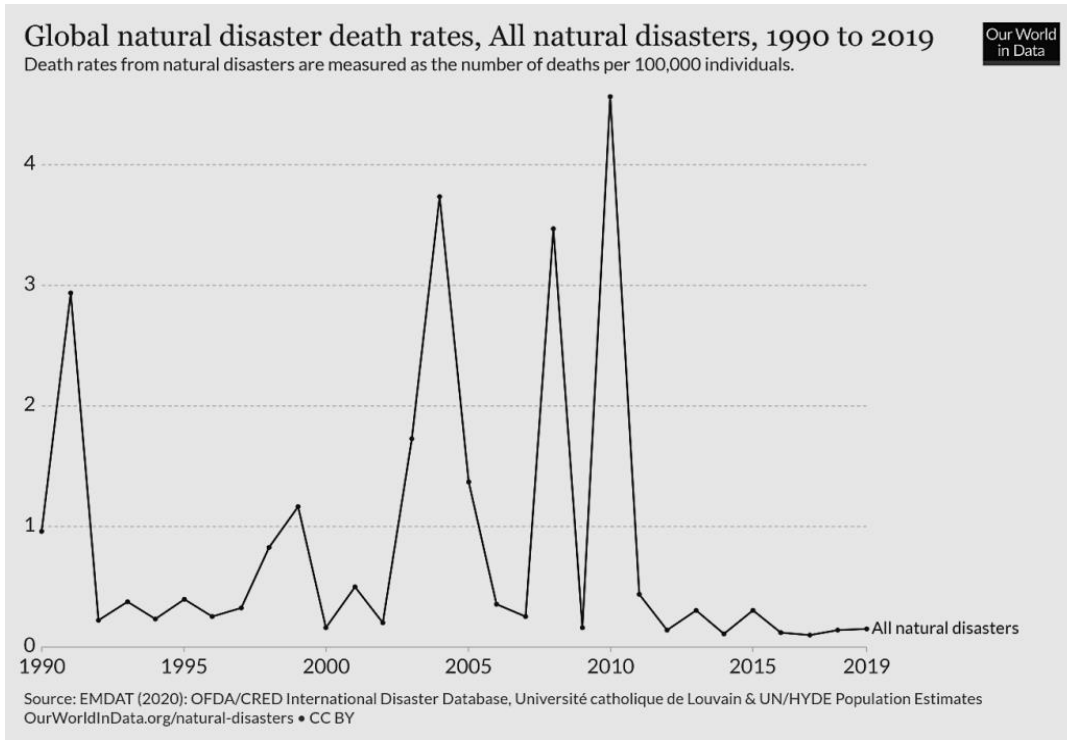
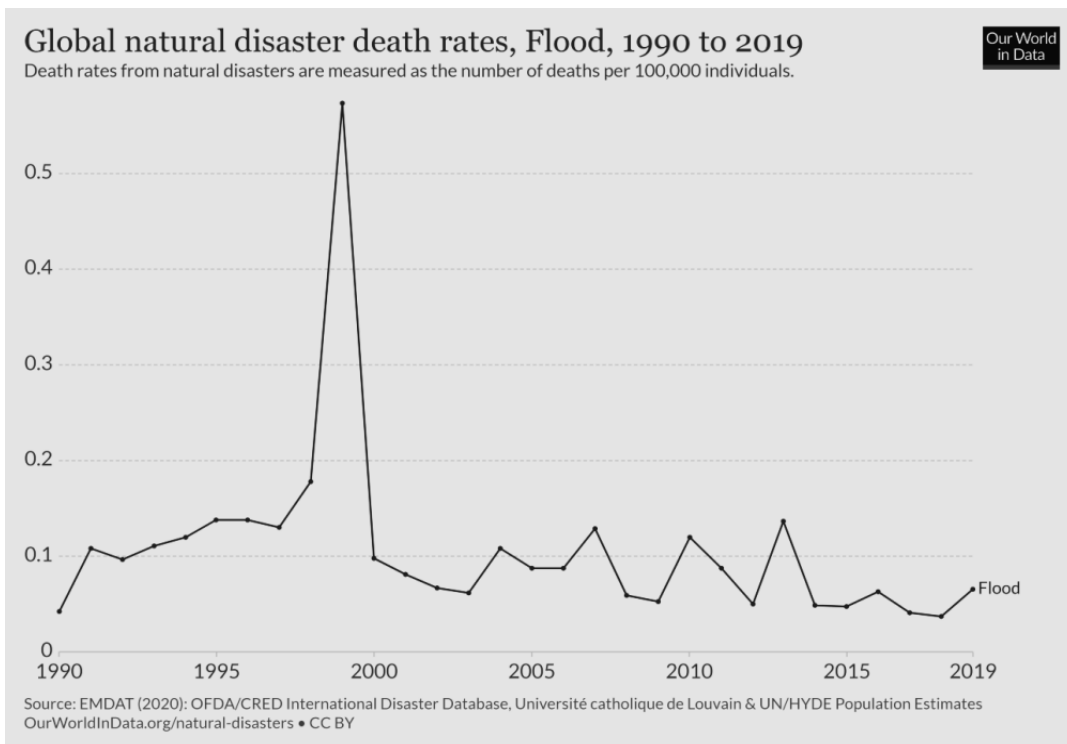


Figure 9: Worldwide Death Rate from Natural Disasters [9, 10].

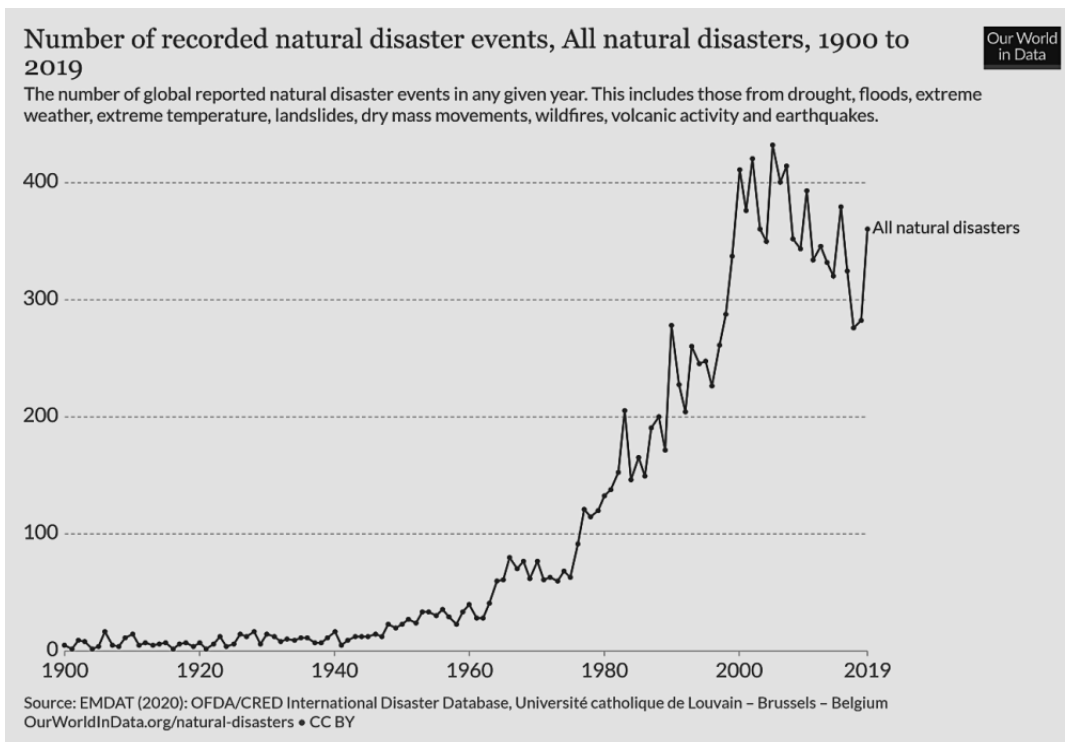




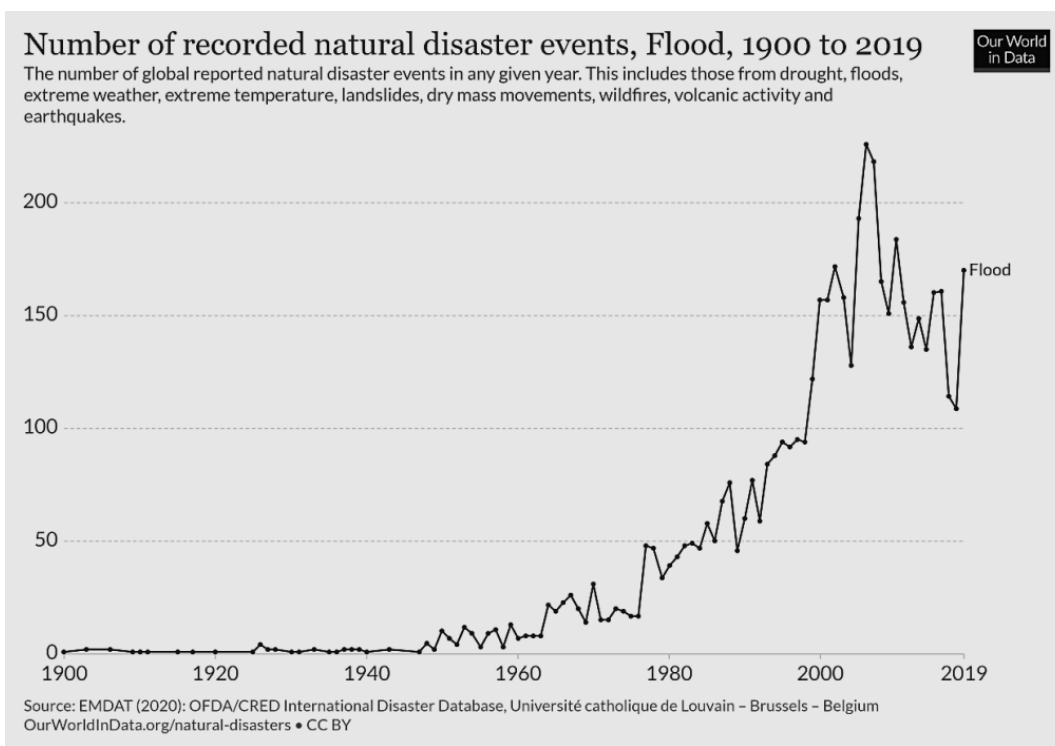
**Figure 10: Global Death Rates due to all Natural Disasters [9, 10].**



**Figure 11: Global Death Rates due to Flood [9, 10].**



**Figure 12: Number of Natural Disaster Events Year Wise-World Wide [9, 10].**



**Figure 13: Number of floods Yearwise World Wide [9, 10].**

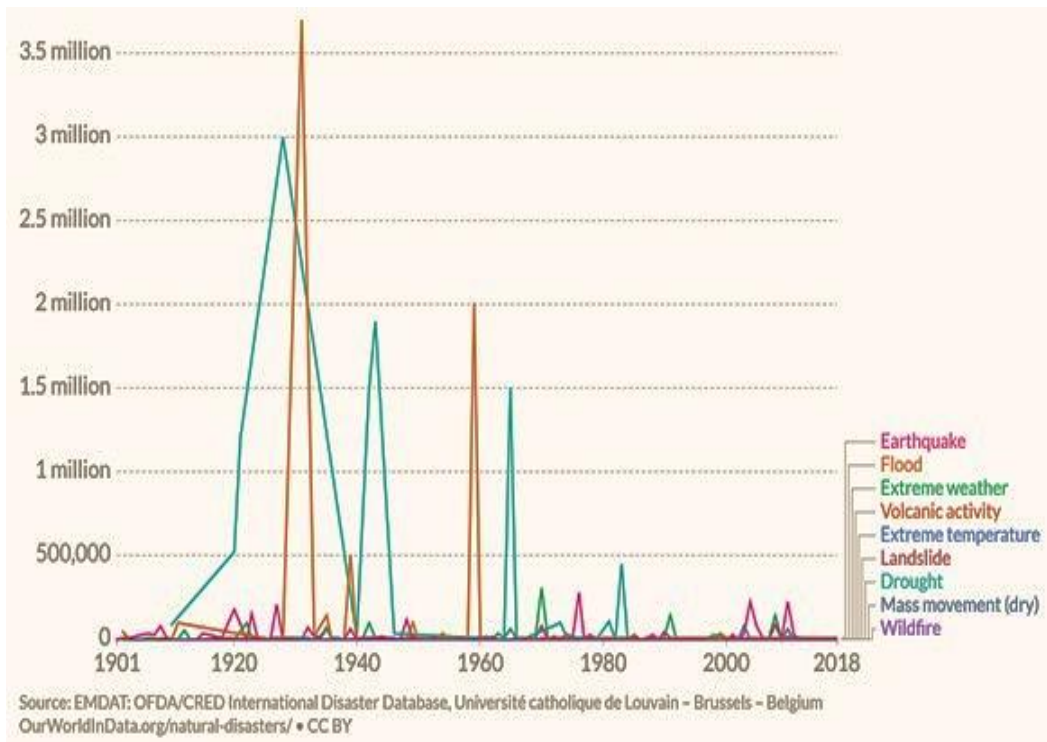


Figure 14: Total Number of Deaths in the World Due to Natural Disasters [9, 10].

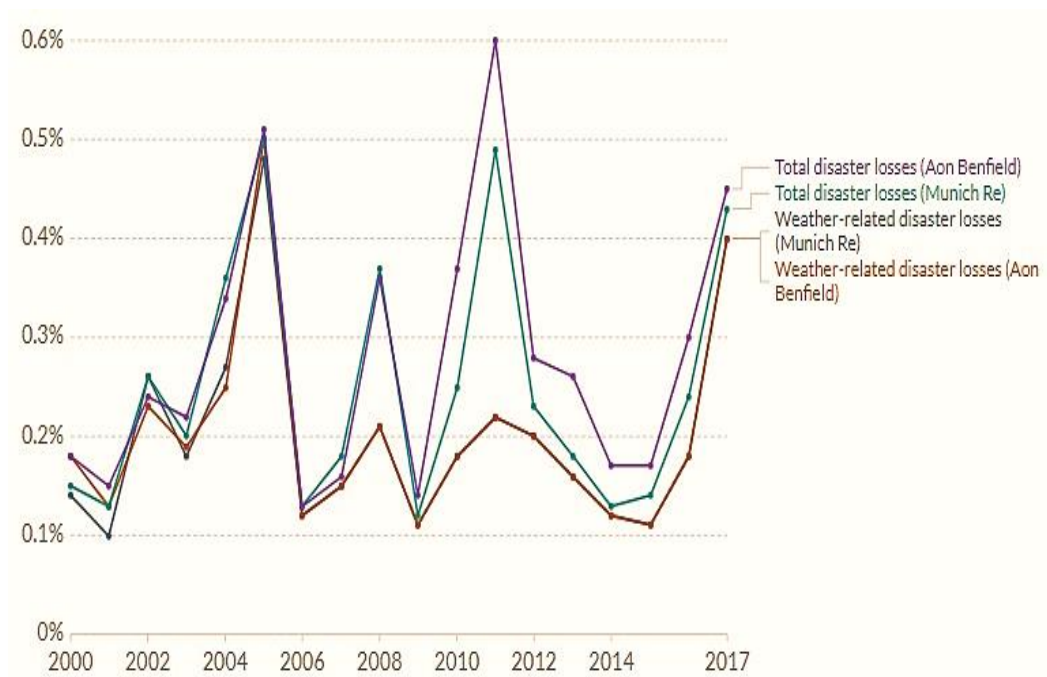


Figure 15: Global Economic Losses from Disasters as a Share of GDP [9, 10].

## 5.1 Impact of Disasters

Natural disasters like flood, cyclone, and earthquake are resulting in substantial loss of human lives and property. **Table 4** shows the total loss of properties and human during various kinds of disaster in 2005-14 and the average data of the last 30 years.

*Table 4: Impact of Natural Disaster in World [11]*

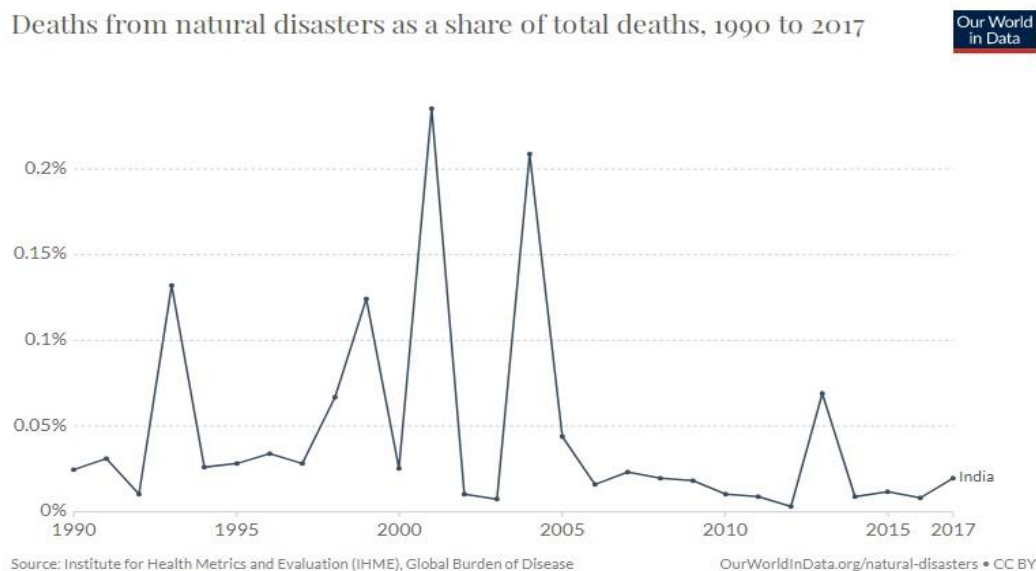
Time Span → Disasters and Loss ↓	During 2015	During 2014	Last 10 Years (2005-14)	Last 30 Years (1985-2014)
Number of Disasters	377	341	4,042	10,322
Property Loss (Approx.) M US\$	70,960	97,770	14,30,551	25,61,999
Loss of Human Lives	23,774	20,809	8,22,325	19,47,947

## 6. DISASTERS AT INDIA LEVEL

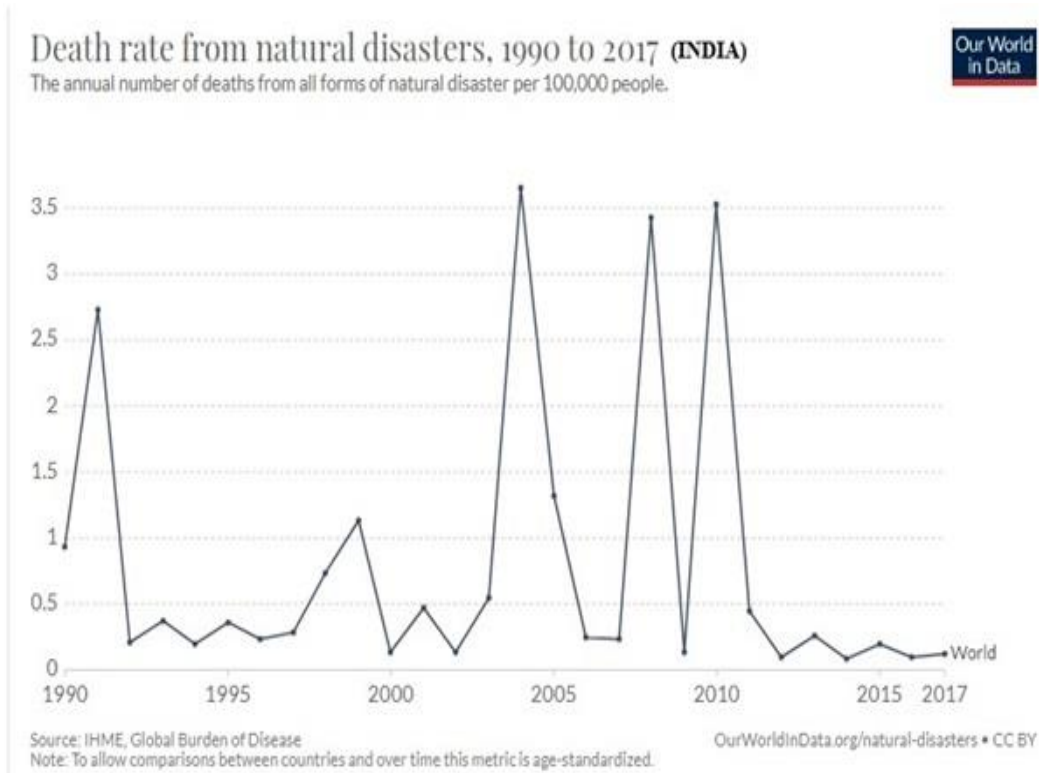
In India due to geo-climatic and socio-economic conditions and large populations are responsible for various disasters. During the time of the last thirty years, India has been struck by 431 natural and man-made disasters resulting in vast losses of life and property. In the last three decades, almost ~1.43 lakh people have lost their lives and 150 crore were affected due to various natural and man-made disasters. The total estimation of properties and other infrastructures loss is more than 4800 crore US\$ according to the prevention of web statistics. The number of deaths and the death rate in India are shown in **figures 16** and **17**[9, 10] respectively.

### 6.1 Major Disasters in India

The hazard vulnerability map of India [12] is displayed in **figure 18**. During 1980-2010, the majority of 25 major disasters took place. Also, drought, heat-wave, cold-wave, coastal erosion and storm surge are affecting some of the areas of the country. In the world, India is one of the ten disasters prone country. This is due to manmade reasons like population growth, urbanization, rapid industrialization, non-scientific development practices etc. and natural factors like different geo-climatic conditions, topographic features, pollution, degradation of natural sources, etc.



**Figure 16: Figure 16: Deaths in INDIA due to Natural Disasters [9, 10].**



**Figure 17: Death Rate in India due to Natural Disasters [9, 10].**

Due to geological as well as geographical situations, India is highly vulnerable to natural disasters. The Himalayan region is prone to landslides and earthquakes. Every year, the plain area is affected by massive floods, a significant desert area in Kachchh-Gujarat and Rajasthan are prone to drought. While the sizeable coastal area is susceptible to storms and cyclones. Details about India’s major deadliest disasters of the last century has been given in **Table 5** [11].

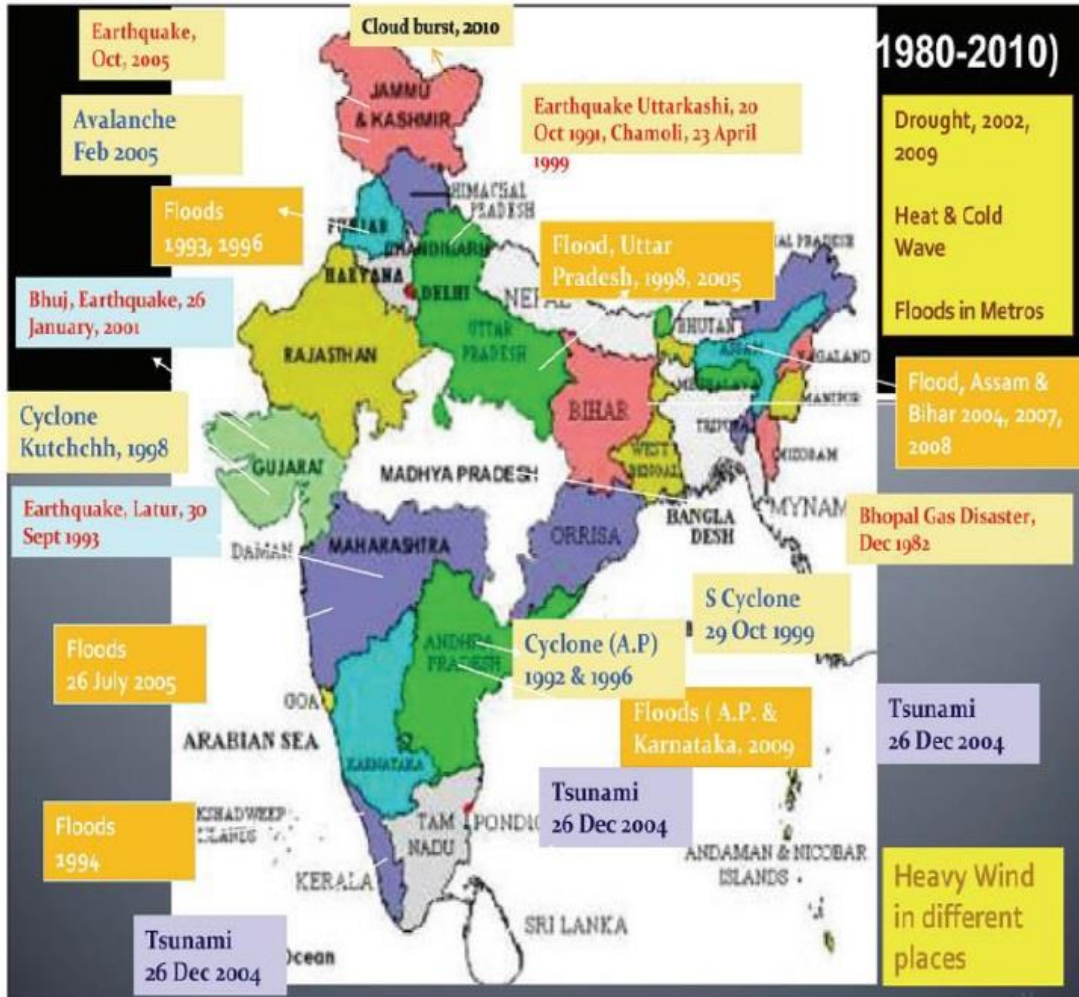


Figure 18: Scenario of Major Disasters in India from 1980-2010 [12].

Table 5: India's Deadliest Disasters in the Last Century [11].

Sr.	Name of Event	Year	State and Area
1	Earthquake	1905	Kangra, Himachal Pradesh.
2	Cyclone	1977	Andhra Pradesh.
3	Latur Earthquake	1993	Latur, Marathwada, Regions of Maharashtra.
4	Orissa Super Cyclone	1999	Orissa.
5	Gujarat Earthquake	2001	Bhuj, Bhachau, Anjar, Ahmedabad, Surat and all major areas of Saurashtra-Katchchh in Gujarat State.
6	Tsunami	2004	The coastline of Kerala, Tamil Nadu, Andhra Pradesh and Pondicherry, Andaman and Nicobar Islands.
7	Maharashtra Floods	2005	Maharashtra.
8	Kashmir Earthquake	2005	Kashmir.
9	Bihar Floods	2008	Tamil Nadu.
10	Nisha Cyclone	2008	Tamil Nadu.

Most natural disasters in India are related to the climate of India and cause massive losses of life in addition to properties. Natural disasters like Droughts, floods, flash-floods (Cloudbursts), cyclones, hurricanes, avalanches, land-slides by torrential rains, snowstorms, earthquakes, etc. pose extreme threats. To be classified as a disaster it should have a profound environmental effect and/or human loss and frequently incurs monetary loss. Other dangers include frequent summer dust storms, which generally track from north to south, cause extensive property damage in Northern India [13, 14] and deposit a huge amount of dirt-dust from dry and waterlessbarren regions. In some parts of India, Hail causes severe damage to standing crops such as rice and wheat and many more crops.

## 6.2 Impacts of Disasters

*Table 6: Impact of Natural Disasters in India [11].*

Time Span → Disasters and Loss↓	During 2015	During 2014	Last 10 years (2005-14)	Last 30 years (1985-2014)
Number of Events	21	16	168	429
Approximate loss of Property in Million US\$	3,949	23,263	43,975	75,420
Loss of Human Lives	3,391	1,064	23,840	1,37,160

**Table 6** [11] provides the effect of natural disasters in India regarding the loss of property and human lives. From this data, it is clear that during the last 30 years ~1.38 lakh people have lost their lives besides the estimated property loss of 76 billion US\$.

## 7. DISASTERS AT GUJARAT LEVEL

Because of climatic conditions, geological features and physical features, 1600 km coastal area Gujarat, which is the longest in India, is highly vulnerable to all significant and major natural hazards like drought, flood, cyclone, earthquake, tsunami, etc. Natural disasters in Gujarat is tabularized in **table 6**. Because of the development of chemical and pharmaceutical industries, Gujarat state is also vulnerable to chemical disasters and industrial disasters. Major Accident Hazard (MAH) units are located Vapi, Hazira, Ankleshwar, Dahej, Jamnagar etc in Gujarat. The incidences of biological disasters are man-made disasters such as transportation accidents, terror attacks, radiological leakage is most probable in the state.

*Table 7: Deadliest Disasters Gujarat in the Last Century [12].*

Sr. No.	Name of Event	Year	Area
1	Earthquake MW 6.1	1945	Anjar (Kachchh)
2	Flood	1979	Morbi.
3	Cyclone 125 KM/Hr.	1981	West Veraval and Porbandar.
4	Cyclone 200 KM/Hr.	1982	Saurashtra region.
5	Drought	1984 to 1987	A different region of the state-Saurashtra and Kachchh regions are more affected.
6	Cyclone	1998	Porbandar.
7	Earth quake MW 7.9	2001	Kachchh.
8	Drought	2001&2002	A different region of the State-Saurashtra and Kachchh regions were more affected.

9	Flood	2006	Surat city and south and central Gujarat.
10	Flood	2013&14	Bharuch, Narmada and Vadodara districts.

### 7.1 Major Disasters in Gujarat

Look at **table 7**. Gujarat is highly vulnerable to natural hazards like earthquake, flood, cyclone, tsunami, drought and man-made hazards like industrial (chemical) accidents. The vulnerability to the Gujarat state for these natural hazards is described above [15].

*Table 8: Impact of Natural Disaster in Gujarat [15].*

Time Span → Disasters and Loss ↓	During 2015	During 2014	Last 10 years (2005-14)	Last 30 years (1985-2014)
Number of Events	2	2	6	14
Approx. Property Loss MUS\$	604	904	3,000	9,580
Loss of Human Lives	156	27	302	14,991

## 8. CIVIL ENGINEERING IN DISASTER MANAGEMENT

Disaster management is the creation of plans through which people reduce vulnerability to hazards and cope with disasters. Apart from the old concept, occasionally disaster management prevent or eliminate the threats instead, as mostly found, it focuses on creating plans to decrease the effect of disasters, save people, property and reestablishment of environment and ecosystem. When a natural catastrophe or man-made disaster happens on a large scale, a disaster management team of trained and skilled persons come to rescue the people trapped in the calamity and successfully handle situations in difficult times. A well-proper planning and careful execution of technical support can decrease the tangible destruction in disasters. With a strong team of engineers, one can reduce the magnitude of damage and save thousands of lives. Engineers; and especially civil engineers play a key role in this disaster and emergency management. The majority of disasters are due to improper town-planning, structural design failure, insufficient infrastructural facilities, unawareness of building construction and maintenance norms, substandard building materials and lack of site survey investigations. All different specialist civil engineers like surveyors, cityplanners, construction managers, structural engineers, geotechnical engineers, marine engineers etc. have their active role in disaster management and mitigation.

For a disaster-prone country like India, disaster management is essentially a crucial subject. Due to the topography and the climate-change, every year, on average 50 million Indians are affected by disasters besides massive property-loss in millions. Annual droughts, flash floods, avalanches, landslides make 24 to 26 of the 35 states and Union territories, disaster-prone. India loses about ~2% of our GDP on an average to disasters [16]. So, disaster management is a very crucial issue wherein civil engineering with each branch has its own vital role to play.

For successful planning and implementation of disaster management, capacity building, the topography of the land, city planning are vital factors. Though the Nonstructural elements help in preparedness, the significance of structural elements must not be overlooked. The role of a civil engineer comes in when the structural aspect of disaster management is considered. The study of modern technologies such as base isolation methods and stress on forensic and earthquake engineering can reduce the damage. Studies on geotechnical and hydraulic engineering reduce the occurrence of landslides. Civil engineers made ensure that damaged roads can be constructed immediately. A strong building foundation



prevents the risk of its collapsing. A geotechnical engineer can construct such high earthquake-resistant buildings enhancing the infrastructure. A hydraulic engineer provides information regarding dams and bridges; and advanced designs for flood control and prevention of destruction of dams. A City planner and project manager can study the vulnerabilities providing proper guidelines required during calamities and disasters. A structural engineer can successfully carry out rescue operations and safety-escape routes in every building along with possible reconstructions. An environmental engineer handles hazardous wastes, toxic wastes, air pollution control, drainage development and radiation protection, which are needed once the disaster has struck in order to control the after-effects. A geotechnical engineer is responsible for the construction of such a high earthquake-resistant building with a strong foundation. The hydraulic engineer gives all the essential information about the various bridges and dams and high-level designs for blocking flood control and destruction of dams. A project supervisor and City administrator study the vulnerabilities presenting proper guidelines required for infrastructures to withstand anything.

The disasters mostly we face other than flood, are earthquake and fire. In earthquake-prone regions, the building should be designed considering all the earthquake load combinations instead of designing buildings for only gravity loads. Even after an earthquake also by making use of civil engineering knowledge, the lives of those who are stuck in collapsed buildings can be saved. For fire, while designing it is needed to provide required access to people to escape.

The versatility of civil engineers according to their specialisation is useful in disaster management and post-disaster rescue and reestablishment steps. Each one plays a vital role as per one's expertise. They are policymaker planner, structural engineer, geotechnical engineer, hydrological / irrigation engineer, environmental engineer, public health and sanitary engineer, surveyor transportation engineer, marine engineer, infrastructure -construction and project manager, services (plumbing, fire-fighting, lift, electrical) consultant, surveyor, site-engineer/ supervisor/ builder/ contractor, research and development; academician etc. A Structural engineer plays an active role in preparing the development plan of an area. All specifications should be followed, the structural analysis should be done using the latest techniques and advanced methods like performance-based designs must be followed rather than simple code based approaches. A Geotechnical engineer study of ground behaviour and examines subsoil ensuring the structure will not betray while calamity. A hydraulic engineer provides information about bridges and dam construction and also suggest flood control measures. A City planner keeps in mind the vulnerability of a specific area to disasters and issues specifications and guidelines for construction activities in these areas. An Environmental engineer maintains an optimum level of the ecosystem during pre and post-disaster time by taking measure for air pollution control, industrial hygiene, radiation protection, hazardous waste management, toxic materials control, water supply, wastewater management, stormwater management, solid waste disposal, public health, land manage etc. An Infrastructural engineer mind for the development of technologies for enhancement of infrastructure, Construction of infrastructures with high natural disaster resistance, Involvement in the rescue operation and reconstruction works after natural disasters. The geotechnical engineer builds high earthquake-resistant buildings enhancing the infrastructure so that the collapsing of any building can be prevented by a strong foundation. For flood control and dams safety, the hydraulic engineer provides all the required information about the various bridges and dams and advanced designs for prevention. City planners and project managers study the vulnerabilities. A structural engineer establishes the rescue operations and safety-escape routes in every building along with possible reconstruction of the entire building. The building construction should be based on NBC (National Building Code) and the vulnerability of that area to various disasters. The building should withstand the maximum possible intensity of the disaster.

Though the design is the primary responsibility of an architect, an engineer must ensure maintaining all kinds of standards of construction [16].

## 9. CONCLUSION

In any given disaster situation the basic duty of the local government is to provide immediate relief to the affected community in form of emergency shelters, emergency watersupply and sanitation provisions along with medical facilities for preventing epidemics. The planning, setting up and maintenance of emergency relief camps, provision of adequate potable water supply adequately hygienic sanitation facilities are the main responsibilities of a Civil Engineer who is associated with the Disaster Management team. In disaster management and mitigation, not only the planning, setting up and maintenance are the core responsibilities of the Civil Engineers but also they have to ensure that the provisions are as per standard norms laid down by various relief organisations like Red Cross etc.

In the mitigation works, structural mitigation (eg. Retrofitting, embankments etc.) must be made properly. In post-disaster situations, the relief camp, proper arrangement of water, sanitation, hygiene must be arranged properly. Since infrastructure facilities are severely damaged in disasters, the reconstruction of these basic infra-services as the post-disaster work eg. roads, bridges, railways, etc are most important to provide relief to affected communities. Assessing damaged structures being fit or unfit to use is also one of the jobs in post disasters.

The damage and destruction due to natural disasters can be minimized if proper and timely information about the disaster is made available. The GIS and RS are essential tools for forecasting and evaluating the effects of disasters and also used to prepare pre and post-disaster management plans with rescue plans for relief operations. Information of multi-hazard maps provides the extent of the geographical effect, risk-level and geographical details like affected human settlements and infrastructural resources. Such details are very helpful to estimate the vulnerability of the area concerning various hazards and to take protective measures. It is challenging and next to impossible to deal with disasters without such details. The matter and data, strongly appeal that a perfect pre-and-post disaster management plan with a disaster forecasting system is inevitable at state as well as national levels.

## 10. REFERENCES

- [1] Mishra, J.P., Kumar D., & Agarwal S. (2011). Disaster Management in India, Government of India, New Delhi, pp. 1-50.
- [2] Mathur, D. K. (2018). Flood Vulnerability Analysis using Remote Sensing and GIS: A Case Study of Olpad Taluka of Surat, PhD Thesis, C.U. Shah Uni, 2018.
- [3] National Disaster Management Authority [NDMA], 2005, <https://www.ndma.gov.in/en/dm-act-2005.html>.
- [4] Basu, M. and Xavier Savarimuthu, S.J. (2015). Fundamentals of Environmental Studies. Cambridge University Press, pp. 315-343.
- [5] <https://ourworldindata.org/natural-disasters>
- [6] High Power Committee on Disaster Management by NMDA, New Delhi, [https://nidm.gov.in/pdf/pubs/hpc\\_report.pdf](https://nidm.gov.in/pdf/pubs/hpc_report.pdf).
- [7] Guha-Sapir and Vanderveken, A. (2015). Annual Disaster Statistical Review 2015: The numbers and trends. DOI: 10.13140/RG.2.2.10378.88001
- [8] <https://reliefweb.int/map/world/world-regional-distribution-disasters-triggering-hazards->
- [9] Institute of Health Metrics and evolution:<https://ourworldindata.org/natural-disasters>.
- [10] <http://ghdx.healthdata.org/gbd-results-tool>

- [11] Natural Catastrophes-the current position. (1999). Special Millennium Issue, Center for Research on Epidemiology of Disasters (CRED) EM-DAT, Belgium, Munich Re Group, 1999. <http://www.emdat.be/>
- [12] Ahmed, A.T. and Sagar, D. (2017). Disasters in India: An Overview. International Journal on Emerging Technologies, 8 (1), pp. 392-397.
- [13] [https://en.wikipedia.org/wiki/Natural\\_disasters\\_in\\_India](https://en.wikipedia.org/wiki/Natural_disasters_in_India)
- [14] Goswami, B.N., Venugopal, V., Sengupta, D., Madhusoodanan, M.S. AND Xavier, P.K. (2006). Increasing trend of extreme rain events over India in a warming environment. Science, 314, pp.(5804): 1442–1445
- [15] Gujarat State Disaster Management Authority [GSDMA], <http://www.gsdma.org/>
- [16] Ragini Gogoi. (2015). Civil Engineering in Disaster Management. Int. J. Sc. Res., 4(6), pp.1117-1122.

## **A COMPARATIVE REVIEW ON DESIGN WIND LOAD AS PER IS 875 PART III 1987 AND IS 875 PART III 2015**

**Sujith Velloor Sudarsanakumar Nair**  
**Sankalchand Patel College of Engineering, Visnagar**

### **ABSTRACT**

The various stakeholders like professional, researcher, engineers, etc... use IS 875 (Part III) Design load (other than earthquake load) for Wind analysis on various structures. The various codal provisions are given for analytical and design purpose for different structures. Based on experience and research the codes are been revised. According to IS 875 P.3 2015 the various parameters are added and revised. This paper present a comparative evaluation of various parameters recommended in IS 875 P.3 1987 edition and 2015 edition.

**KEYWORDS:** Wind Speed, Wind Pressure, Gust factor, Wind Force, Interference Factor

### **1. INTRODUCTION**

Wind is a large scale lateral movement of air from a high pressure range to low pressure range. The studies of wind at various meteorological observations by anemometer are useful for engineering purpose. Nature of wind speed increases with the height of building or structures. Also, the wind speed at different height does not remains constant. As per new code IS 875 P.3 2015 parameter considering high rise building or tall structures are also considered.

### **2. LITERATURE REVIEW**

S. Kumar et. al. (2017) 32 storied RCC building of 96m high in cyclonic region has been taken for wind load analysis. They concluded that static pressure on coastal area is more as per revised code. Design wind pressure decrease with increase in tributary area of the structure. As per revised code the dynamic analysis gives design for along wind as well as cross-wind forces.

Dr. S.V. Joshi & S. Kawale (2017) calculated the wind load with gust factor and compared using IS code IS: 875 – (P.3) – 1987 and IS: 875 – (P.3) – 2015 for zone III with terrain category III in STAAD Pro. They had concluded that gust factor and pressure increases using revised code, Increase in the value of bending moment for the model using revised code and maximum deflection of 192mm are see in model using revised code.

Prakash Channappagoudar et. al. (2018) studied the performance of high rise building and concluded that lateral forces for dynamic analysis along x and z direction has reduced in code IS: 875 - (P.3) - 2015 when compared to earlier code, Displacement is reduced in model of IS: 875 - (P.3) - 2015 as lateral force reduces, Time period increases as there is increase in height for 27 floors and 39 floors acceleration is also reduced by modeling with new code and base reaction in two directions as per new code reduction is seen in the results.

H M Sreenidhi et. al. (2019) studied G+17 building for wind analysis and concluded that Gust factor, Lateral forces, Intensity, Displacement and Storey Drift at the top most storey has increased for IS: 875 (P.3) edition 2015 as compared to edition 1987.

### 3. OBJECTIVE

1. To review the codal provision clause in IS 875 P.3 1987 edition and 2015 edition.
2. To understand the difference in edition 1987 and edition 2015 code in a quick and simpler way.
3. To study the parameters with modeling a G+10 building using staad pro.

### 4. METHODOLOGY

The present study focus on the revised clauses for wind load calculation according to IS 875 P.3 2015 edition

1. Check for static method and dynamic method using clause 9.1 of IS: 875 P.3 2015
  - (a) Closed structure buildings with a height to minimum lateral dimension ratio are as follows:

Table: 1 Height to minimum lateral dimension ratio

static	< 5
dynamic	> 5

- (b) Natural frequency for a Structural Building in the 1<sup>st</sup> mode are as follows:

Table: 2 Natural Frequency in the 1<sup>st</sup> mode

static	> 1.0 Hz
dynamic	< 1.0 Hz

2. Design Wind Speed ( $V_z$ ).
3. Design Wind Pressure ( $P_z$ ).
4. Design Wind Load ( $F$ )

### 5. DETAIL OF PRESENT STUDY

#### 5.1 Comparison of important parameter IS 875 (Part III) in edition 1987 and edition 2015

Table: 3 Comparisons of Different Parameters

Sr. No	Parameter	IS 875 (Part III) 1987	IS 875 (Part III) 2015
1	<b>The design wind speed (<math>V_z</math>)</b>	$V_z = V_b k_1 k_2 k_3$ k <sub>1</sub> risk factor k <sub>2</sub> size factor k <sub>3</sub> topography factor V <sub>b</sub> basic wind speed at any height (m/s)	$V_z = V_b k_1 k_2 k_3 k_4$ k <sub>1</sub> risk factor [based on clause 6.3.1] k <sub>2</sub> size factor [based on clause 6.3.2] k <sub>3</sub> topography factor [based on clause 6.3.3] k <sub>4</sub> importance factor for the cyclonic region [based on clause 6.3.4] V <sub>b</sub> basic wind speed at any height (m/s)  <b>Values of importance factor for the cyclonic region are given below:</b>

			[Emergency services structures $k_4 = 1.30$ ] [Industrial structures $k_4 = 1.15$ ] [Other structures $k_4 = 1.00$ ]																																										
2	<b>Probability factor <math>k_1</math> (risk coefficient)</b>	$k_1 = \frac{X_N, P}{X_{50, 0.63}} = \frac{A-B [\ln\{-\frac{1}{N} \ln(1-P_N)\}]}{A + 4 B}$ <p>N Expected Average design life of the structure (in Year)  <math>P_N</math> risk level (in N year consecutive)  <math>X_N, P</math> wind speed at extreme for N and <math>P_N</math>  <math>X_{50, 0.63}</math> wind speed at extreme for N 50 year and <math>P_N</math> 0.63                      Basic wind speed for A &amp; B at different zone are as follows</p> <table border="1"> <thead> <tr> <th>Zone</th> <th>A (kmph)</th> <th>B (kmph)</th> </tr> </thead> <tbody> <tr> <td>33 m/s</td> <td>33.2</td> <td>9.2</td> </tr> <tr> <td>39 m/s</td> <td>84.0</td> <td>14.0</td> </tr> <tr> <td>44 m/s</td> <td>88.0</td> <td>18.0</td> </tr> <tr> <td>47 m/s</td> <td>88.0</td> <td>20.5</td> </tr> <tr> <td>50 m/s</td> <td>88.8</td> <td>22.8</td> </tr> <tr> <td>55 m/s</td> <td>90.8</td> <td>27.3</td> </tr> </tbody> </table>	Zone	A (kmph)	B (kmph)	33 m/s	33.2	9.2	39 m/s	84.0	14.0	44 m/s	88.0	18.0	47 m/s	88.0	20.5	50 m/s	88.8	22.8	55 m/s	90.8	27.3	$k_1 = \frac{X_N, P}{X_{50, 0.63}} = \frac{A-B [\ln\{-\frac{1}{N} \ln(1-P_N)\}]}{A + 4 B}$ <p>N Expected Average design life of the structure (in Year)  <math>P_N</math> risk level (in N year consecutive)  <math>X_N, P</math> wind speed at extreme for N and <math>P_N</math>  <math>X_{50, 0.63}</math> wind speed at extreme for N 50 year and <math>P_N</math> 0.63                      Basic wind speed for A &amp; B at different zone are as follows</p> <table border="1"> <thead> <tr> <th>Zone</th> <th>A (m/s)</th> <th>B (m/s)</th> </tr> </thead> <tbody> <tr> <td>33 m/s</td> <td>23.1</td> <td>2.6</td> </tr> <tr> <td>39 m/s</td> <td>23.3</td> <td>3.9</td> </tr> <tr> <td>44 m/s</td> <td>24.4</td> <td>5.0</td> </tr> <tr> <td>47 m/s</td> <td>24.4</td> <td>5.7</td> </tr> <tr> <td>50 m/s</td> <td>24.7</td> <td>6.3</td> </tr> <tr> <td>55 m/s</td> <td>25.2</td> <td>7.6</td> </tr> </tbody> </table>	Zone	A (m/s)	B (m/s)	33 m/s	23.1	2.6	39 m/s	23.3	3.9	44 m/s	24.4	5.0	47 m/s	24.4	5.7	50 m/s	24.7	6.3	55 m/s	25.2	7.6
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3	<b>Terrain, height and structure size factor <math>k_2</math></b>	Factor changes with height of structure and terrain category (1, 2, 3 and 4) and also Class of structure (Class A, Class B or Class C)	Factor changes with height of structure and terrain category (1, 2, 3 and 4)																																										
4	<b>Hourly Mean Wind speed</b>	--- Not considered ---	$\tilde{V}_{Z,H} = k_{2,i} V_b$ <p><math>k_{2,i}</math> hourly mean wind speed factor for terrain category 1  <math>k_{2,i} = 0.1423 [\ln(\frac{z}{z_{0,i}})](z_{0,i})^{0.0706}</math>                      Design hourly mean wind speed at height z  <math display="block">\tilde{V}_{Z,d} = k_{2,i} V_b k_1 k_3 k_4</math></p>																																										

5	<b>Turbulence intensity</b>	--- Not considered ---	<p>The turbulence intensity variation with height for different terrain category.</p> <p>Terrain Category 1  <math display="block">I_{z,1} = 0.3507 - 0.0535 \log_{10}\left(\frac{z}{z_{o1}}\right)</math> </p> <p>Terrain Category 2  <math display="block">I_{z,2} = I_{z,1} + \frac{1}{7}(I_{z,4} - I_{z,1})</math> </p> <p>Terrain Category 3  <math display="block">I_{z,3} = I_{z,1} + \frac{3}{7}(I_{z,4} - I_{z,1})</math> </p> <p>Terrain Category 4  <math display="block">I_{z,4} = 0.466 - 0.1358 \log_{10}\left(\frac{z}{z_{o4}}\right)</math> </p>
6	<b>The design wind pressure (<math>P_z</math>)</b>	$P_z = 0.6 (V_z)^2$ <p><math>V_z</math> design wind velocity at height m/s</p>	<p>The basic wind pressure  <math display="block">P_z = 0.6 (V_z)^2</math> <math>V_z</math> design wind velocity at height m/s</p> <p>The design wind pressure  <math display="block">P_z = K_d K_a K_c P_z</math> </p> <p><math>K_d</math> wind directionally factor [based on clause 7.2.1]  <math>K_a</math> area averaging factor [based on clause 7.2.2]  <math>K_c</math> combination factor [based on clause 7.2.3]  <math>P_z</math> basic wind pressure</p>
7	<b>The total wind force (F)</b>	$F = C_f A_e P_z$ <p><math>C_f</math> force coefficient depends upon shape of element plan size and wind direction  <math>A_e</math> effective frontal area  <math>P_z</math> design wind pressure</p> <p>Wind load  <math display="block">F = C_f A_e P_z G</math> <math>G</math> gust factor</p>	$F = C_f A_e P_z$ <p><math>C_f</math> force coefficient depends upon shape of element plan size and wind direction  <math>A_e</math> effective frontal area  <math>P_z</math> design wind pressure</p> <p>Wind load  <math display="block">F = C_f A_e P_z G</math> <math>G</math> gust factor</p> <p><math display="block">M = \sum F Z</math> <math>M</math> Bending Moment along wind base</p>

8	<b>Wind load on individual member (F)</b>	$F = (C_{pe} \pm C_{pi})A P_d$ <p><math>C_{pe}</math> coefficient of external pressure  <math>C_{pi}</math> coefficient of internal pressure  <math>A</math> Structural element surface area  <math>P_d</math> wind pressure design</p>	$F = (C_{pe} \pm C_{pi})A P_d$ <p><math>C_{pe}</math> coefficient of external pressure [based on Table: 5 (values are modified)]  <math>C_{pi}</math> coefficient of internal pressure [based on clause 7.3.2]  <math>A</math> Structural element surface area  <math>P_d</math> wind pressure design</p>										
9	<b>Wind Interference Factor (IF)</b>	--- Not considered ---	<p>Interference effect studied on tall structure is considered by multiplying (IF) with wind load</p> <table border="1" data-bbox="922 646 1435 741"> <thead> <tr> <th>Zone</th> <th>Z<sub>1</sub></th> <th>Z<sub>2</sub></th> <th>Z<sub>3</sub></th> <th>Z<sub>4</sub></th> </tr> </thead> <tbody> <tr> <td>IF</td> <td>1.35</td> <td>1.25</td> <td>1.15</td> <td>1.07</td> </tr> </tbody> </table>	Zone	Z <sub>1</sub>	Z <sub>2</sub>	Z <sub>3</sub>	Z <sub>4</sub>	IF	1.35	1.25	1.15	1.07
Zone	Z <sub>1</sub>	Z <sub>2</sub>	Z <sub>3</sub>	Z <sub>4</sub>									
IF	1.35	1.25	1.15	1.07									
10	<b>Dynamic wind response Gust factor (G)</b>	$G = 1 + g f \frac{r \sqrt{[B (1 + \phi)^2 + SE] / \beta}}{\beta}$ <p><math>g f</math> peak factor  <math>r</math> roughness factor [size of structure &amp; roughness ground]  <math>B</math> background factor  <math>S</math> reduction size factor  <math>E</math> Wind stream energy at a natural frequency of the structure  <math>\phi</math> building height less than 75m (in terrain IV) and 25m (in terrain III)  <math>\phi = 0</math> (Other than above feature structure)  <math>\beta</math> damping coefficient of structure</p>	$G = \frac{1+r}{\beta} \sqrt{\frac{g v^2 B s (1+g^2) + H_s g R^2 S E}{\beta}}$ <p><math>r</math> roughness factor [2 times turbulence intensity]  <math>g v</math> peak factor = 3 terrain 1 &amp; 2                                    = 4 terrain 3 &amp; 4  <math>B_s</math> background factor [based on clause 10.2]  <math>H_s</math> Height factor (resonance response) [based on clause 10.2]  <math>gR</math> Peak factor (resonance response) [based on clause 10.2]  <math>S</math> size reduction factor [based on clause 10.2]  <math>E</math> spectrum of turbulence [based on clause 10.2]  <math>\beta</math> damping coefficient of structure [based on Table: 36 clause 10.2]</p>										
11	<b>Frequency of vortex (slender structure)</b>	$\eta = \frac{S V d}{b}$ <p><math>S</math> Strouhal No.  <math>V d</math> wind velocity design  <math>b</math> breadth of the structure</p>	$f_a = \frac{S t \tilde{V}_z H}{b}$ <p><math>S</math> Strouhal No. [based on clause 9.2.1]  <math>\tilde{V}_z H</math> Mean hourly wind speed  <math>b</math> breadth of the structure</p>										



## 5.2 DETAIL OF STRUCTURE

<b>Multi-storey Building:</b>	G+10
<b>Location:</b>	Mumbai
<b>Plan Area:</b>	16m x 18m
<b>Height of Building:</b>	30m
<b>Beam Size:</b>	350 mm x 350 mm
<b>Column Size:</b>	450 mm x 450 mm
<b>Slab Thickness:</b>	150mm

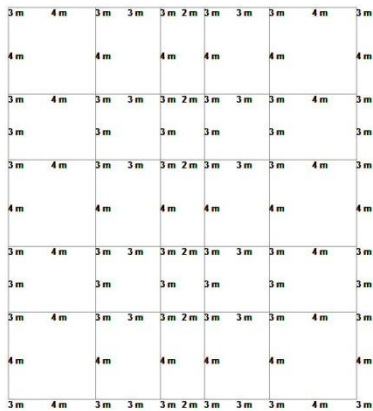


Figure: 1 Plan of building

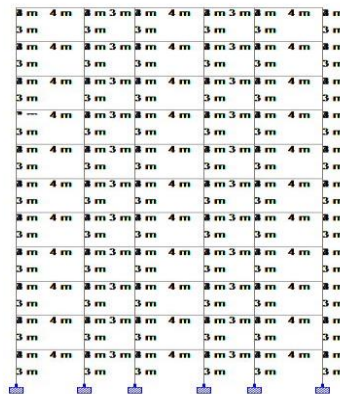


Figure: 2 Elevation of building

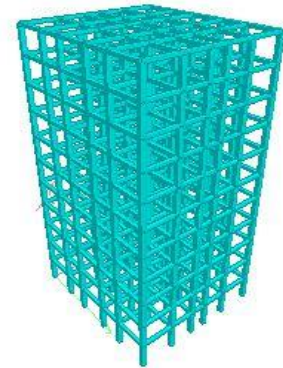


Figure: 3 3D Structure

## 5.3 LOADING CONDITIONS

Table: 4 Dead load calculation as per IS 875 (P.3)

Self-weight of Beams and Columns	as per Staad Pro
Self-weight of Slab	3.75 kN/m <sup>2</sup>
Floor Finish	1.00 kN/m <sup>2</sup>

Table: 5 Live load calculation as per IS 875 (P.3)

Live load on floors	3.00 kN/m <sup>2</sup>
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Table: 6 Wind load calculation as per IS 875 (P.3)

IS 875 (Part III) 1987			IS 875 (Part III) 2015		
The design wind speed	Vz = Vb k1 k2 k3		The design wind speed	Vz = Vb k1 k2 k3 k4	
risk factor	k1	1	risk factor	k1	1
topography factor	k3	1	topography factor	k3	1
basic wind speed at any height (m/s)	Vb	44	importance factor for the cyclonic region	k4	1
			basic wind speed at any height (m/s)	Vb	44
Height	k2	Vz	Height	k2	Vz
size factor at 10m height	1.05	46.2	size factor at 10m height	1.05	46.2
size factor at 15m height	1.09	47.96	size factor at 15m height	1.09	47.96
size factor at 20m height	1.12	49.28	size factor at 20m height	1.12	49.28
size factor at 30m height	1.15	50.6	size factor at 30m height	1.15	50.6
The design wind pressure (kN/m <sup>2</sup> )	Pz = 0.6 (Vz) <sup>2</sup>		The design wind pressure (kN/m <sup>2</sup> )	Pz = [Kd Ka Kc] 0.6 (Vz) <sup>2</sup>	
Design wind pressure at 10m height	Pz	1.280664		Kd	0.9
Design wind pressure at 15m height	Pz	1.38009696		Ka	0.8
Design wind pressure at 20m height	Pz	1.45711104		Kc	0.9
Design wind pressure at 30m height	Pz	1.536216	Design wind pressure at 10m height	Pz	0.829870272
			Design wind pressure at 15m height	Pz	0.824617036
			Design wind pressure at 20m height	Pz	0.897423977
			Design wind pressure at 30m height	Pz	0.943436041

## 6. RESULTS & DISCUSSION

### Maximum Displacement

Displacement is reduced as per revised code 2015 edition compared with old code 1987 edition.

Table: 7 Comparisons of maximum displacements

Code	X Direction (mm)	Z Direction (mm)
<b>IS 875 (Part III) 1987</b>	45.661	33.615
<b>IS 875 (Part III) 2015</b>	28.089	20.662

### Base Reactions

Reactions are reduced as per revised code 2015 edition compared with old code 1987 edition.

Table: 8 Comparisons of Base Reaction

Code	F <sub>x</sub> (kN)	F <sub>y</sub> (kN)	F <sub>z</sub> (kN)
<b>IS 875 (Part III) 1987</b>	67.261	968.517	44.422
<b>IS 875 (Part III) 2015</b>	42.306	1068.037	28.438

### Maximum Moment

Moment is reduced as per revised code 2015 edition compared with old code 1987 edition.

Table: 9 Comparisons of Maximum moment

Code	M <sub>x</sub> (kNm)	M <sub>y</sub> (kNm)	M <sub>z</sub> (kNm)
<b>IS 875 (Part III) 1987</b>	93.106	0.029	134.526
<b>IS 875 (Part III) 2015</b>	58.557	0.017	83.941

### Wind Force

Wind force on individual member is reduced as per revised code 2015 edition compared with old code 1987 edition.

Table: 10 Comparisons of Wind force on individual members

Code	X Direction (kN)	Z Direction (kN)
<b>IS 875 (Part III) 1987</b>	4.9945	1.3114
<b>IS 875 (Part III) 2015</b>	3.2364	0.8076

### Wind Intensity

Wind intensity is reduced as per revised code 2015 edition compared with old code 1987 edition.

Table: 11 Comparisons of Wind intensity.

Code	Intensity (kN/m <sup>2</sup> )
<b>IS 875 (Part III) 1987</b>	1.5362
<b>IS 875 (Part III) 2015</b>	0.9434

## 7. CONCLUSION

1. As per revised code, modification factor for cyclonic region ( $K_4$ ) is added to design wind speed which improves behaviour of sea shore structures.
2. As per new code, Wind directionality factor for different structures, area averaging factor for load calculation and Combination factor combining external and internal pressure on roof and wall are added to design wind pressure.
3. The newly recommended code has interference factor for considering nearby existing building of similar size.
4. The new code has good analytical results for dynamic structures providing different parameters, roughness, height, peak factors etc.
5. Expressions for variation in height of mean hourly wind speed and turbulence intensity in any terrains have been suggested in new code.
6. The revised code will provide higher safety to the structures for static and dynamic analysis.

## REFERENCES

1. IS: 875 (P.3) :1987 Practice Code for wind load design
2. IS: 875 (P.3) :2015 Practice Code for wind load design
3. Surendra Kumar, Mr. Shree Prakash, Mr. Mirza Aamir Baig (2017) “A Comparative Analysis of Multi-Storeyed RCC Structures Considering Cyclonic Factor” International Journal of Engineering Science and Computing, Volume : 7, Issue : 08, ISSN : 2321 - 061
4. Saurabh Kawale, Dr. S.V. Joshi (2017) “Analysis of High Rise Building for Wind Load” International Journal for Scientific Research & Development Volume : 5, Issue : 03, ISSN : 2321 - 0613
5. Prakash Channappagoudar, Vineetha Palankar, R. Shanthi Vengadeshwari, Rakesh Hiremath (2018) “Parametric comparison study on performance of the building under lateral loads as per IS: 875 P.3 1987 and revised code of IS: 875 P.3 2015” International Research Journal of Engineering and Technology Volume : 05 Issue : 05 ISSN : 2395-0056
6. Sreenidhi H M, Shivaraju G D, Dr. T V Mallesh, S R Ramesh (2019) “Comparison of IS-875 (P.3) 1987 & 2015 for Wind Analysis for the high rise building using ETabs” International Research Journal of Engineering and Technology Volume : 06 Issue : 08 ISSN : 2395-0056

# **A HYBRID INTELLIGENT INTRUSION DETECTION SYSTEM USING DOMAIN KNOWLEDGE AND ENSEMBLE LEARNING**

**Ms. Pranavi Patel**  
SVIT, Vasad /KJIT, Savali

**Ms. Mala Mehta**  
SVIT, Vasad

## **ABSTRACT**

An intrusion Detection System (IDS) plays a very vital role in protecting systems. For many years researchers have been working on efficient dimensionality reduction procedures, we introduce Domain Knowledge (CIA principles) relevant features to avoid complex methods. Artificial Intelligence has many machine learning algorithms which are effective to detect specific types of attacks only. To overcome this problem we used Ensemble Learning to combine Random Forest, AdaBoost, Naïve Bayes, K-Nearest Neighbor, and Decision Tree. The signature-based IDS and train-test-split method is used to modify and compute. To test our hybrid method we utilized four datasets which are KDDCup99, NSLKDD, UNSW-NB15, and CICIDS, and we gained accuracy of 99%, 96%, 94%, and 99% respectively. Additionally, our method overcomes the False Positive Rate (FPR) problem majorly. Compared to other models our hybrid model shows improved accuracy and a major reduction in FPR.

**KEYWORDS:** Hybrid-IDS model, Domain Knowledge, CIA Principle, SMOTE, Ensemble Learning, Machine Learning, Intrusion, Datasets and intrusion detection.

## **1. INTRODUCTION**

As almost every field has become digitalized, it has created a need for robust intrusion detection. Machine Learning has become the priority in detecting cyber threats effectively in the last few years. Many researchers have used single algorithms for intrusion detection with different preprocessing methods to improve IDS. However, the methodologies were not effective because every specific algorithm is effective in detecting specific types of attacks only. This creates the need for a combined approach to making IDS effective. Many authors have used different methods for their model. And based on their results, we have figured out some most effective algorithms which are Random Forest (RF), AdaBoost (AB), Naïve Bayes (NB), K-Nearest Neighbor (KNN), and Decision Tree (DT). And to combine their computation efficiency we used the MAX-voting approach of Ensemble Learning (EL). Which is the most used approach for classification problems in EL.

Another factor that affects the performance of IDS is dimensionality reduction. For that, we used Domain Knowledge (DK) features which are CIA principles relevant features. The features are associated with Confidentiality, Integrity, and availability; rules of the network. Many types of studies have been using various complex methods for dimensionality reduction which lead to more computational hazards in IDS. To overcome this issue we have obtained DK features to solve the need for a complex dimensionality reduction procedure in IDS.

We have proposed a hybrid model using both domain knowledge and ensemble learning. As changing natures of the network sometimes old threat patterns are recycled, and also different variants of network feature in change. To ensure that our system gives better performance in different network patterns we

utilized datasets in which two are of early network patterns (KDDCup99, NSLKDD), one of the moderate network patterns (UNSW-NB15) and another of recent network patterns (CICIDS-2017) data sets are used.

In this paper, the next section gives a brief summary of the literature we have studied (Sec. 2). Onward, in Sec.3 a proposed Hybrid model's workflow is defined. Sec.4 includes the results of the proposed IDS model. In Sec. 5 we concluded our study with some future scope.

## 2. LITERATURE STUDY

In [1] researchers have developed a multi-tree algorithm for combining results of the multiple ML methodologies. Simultaneously they used an adaptive voting method in EL for classification. Additionally, for pre-processing and dimensionality reduction PCA has been utilized. In [2] paper they have utilized efficiency of particle swarm optimization, ant colony algorithm, and genetic algorithm in a hybrid manner to obtain feature selection. Onwards, they have used the two-stage classifier ensemble method to combine all Meta learners and base classifiers. They gained significant improvement in comparison with previously available methods. [3] A novel fuzzy ensemble feature selection with a combined fusion of SVM, KNN, and ANN is obtained. This feature selection method helps to increase accuracy. The authors of [4] developed a Semi-supervised learning model to combine both supervised and unsupervised learning models with EL. They gained an accuracy of 84.54% on KDDCup99.

To better explainability of DK (CIA principles-based features) [5] uses the Black Box-testing method for showing the usability of these features. They have used SMOTE to overcome the imbalance in datasets. Onwards, classification algorithms achieved results that show these features are performing well in detecting unknown attacks, but it does not perform well in detecting known attacks.

The authors of [6] have used the Sparks HDFS system in a real-time environment to overcome issues of Distributed Denial of Service attacks in Ad-hoc networks. An RF classification algorithm was being used and gained a higher detection rate. However, the model has issued more False Positive Rates. [7] Stacked Sparse Auto-encoder is used for feature selection and Support Vector Machine which gives a higher detection rate and also comparatively few False Positives.

The researchers of [8] developed the modified model of a backpropagation neural network by adding LM (Levenberg-Marquardt) and gaining a significant detection ratio. The authors of [9] have considered authentication problems in IDS. And the proposed model of ANN is a supervised learning model. A considerable improvement is gained inaccuracy (84%) on UNSW-NB15. In [10] neural networks were utilized for MCPS (Medical Cyber-Physical System), which is a new field that requires strong Intrusion detection methods. As for detecting disease from scanned reports, they used the KDDCup99 dataset to test results and gained better detection than previous studies. The model of [11] was designed to improve detection procedures. They considered Gated Recurrent Units (GRU) for feature selection and RNN with LSTM for classification. To overcome the data imbalance the researchers of [12] invented a model which works on raw data to speed up the classification computation on CNN. The [13] proposed a model which uses a feed-forward deep neural network (FFDNN), to justify the model they used the NSL-KDD dataset. And gained high accuracy in both, binary as well as multi-class classification.

One Side Selection and SMOTE's combined method was used to develop balanced datasets. Then CNN was used to gain spatial features and BiLSTM for temporal features and this hybrid model achieved 80% accuracy [14]. Authors of [15] have tested various machine learning algorithms on different publicly available datasets and concluded that DNN gives a better overall performance on the cost of more timing as DNN is very complex. [16] A Deep Auto-Encoder (DAE) algorithm is being applied on KDDCup99. To avoid overfitting they used the greedy-layer wise fashion DAE and achieved 94.42% (True Positive) and 94.71% (Accuracy). Self-taught learning is being used to feature and dimensionality reduction for computation purposes they used SVM [17, 18].

For dimensionality reduction [19] uses Ant Colony Optimization (ACO) and Particle Swarm Optimization (PSO) with KNN, SVM, and NB. In [20] weighted SVM with Min-Max Scaler and standardization for dealing with an imbalance in data. AddaBoost shows better performance in detecting cyber threats and also gives a better performance ratio compared to other methods [21]. SVM, ANN, DT, BN, GA, KNN, Fuzzy K-means are more accurate data mining methodologies [22]. SVM, RF, EL's comparative analysis is being performed in [23] and EL outperforms the other two methods.

### 3. PROPOSED HYBRID IDS MODEL

The proposed hybrid model uses the four benchmarked data sets for cyber security. Due to the various issues in datasets such as data corruption, traffic variety, inconsistencies, ancient contemporary attacks, it has become critical to rely on one dataset's performance for a sustainable IDS model. In ML we have used the supervised learning model. In the supervised learning model, labeled data sets to train the data. Then used that trained data to test the model. For training and testing, we optimized train-test-split methodologies, the portion of training is taken by 70% of the respective datasets and testing has assigned a 30% portion of the respective datasets.

#### 3.1 Domain Knowledge

Domain Knowledge (i.e. CIA Principles) features are on the crucial regulations which are confidentiality, integrity, and availability. We have used DK for signature-based IDS, in previous studies of DK it is majorly known for anomaly detection, however, we have used it for signature-based detection and gained effectively higher accuracy. Different datasets constraints unique features due to that DK features are different respectively. Table 1. Shows DK features of different datasets. Only KDDCup99 and NSL-KDD's features are the same because NSL-KDD is derived from KDDCup99. Although, CICIDS2017's some features are renamed from KDDCup99.

**Table: 1 DK Features in Different Datasets**

No.	KDDCup99 and NSL-KDD	UNSW-NB15	CICIDS2017
1.	Flow Duration	swin	Ack Flag Count
2.	TotalBackward Packets	dwin	Active Mean

3.	Fwd Packet Length Mean	stepb	Active Min
4.	Fwd Packet Length Std	dtcpd	Average Packet Size
5.	Flow IAT Mean	smeansz	Bwd IAT Mean
6.	Flow IAT Std	dmeans	Bwd Packet Length Std
7.	Flow IAT Min	trans-depth	Bwd Packets/s
8.	Fwd IAT Mean	res_bdy_len	Fwd IAT Mean
9.	Fwd IAT Min	ct_srv_src	Fwd IAT Min
10.	Bwd IAT Mean	ct_srv_dst	Fwd Packet Length Mean
11.	Fwd PSH Flags	ct_dst_Itm	Fwd packets/s
12.	Fwd Packets/s	ct_src_Itm	Fwd PSH Flags
13.	Bwd Packets/s	ct_dst_sport_Itm	Flow Duration
14.	Syn Flag Count	ct_dst_src_Itm	Flow IAT Mean
15.	PSH Flag Count	-	Flow IAT Min
16.	Ack Flag Count	-	Flow IAT Std
17.	Average Pack Size	-	Init_Win_bytes _Froward
18.	Sub-flow Fwd Bytes	-	PSH Flag Count
19.	Int_Win_bytes_forward	-	Subflow Fwd Bytes
20.	Active Min	-	SYN Flag Count
21.	Idle Mean	-	Total Length of Fwd Packets



### 3.2 SMOTE

Preprocessing of the datasets plays a very crucial role in every model. Fore mostly, we defined labeled features in binary classification (1 = Intrusions or attacks and 0 = normal traffic). Then to unified datasets for easy utilization of the datasets that must require steps for ML algorithms. So, we have applied StandardScaler. The major issue all the datasets suffer from is a class imbalance in datasets, any one class's majority creates biases in a training model that leads to less accuracy and more false positives. To overcome the imbalance of datasets we used SMOTE (Synthetic Majority Over-sample Technique). SMOTE creates duplicate samples of the minority class to the majority classes samples. Table 2. Shows SMOTE's sample of datasets. CICIDS 2017 is a collection of datasets obtained from working days, in which Monday's datasets do not contain any intrusions that are why it is not included in this study.

**Table: 2. Comparative analysis of datasets before and after smote**

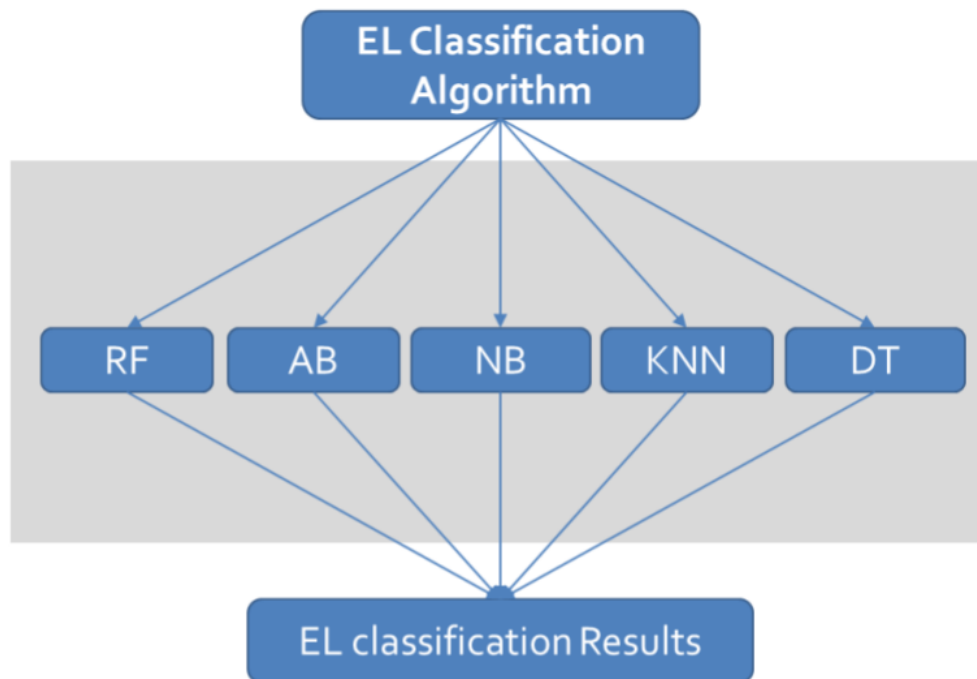
<b>Datasets</b>	<b>Before SMOTE (0)</b>	<b>Before SMOTE (1)</b>	<b>After SMOTE (0)</b>	<b>After SMOTE (1)</b>
<b>KDDCup99</b>	67943	277871	277871	277871
<b>NSL-KDD</b>	47087	41094	47087	47087
<b>UNSW-NB15</b>	25879	31753	31753	31753
<b>Tue CICIDS</b>	9651	302485	302485	302485
<b>Wed CICIDS</b>	308051	176841	308051	308051
<b>Thu morning CICIDS</b>	117752	1504	117752	117752
<b>Thu afternoon CICIDS</b>	201995	26	201995	201995
<b>Fri morning CICIDS</b>	132354	1369	132354	132354
<b>Fri afternoon 1 CICIDS</b>	68214	89807	89807	89807
<b>Fri afternoon 2 CICIDS</b>	89214	111312	111312	111312

### 3.3 Ensemble Learning

An Ensemble Learning (EL) is used to combine five classification methods which are RF, AB, NB, KNN, and DT respectively. In EL, we used the Max-voting approach for classification. In Max-voting selected models' computation happened individually till they gained classification results. The individual classification results are then combined in EL. The majorly classified class labels become the final classification declarations. Fig 1. Shows the Max-voting approach EL.

RF is a Meta estimator of multiple decision trees that contains various sub-samples of datasets whose average is used to enhance predictive accuracy and control over-fitting. An AB is also a meta-estimator that uses corresponding weights of fitting from various stages, it is also effective in difficult classification natures. NB is a supervised learning algorithm based on the Bayes theorem with naive assumptions of contingent interdependence between pairs of features. KNN is an uncomplicated ML algorithm; its predictions are accurate even though similar patterns are found instead of specified patterns. DT structure is effective with both classification and regression. Its estimation starts from the root to the node for defining class labels.

**Figure 1 Max-voting approach of Ensemble Learning**



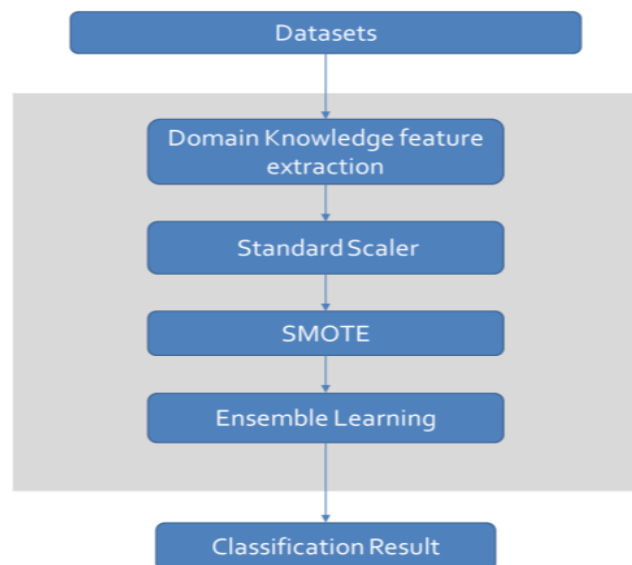
### 3.4 Hybrid-IDS

Our hybrid model combines DK features with ensemble classification workflow as defined in Fig. 2. The system begins with four standard datasets which are KDDCup99, NSL-KDD, UNSW-NB15, and CICIDS2017. These datasets contain past cybercrimes network patterns. Using those patterns we can make cyberspace a secure environment with sustainable IDS. In DK feature extraction we have removed all the features except mentioned features in Table 1. According to different datasets. StandardScaler converts connections in numeric and normalizes data for ML computations. The imbalance of classes has been overcome using SMOTE oversampling methodologies. Finally, EL combines all the classification results using the Max-voting approach. EL's classification results from the whole procedure become final classification results of connection to be malicious or normal traffic.

## 4. RESULTS

Accuracy is measured for the basic detection of true positive, false positive, true negative, false negative's detection measures are computer. The recall is portion true positive and false negative. It is mostly used when FN is more sensitive (i.e. medical field). Precision is measured through true positive and ratio of true positive with false-positive. Whenever FP is more important precision is being used (i.e. spam). F1-score is measured based on precision and recall multiplication divided by the summation of both and by multiplying two with results. Tables from 3 to 12 show datasets computations results. Support is the number of records defined by the scores. In this paper, we have taken all the results in between 0.00 to 1.00, where 0.00 denotes 0% and 1.00 denotes 100%.

**Figure 2 Proposed Hybrid Model**



**Table 3 computational results of KDDCup99**

Measure	Precision	Recall	f-1 score	Support
<b>0</b>	0.98	1.00	0.99	29334
<b>1</b>	1.00	0.99	1.00	118872
<b>Accuracy</b>	-	-	0.99	148206
<b>Macro Average</b>	0.99	1.00	0.99	148206
<b>Weighted Average</b>	1.00	0.99	0.99	148208

We have applied the classic method for Machine Learning evaluation for evaluating results the Precision, Recall, f-1 scores were calculated from Support connection records. Using only accuracy as measures were having the problem of overfitting. In overfitting, algorithms are very effective over trained models, but outside trained records, it does not perform well. To overcome these issues the previous researchers have invented measures Precision, it's used where False Positive is in more concern and Recall, it's used where False Negative in our case both are important because False Positive stops request of genuine connection from accessing services and False Negative let intrusion to successfully run on Networks. For combinational results of Precision and Recall FBeta score is found but the majority of all the research takes Beta's score as 1 and it is called as F-1 Score. Accuracy is a measure of the combinational results of both normal connections and malicious connections so in Precision and Recall it is undefinable. As it's not definable we have denoted it as "-" in tables of computational results.

**Table 4 Computational results of NSL-KDD**

Measure	Precision	Recall	f-1 score	Support
<b>0</b>	0.95	0.99	0.97	20256
<b>1</b>	0.99	0.93	0.96	17536
<b>Accuracy</b>	-	-	0.96	37792
<b>Macro Average</b>	0.97	0.96	0.96	37792
<b>Weighted Average</b>	0.97	0.96	0.96	37792

**Table 5 Computational results of UNSW-NB15**

Measure	Precision	Recall	f-1 score	Support
<b>0</b>	0.91	0.98	0.94	11121
<b>1</b>	0.98	0.92	0.95	13579
<b>Accuracy</b>	-	-	0.95	24700
<b>Macro Average</b>	0.95	0.95	0.95	24700

<b>Weighted Average</b>	0.95	0.95	0.95	24700
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**Table 6 computational results of CICIDS Tuesday**

<b>Measure</b>	<b>Precision</b>	<b>Recall</b>	<b>f-1 score</b>	<b>Support</b>
<b>0</b>	1.00	1.00	1.00	129589
<b>1</b>	1.00	1.00	1.00	4184
<b>Accuracy</b>	-	-	1.00	133773
<b>Macro Average</b>	1.00	1.00	1.00	133773
<b>Weighted Average</b>	1.00	1.00	1.00	133773

**Table 7 computational results of CICIDS Wednesday**

<b>Measure</b>	<b>Precision</b>	<b>Recall</b>	<b>f-1 score</b>	<b>Support</b>
<b>0</b>	1.00	1.00	1.00	131980
<b>1</b>	1.00	1.00	1.00	75831
<b>Accuracy</b>	-	-	1.00	207811
<b>Macro Average</b>	1.00	1.00	1.00	207811
<b>Weighted Average</b>	1.00	1.00	1.00	207811

**Table 8 computational results of CICIDS Thursday morning**

<b>Measure</b>	<b>Precision</b>	<b>Recall</b>	<b>f-1 score</b>	<b>Support</b>
<b>0</b>	1.00	1.00	1.00	50434
<b>1</b>	0.96	0.99	0.97	676
<b>Accuracy</b>	-	-	1.00	51110
<b>Macro Average</b>	0.98	0.99	0.99	51110
<b>Weighted Average</b>	1.00	1.00	1.00	51110

**Table 9 computational results of CICIDS Thursday afternoon**

Measure	Precision	Recall	f-1 score	Support
<b>0</b>	1.00	1.00	1.00	86571
<b>1</b>	0.41	0.70	0.52	10
<b>Accuracy</b>	-	-	1.00	86581
<b>Macro Average</b>	0.71	0.85	0.76	86581
<b>Weighted Average</b>	1.00	1.00	1.00	86581

In KDDCup99 we have obtained an accuracy of 0.99 with all the connections which support all the records of data sets which are 148206. Macro and Weighted both averages show 0.99 and 1.00 in both alternatively (Table 3). NSL-KDD has 37792 records total in datasets. The achieved accuracy of the dataset is equivalent to 0.97 (Table 4). For UNSW-NB15 precision according to 0 and 1 is 0.91 and 0.98 respectively (Table 5). Table 6 to Table 12 shows CICIDS's computational results which show CICIDS Tuesday, CICIDS Wednesday, CICIDS Friday afternoon 1, CICIDS Friday afternoon 2 have achieved overall the 1.00 accuracy and also all the measures listed in the table for evaluation have achieved the best results or we can also say ideal system results we have gained. In CICIDS Thursday morning Normal connections are defined correctly with all 0 (normal connections) are achieved 1.00 in support of the 131980. For CICIDS Thursday is also normal connections are defined correctly, however, here the intrusion classification has 0.41, 0.70, and 0.51 Precision, Recall, and f-1 score respectively. The records of CICIDS Friday morning have shown comparatively less Macro Average in Precision which is 0.83. Overall results gained from all the datasets show our method is effective for the classification of malicious behavior and normal connections.

**Table 10 computational results of CICIDS Friday morning**

Measure	Precision	Recall	f-1 score	Support
<b>0</b>	1.00	0.99	1.00	56713
<b>1</b>	0.67	0.99	0.80	597
<b>Accuracy</b>	-	-	0.99	57310
<b>Macro Average</b>	0.83	0.99	0.90	57310
<b>Weighted Average</b>	1.00	0.99	1.00	57310

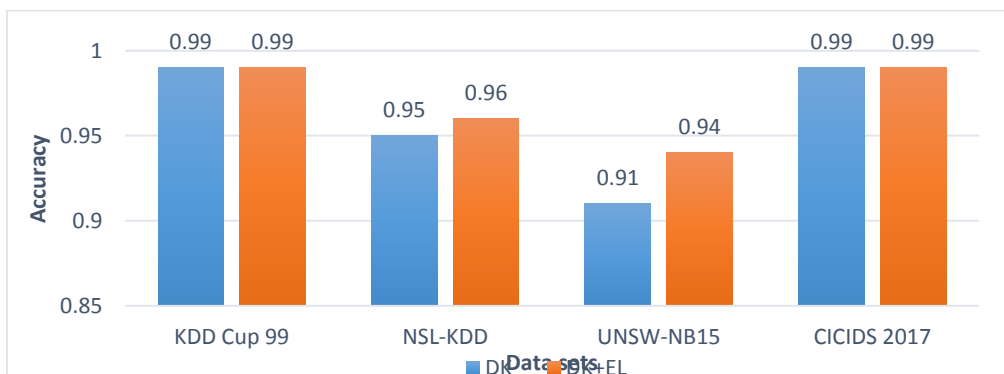
**Table 11 computational results of CICIDS Friday afternoon 1**

Measure	Precision	Recall	f-1 score	Support
<b>0</b>	1.00	1.00	1.00	29504
<b>1</b>	1.00	1.00	1.00	38220
<b>Accuracy</b>	-	-	1.00	67724
<b>Macro Average</b>	1.00	1.00	1.00	67724
<b>Weighted Average</b>	1.00	1.00	1.00	67724

**Table 12 computational results of CICIDS Friday afternoon 2**

Measure	Precision	Recall	f-1 score	Support
<b>0</b>	1.00	1.00	1.00	38323
<b>1</b>	1.00	1.00	1.00	47618
<b>Accuracy</b>	-	-	1.00	85941
<b>Macro Average</b>	1.00	1.00	1.00	85941
<b>Weighted Average</b>	1.00	1.00	1.00	85941

In KDDCup99 and CICIDS2017 we have reached every score near to perfect in precision, recall, f1-score, and support by using our proposed Hybrid-model. For NSL-KDD every score is being reached to 96% and for UNSW-NB15 it is 95%. Our proposed model's score is giving more accuracy than till now's studies. Additionally Table. 13. Shows comparative analysis of all the classifications results. Hybrid-model not only gives more accuracy but also solves the majority problem of high False Positive Rate (RPR) which is majorly addressed as issues have concurred.

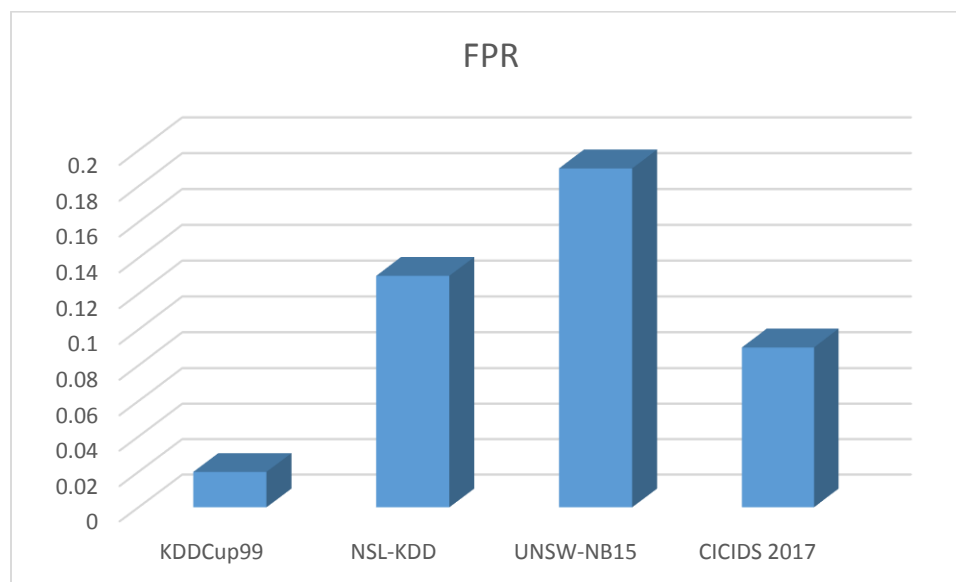
**Figure 3 Comparison between only DK and DK + EL**

**Table: 13. Comparative analysis of all the classifications results.**

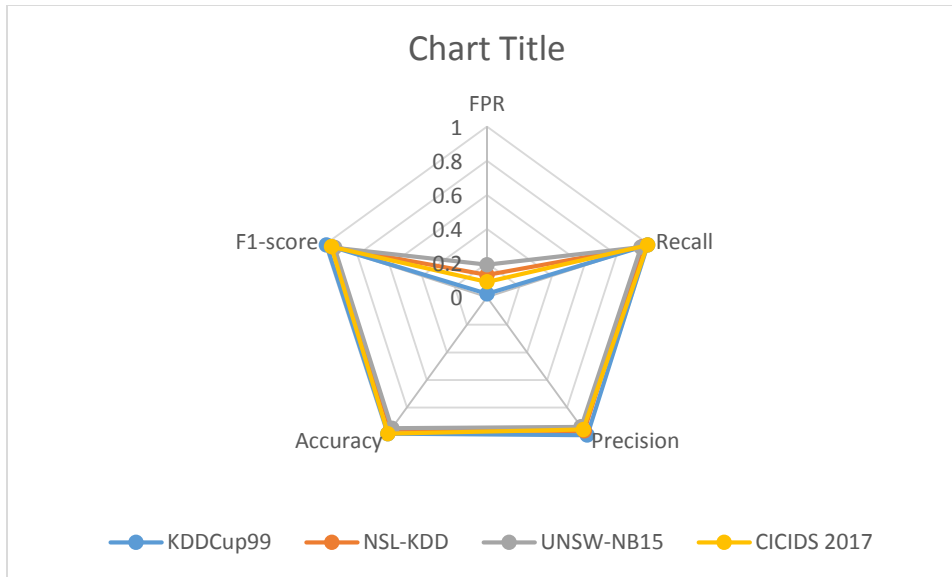
Dataset	FPR	Recall	Precision	Accuracy	F1-score
<b>KDDCup99</b>	0.02	0.99	1.00	0.99	0.99
<b>NSL-KDD</b>	0.13	0.96	0.97	0.96	0.95
<b>UNSW-NB15</b>	0.19	0.95	0.94	0.95	0.94
<b>CICIDS 2017</b>	0.09	0.99	0.96	0.99	0.96

The accuracy achieved at all different levels of the implementation phase is different; only DK with K-NN for utilized datasets varies from some datasets which show improved accuracy of datasets. Figure 4. Show the comparative results of the accuracy with the Domain Knowledge and Combining it with Ensemble Learning. CICIDS and KDDCup99 do not have any noticeable change in considered decimals points. However, NSL-KDD and UNSW-NB15 show improved results from only applying DK.

The second major concern of developing the system that overcomes False Positive Rate we effectively have reduced the FPR in our proposed hybrid model. Figure 4. Shows the datasets relevant FPR. We significantly gained 0.02 in KDDCup99. And UNSW-NB15 shows relevantly more than other datasets recorded FPR. NSL-KDD and CICIDS2017 have 0.13 and 0.09 respectively. Figure 5. Shows a Radar chart of over-evaluation of our proposed model according to the respective datasets.

**Figure 4 Comparison between only DK and EL**



**Figure 5 Model Evaluation Graph**

#### 4. CONCLUSION

Due to the fluctuating nature of Intrusions and also network patterns, it is required to test models on different kinds of network patterns with different malware records in unique benchmarked datasets. Currently, many IA techniques are being used for feature selection. However, the majority of them suffer from higher False Positive Rates (FPR) in our studies we have been concerned with all the measures for Intrusion detection. As intruders have advanced in attacking, we also need to make our system free from different vulnerabilities. Sustainable IDS has become a must while the majority of fields have been shifted to online. Our developed model shows sustainability over recorded Intrusions from previous years.

In future work we would like to work on two measures effectively, the initial one is even reducing the false positive rate and the final one is performance evaluation on a real-time network rather than recorded sets.

#### REFERENCES

- [1]. Xianwei Gao, Chun Shan, Changzhen Hu, Zequn Niu, And Zhen Li; An Adaptive Ensemble Machine Learning Model For Intrusion Detection; Volume 7, (2019) IEEEAccess.
- [2]. Bayu Adhi Tama 1, Marco Comuzzi1, And Kyung-Hyune Rhee; Tse-Ids: A Two-Stage Classifier Ensemble For Intelligent Anomaly-Based Intrusion Detection System; Volume 7, (2019); IEEEAccess.
- [3]. Pullagura Indira Priyadarsini1 , G. Anuradha2; A Novel Ensemble Modeling For Intrusion Detection System; Volume 10; (2019); IJECE
- [4]. Kehe Wu, Zuge Chen, And Wei Li; A Novel Intrusion Detection Model For A Massive Network Using Convolutional Neural Networks; Volume 6, (2018); IEEEAccess.
- [4]. Sheikh Rabiul Islam, William Eberle, Sheikh K. Ghafoor, Ambareen Siraj, Mike Roger; Domain Knowledge Aided Explainable Artificial Intelligence For Intrusion Detection And Response; Arxiv:1911.09853v2 [Cs.Ai] 22 Feb (2020); AAAI.
- [5]. Ying Gao, Hongrui Wu, Binjie Song, Yaqia Jin, Xiongwen Luo, And Xing Zeng; A Distributed Network Intrusion Detection System For Distributed Denial Of Service Attacks In Vehicular Ad Hoc Network; Volume 7, (2019); IEEEAccess.

- [6]. Binghao Yan And Guodong Han; Effective Feature Extraction Via Stacked Sparse Autoencoder To Improve Intrusion Detection System; Volume 6, (2018); IEEEAccess.
- [7]. Aimin Yang 1,2, Yunxi Zhuansun1,2, Chenshuai Liu2, Jie Li 2,3, And Chunying Zhang1,2; Design Of Intrusion Detection System For Internet Of Things Based On Improved Bp Neural Network; Volume 7, (2019); IEEEAccess.
- [8]. Sohaib Hanif, Tuba Ilyas, Muhammad Zeeshan; Intrusion Detection In Iot Using Artificial Neural Networks On Unsw-15 Dataset; February (2020); ResearchGate.
- [9]. Nishat Mowla, Inshil Doh, Kijoon Chae; Evolving Neural Network Intrusion Detection System For Mcps; Volume 6, (2017), TACT.
- [10]. Congyuan Xu, (Student Member, Ieee), Jizhong Shen, Xin Du, And Fan Zhang, (Member, Ieee); An Intrusion Detection System Using A Deep Neural Network With Gated Recurrent Units; Volume 6, (2018); IEEEAccess.
- [11]. Kehe Wu, Zuge Chen, And Wei Li; A Novel Intrusion Detection Model For A Massive Network Using Convolutional Neural Networks; Volume 6, (2018); IEEEAccess.
- [12]. Kaiyuan Jiang, Wenya Wang, Aili Wang, And Haibin Wu; Network Intrusion Detection Combined Hybrid Sampling With Deep Hierarchical Network; Volume 8, (2020); IEEEAccess.
- [13]. Kaiyuan Jiang, Wenya Wang, Aili Wang, And Haibin Wu; Network Intrusion Detection Combined Hybrid Sampling With Deep Hierarchical Network; Volume 8, (2020); IEEEAccess.
- [14]. R. Vinayakumar 1, Mamoun Alazab2, (Senior Member, Ieee), K. P. Soman1, Prabaharan Poornachandran3, Ameer Al-Nemrat4, And Sitalakshmi Venkatraman5; Deep Learning Approach For Intelligent Intrusion Detection System; Volume 7, (2019); IEEEAccess.
- [15]. Fahimeh Farahnakian, Jukka Heikkonen; A Deep Auto-Encoder Based Approach For Intrusion Detection System; February 11 ~ 14, (2018); ICACT.
- [16]. Majjed Al-Qatf, Yu Lasheng, Mohammed Al-Habib, And Kamal Al-Sabahi; Deep Learning Approach Combining Sparse Autoencoder With Svm For Network Intrusion Detection; Volume 6, (2018); IEEEAccess.
- [17]. Admir Midzic 1, Zikrija Avdagic2, And Samir Omanovic3; Intrusion Detection System Modeling Based On Learning From Network Traffic Data; Volume 12, (2018); KSII.
- [18]. Husam Ibrahim Alsaadi1,2, Rafah M. Almuttairi3, Oguz Bayat1, And Osman Nuri Ucani1; Computational Intelligence Algorithms To Handle Dimensionality Reduction For Enhancing Intrusion Detection System; 293-308 (2020); Journal Of Information Science And Engineering
- [19]. Alaeddin Alabdallah1, Mohammed Awad2; Using Weighted Support Vector Machine To Address The Imbalanced Classes Problem Of Intrusion Detection System; Volume 12, (2018); KSII.
- [20]. D. Sudaroli Vijayakumar1 & S. Ganapathy2; Machine Learning Approach To Combat False Alarms In Wireless Intrusion Detection System; Volume 11, (2018); Computer And Information Science
- [21]. Fadi Salo 1, Mohammadnoor Injadat 1, Ali Bou Nassif 1,2, Abdallah Shami 1, And Aleksander Essex 1; Data Mining Techniques In Intrusion Detection Systems: A Systematic Literature Review; Volume 6, (2018); IEEEAccess.
- [22]. Iftikhar Ahmad 1, Mohammad Basher1, Muhammad Javed Iqbal2, And Aneel Rahim3; Performance Comparison Of Support Vector Machine, Random Forest, And Extreme Learning Machine For Intrusion Detection; Volume 6, (2018); IEEEAccess.

# **GPS RECEIVER BASED ACCIDENTAL PREVENTION SPEED CONTROL SYSTEM**

**Mr. Samyakkumar Jain**  
Institute of Technology, Nirma University

**Mr. Zeal Patel**  
Advanced Robotics Group, Houston, Texas, US

**Ms. Ritu Bansal**  
Symbiosis Centre of Information and Tech. Pune

**Ms. Priyanka Thakkar**  
Technical University Darmstadt, Germany

## **Abstract**

This work proposes designing and implementation of the speed control system to prevent over-speeding, as it is increasingly one of the major concerns for some countries. Major causes of the accidents that occur in day-to-day cycles are either due to over-speeding or being ignorant of the speed limit sign-boards. Considering these facts, the proposed design and work is to achieve speed control, based on vehicle location and form sensor networks in overall cities with the use of public transport or personal vehicles. In the proposed design, speed can be reduced with the help of the Speed Control Unit (which consists of motor/actuator or pneumatic cylinders or by directly accessing the ECU (Engine Control Unit)), according to location-specific pre-defined speed limits that have been stored into the database. Based on the information collected by sensors, the proposed mathematical model will take the decision and generate a control system to perform certain actions such as warning alarm indication or reduction of the speed slowly or gradually based on the safety parameters. The proposed design has been implemented and verified using the test runs around the college campus with virtually mapped real-world maps & speed limits parameters.

**Keywords: ECU (Engine Control Unit), GPS (Global Positioning System) receiver, Processing Unit, Speed Control Unit**

## **1. INTRODUCTION**

In day-to-day life, it is common that we hear news regarding the occurrence of deaths due to over-speeding, be it, students rammed over by vehicles in school zones or buses falling into mountain gorges. Over-speeding has become one of the increasing concerns of any nation. Statistics show that over 67% of accidents occur due to over speeding, accounting for around 61% of deaths every year. As many as 1000 school-going children get injured and have become victims of speeding in school zones where the speed limit is not observed and maintained. These data should not come as a surprise, considering 73% of drivers maintain their usual speed while driving through these areas and about 7% ignore the stop signs. India loses around 8 billion \$ annually due to road accidents, clearly affecting the GDP of the country.

Keeping these data in mind, the main objective of this proposed design is to reduce and limit the speed of vehicles whenever they cross sensitive areas like school zones and mountain ranges, which in return will lead to a decrease in the number of accident cases.

The speed limits for particular roads, highways are decided based on global parameters like Nature, Engineering, and Humans. The high-way and traffic researchers collect a huge amount of data through

different methods from the real world and create a cost-based model to analyze/research these data. Researchers also consider the parameters like weather, visibility, terrain, and location while working on some roads, hills, or high-way places to decide speed limits. These data can also be used for several other purposes such as road, crash risk, traffic [1], road material, shoulder space, and maintenance schedules. Generally, human-related data is the main focus taken into consideration while deciding the speed limits, for which researchers follow the 85<sup>th</sup> percentile rule.

The speed limit is not only a technical/technological thing, but it is also a combination of Physics and Biology overall, because the faster the speed, the less time for the human brain to react when something goes wrong. According to the data, the faster a person is moving, the more is the kinetic energy in the vehicle which increases the chance of a worse crash and is also indirectly proportional to the speed of the vehicle. Due to the amalgamation of data collected through various sources and human efforts involved to analyze these data, it may result in small deviation while constructing roads depending on location and infrastructure, leading to accidents.

The proceeding sections of this article are organized as follows: Section 2 introduces vehicle speed control/limiting methods and literature review. Section 3 describes the research work for the proposed accident prevention speed control system. Section 4 evaluates the proposed techniques in terms of reliability, area, and performance overheads.

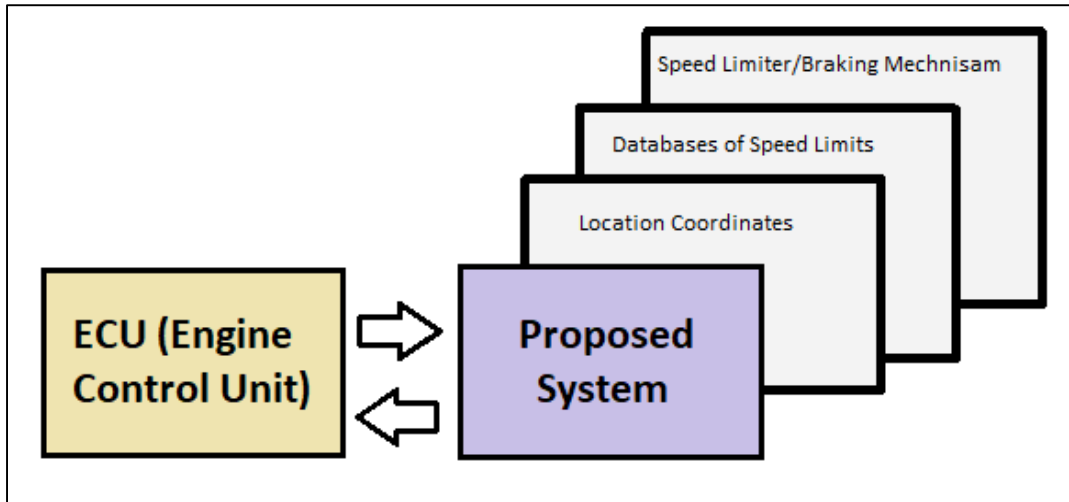
## **2. VEHICLE SPEED CONTROL/LIMITING METHODS**

By controlling the vehicle speed, it gives benefits like reduction in traffic noise, Pollution, Green House Gases, Average Fuel Consumption, and its Barrier effects. Many devices and methods [2] [3] [4] are available in the market for the same but as such, no official rules [5] have been created. To control the speed of vehicles there are 2 possible ways, the first is infrastructure changes in roads, Landmarks, Humps, Platforms and the second is Vehicle Technology and Enforcement. The infrastructure changes include (1) Adaptions for speed reduction at high-risk locations using speed hump and raising platforms for pedestrians [6][7], (2) Gateway infrastructure treatments by indicating new speed regime, (3) Roundabouts slow traffic at intersections via positively change the potential impact angle, provide better visibility and clarity about traffic flow and right-of-way [8], (4) Pavement narrowness and optical treatments which present a feeling or even illusion that the driver is going too fast [1].

The infrastructure changes may require proper planning and a picture of long-term execution. The Vehicle Technology includes external supportive active and passive systems where active systems will automatically intervene and correct the speed and confirm with safe speed limit and passive systems will only warn the driver of the vehicle traveling at an unsafe speed [5]. This Vehicle Technology can be implemented with the Enforcement to improve the awareness and compliance of Traffic Rules and Road-Signs which can be integrated with Spot Cameras and Automated in-vehicle enforcement devices/systems.

## **3. RESEARCH WORK**

As over speeding is a major issue in the normal vehicle in the market, the proposed design consists of a Location-specific database, speed measurement, location coordinates, and speed limiter/braking mechanism as shown in Fig. 1 which will be communicated with the existing ECU of the Vehicle.

*Fig 1: Block Diagram of the proposed technique*

The processor has an inbuilt mathematical model that uses the current speed and location which will be compared with the location-specific defined speed limit from the database. Based on the result from a mathematical model, the action needs to be taken against the over/instantaneous speed with measuring parameters like effective speed difference, force, and timing details. The system will perform the event of reducing the speed of the vehicle as per the specified parameters by a mathematical model.

### 3.1 Location Specific Speed Limit Database

As per the rules and regulations of the government, every road, landmark, the highway has some speed limit based on the geographic or nearby landmark locations which need to be followed by every vehicle based on its weight and vehicle category. During the construction of the road or any infrastructure, location-specific details and the traffic/road laws are applied as per the guidelines mentioned in the rule/section. Vehicles should be instructed to follow speed limit guidelines, considering the safety of children & other public near hospitals, schools/colleges, accident-prone areas, etc. These all speed-related data is put on the banner/signs so that drivers can follow the same. The author has proposed a safety system in which these data will be stored and recorded for the use of Electronic Safety System to fetch the information about the road, landmarks, and traffic rules related data.

### 3.2 Instantaneous Speed and Location Measurement

The other component of the proposed system is that system uses speed and location which needs to be used for querying the road details and to make a comparison for decision making.

Information on potential speeding can be taken from GPS location, road maps, radio beacons, optical recognition, and dead reckoning techniques. As far as the real-time position/tracking is concerned, Satellite-based systems like GPS & NavIC are more reliable compared to other techniques but these rely on the infrastructure of roads/landmarks and vehicle technology used in Dashboard and ECU. As satellite and communication technology has become advanced nowadays, the amount of accuracy for location

measurement is increasing significantly. The high-way and traffic researchers use road maps, radio beacons, optical recognition, and speed radars for other purposes.

### 3.3 Braking System or Speed Limiter

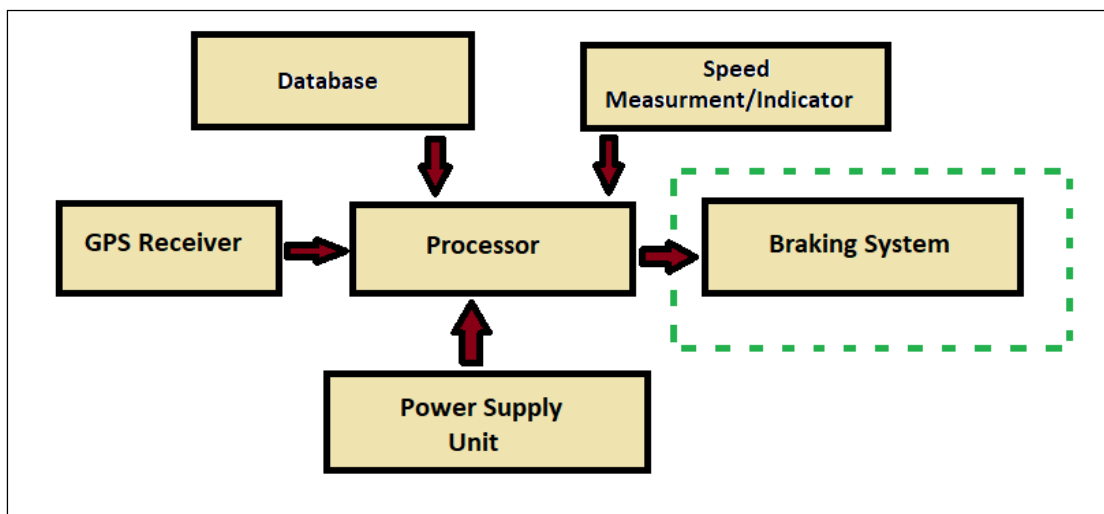
In many vehicles, the adjustable speed limiter or Intelligent Control Systems are equipped, where Adjustable Speed Limiter has freedom/controllability to driver to change or adjust threshold speed. Speed limiters are installed only on some categories of cars/vehicles which are mostly counted in premium categories. Speed limiters work based on the sensors reading from the vehicle dashboard/ECU. These speed limiters will transfer the command and control to ECU to stop the flow of the fuel further, after reaching the threshold limit which has been calculated through differential equations and models set by the manufacturer.

Braking systems are also a crucial part of vehicle technology, as direct brakes cannot be applied via the system for security and safety purposes. The ABS (Anti Braking System) helps the ECU to calculate the amount of force/action needed to be applied to stop at emergencies and prevent a crash. The proposed system will be in the form of an external device that can be installed manually on the vehicle based on the enforcement laws embedded by the government/traffic & road department. The reason behind using the external device is that every vehicle is not equipped with such technology and is not designed based on such criteria. This device can be embedded to increase the amount of road safety and save economic losses.

## 4. IMPLEMENTATION & SIMULATION RESULTS

The proposed design consists of Speed Measurement, Processing Unit, and Braking System as shown in Fig 2. The processing unit consists of a processor, power supply module, database, and indicators.

Fig 2: Block Diagram of the proposed technique



As the proposed Safety System boots up, the processor will invoke the commands to collect the instantaneous location from the GPS receiver and transfer it to the measurement model created by authors which is responsible for the course of action needed to perform by the processor and other supportive

components. This model will query the database for safety limits and road details which will be further getting compared with the current speed of the vehicle. According to the difference between current speed and safety limits, the model will transfer data and control to the processor, through which the processor will generate an indicator/alarm at the user Dashboard and instruct him/her to decrease the speed and keep pooling the current speed data. If the driver will not respond to the indicator/alarm, the system will come into action simultaneously pooling data from the location receiver.

*Fig 3: Technology Schematic of the proposed technique*

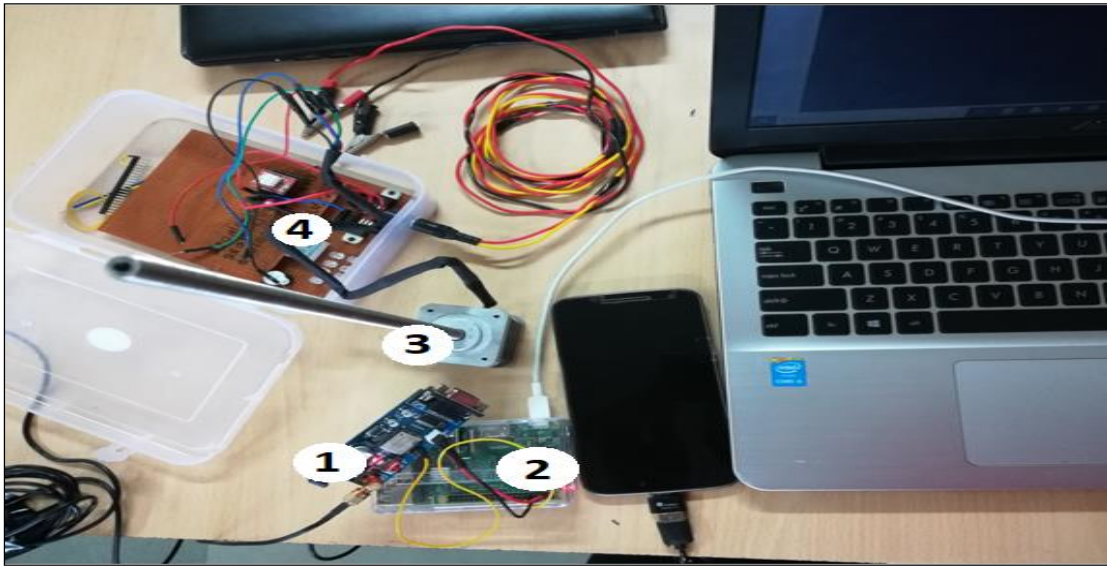


Fig. 3 shows the schematic/implementation of the proposed design, in which GPS Receiver is denoted as Tag-1, Processing Module as Tag-2, Braking System as Tag-3, and Power Management System as Tag-4. As Processing Unit an author has taken Raspberry Pi 3 which contributes as Processing Module, Data Base, and Custom Measurement & decision-making model.

*Fig 4: Simulation of test run for proposed system integrated with Google Maps on Location 1*



The proposed technique and its implementation have been tested around a college campus with the help of virtual/hypothetical points of limit speed restrictions where the driver had to pass through within the speed limit decided in the databases. These hypothetical locations have been denoted as Location 1 and Location 2 in Fig. 4. This image is taken with help of Google Maps. Our system is linked with maps to create, track and analyze the performance. Based on these test run scenarios, the author has found several modifications and scope of improvements in the developed mathematical model for computation of action.

*Fig 5: Simulation Logs of test run for proposed system via remote desktop sharing*

```
latitude: 23.1079566667 longitude: 72.595
over speeding at loc 1
over speeding at loc 1
over speeding at loc 1
over speeding at loc 1
over speeding at loc 1
over speeding at loc 1
over speeding at loc 1
over speeding at loc 1
over speeding at loc 1
over speeding at loc 1
over speeding at loc 1
over speeding at loc 1
over speeding at loc 1
over speeding at loc 1
over speeding at loc 1
over speeding at loc 1
over speeding at loc 1
speed : 36.28 km/h

over speeding at loc 1
over speeding at loc 1
Time in UTC 08:47:54.000
latitude: 23.1078933333 longitude: 72.5951933333
```

This test run has been performed to test and validate the working of each component in the system which mainly includes Measurement of Action and Braking actuation/Action as per the requirements. In the test, the driver has over speeded the vehicle (in virtual/hypothetical experiment, the author has scaled down the limits and threshold values with appropriate mapping techniques), for which the system has been completely into action mode from end-to-end. Fig.5 shows the logs for the over-speeding scenario.

Fig. 4 & 5 show the live simulation of the test run performed by the author on the different receiving ends of the system. As noted in Fig. 4, the live location has been shared and combined with Google Maps with the help of a custom interface script. Fig. 5 demonstrates the remote desktop which is connected with the Processing Unit of the System, showing important information displayed on the command line using logs/debug points.



*Fig 6: Simulation of test run for proposed system integrated with Google Maps on Location 2*



Fig.6 shows the simulation results that have been tested for Location 2 and the author has successfully validated the functionality and correctness of the proposed system.

## 5. CONCLUSION

Speed Limits, Over-Speeding, and Neglecting Sign Boards have been overcome by Intelligent Autonomous Vehicle System. The demand for an autonomous vehicle with safety, accuracy and reliable design has been on the rise in recent years. Researchers and Scientists are working on Autonomous Vehicle technology with a couple of test runs but safety, reliability, and faith in Autonomous systems are still some issues faced by humans. To overcome the above-mentioned challenges, the proposed design for an accident prevention system is implemented, integrated, and tested into the small real-world field. Implementations like adding extra computing modules, sensors to implement mesh network of multiple devices, and detailed focused design on mechanical/electronic braking system design can be the future scope of the proposed work. The work can be further extended by integrating the system with Traffic Cameras and a real-time ticket issue system for violation of road & traffic enforcement laws. The proposed system can be implemented for better performance and reliable solutions with the intervention of the industries and ECU manufacturing companies.

## REFERENCES

- [1] Major, R., & Mészáros, G. (2020). Thoughts on Road Traffic Control. *Internal Security*, 12(2), 54–55. <https://doi.org/10.5604/01.3001.0014.6703>
- [2] Kumar, V. P., Rajesh, K., Ganesh, M., Kumar, I. R. P., & Dubey, S. (2014). Overspeeding and Rash Driving Vehicle Detection System. *2014 Texas Instruments India Educators' Conference (TIIEC)*. <https://doi.org/10.1109/tiiec.2014.013>
- [3] Khan, M. A., & Khan, S. F. (2018). IoT based framework for Vehicle Over-speed detection. *2018 1st International Conference on Computer Applications & Information Security (ICCAIS)*. <https://doi.org/10.1109/cais.2018.8441951>

- [4] A.K., K.J.A., & A.D.R. (2019). A Research For Tracking Overspeeding Vehicles. *International Journal of Recent Technology and Engineering*, 8(2), 5026–5028. <https://doi.org/10.35940/ijrte.b1082.078219>
- [5] Su, D., Guo, Z., Li, Z., & Zhou, Y. (2016). Operation Risk Model and Monitoring-warning System of Expressway Tunnels. *Transportation Research Procedia*, 14, 1315–1324. <https://doi.org/10.1016/j.trpro.2016.05.204>
- [6] Bhamrah, R. S. (2016). Variable Density Speed Hump. *International Journal of Students' Research in Technology & Management*, 4(2), 35–37. <https://doi.org/10.18510/ijstrtm.2016.423>
- [7] Salau, T. A. O., Adeyefa, A. O. O., & Oke, S. A. (2004). VEHICLE SPEED CONTROL USING ROAD BUMPS. *TRANSPORT*, 19(3), 130–136. <https://doi.org/10.3846/16484142.2004.9637965>
- [8] Rey, G., Clair, D., Fogli, M., & Bernardin, F. (2011). Probabilistic assessment of roadway departure risk in a curve. *Vehicle System Dynamics*, 49(10), 1649–1671. <https://doi.org/10.1080/00423114.2010.532556>

## **DRONE BASED IMAGING SYSTEM FOR WASTE ASSESSMENT**

**Bagwe Sarvesh**

**Vishwakarma Govt. Engineering College**

**Love Fadia**

**Vishwakarma Govt. Engineering College**

**Reetika**

**Vishwakarma Govt. Engineering College**

**Neha Uttwani**

**Vishwakarma Govt. Engineering College**

**Jayesh Diwan**

**Vishwakarma Govt. Engineering College**

### **ABSTRACT**

One of the paramount issues faced by cities and towns is related to the management of municipal solid waste (MSW). The waste quantity is increasing day by day; municipal authorities are unable to scale up the facilities required for proper management and disposal of waste. In many cities and towns, garbage is littered on roads and footpaths and spotted at dumping yards. Drone-based waste assessment can be critical in solid waste management and recycling as they can take aerial photos or videos of such sites. The proposed work is to build a drone that takes photographs of nearby waste sites and bins using a camera mounted on it. After that, the pictures can be examined with the help of Image Processing Techniques to deduce whether there is a need for garbage collection or not. The above steps can be possible using a flight controller mounted on it and an application.

**Keywords: Garbage Assessment, Unmanned Aerial Vehicle, Image Processing**

### **1 INTRODUCTION**

Unmanned aerial vehicles (UAVs) are aircraft that fly autonomously, through the use of remote control, or both, and are outfitted with sensors, target designators, or electronic transmitters that communicate with the controller and provide information about the UAV. [1]

This model focuses on one such implementation making the use of the drone. The drone mainly uses imaging techniques to create a multipurpose project based on different applications. A few of its applications include 1) Traffic Management 2) Disaster Management 3) Waste Detection, Control, etc. Besides this, some other accidents such as landslides or fire incidents in multi-story buildings can be reported to the concerned authorities for immediate action through live video captured by this drone. The drone can be operated in two ways: manually and automatically. In manual flight mode, the drone receives instruction using a remote-controlled transmitter that sends a signal to the drone receiver, which aids in smooth control. Furthermore, the drone utilizes the Global positioning system to navigate through a predetermined path in the automatic flight mode. Besides this, there are certain prevention measures also, which can be implemented in case of loss of contact.

## 2 LITERATURE SURVEY

1. Using the movement of an unmanned aerial vehicle, [2] A system is established for recognizing solid waste (UAV). A drone is used to detect rubbish using image processing algorithms that identify waste-contaminated regions and send location information to the proper authorities. They've wired in an Arduino to take images, as well as GPS and GSM modules for tracking and communication. The project's goal is to identify large amounts of waste; there is no segregation.
2. In the context of a Smart Cities Logistics system, [3] A concept for a Drone System was submitted for Detecting, Classifying, and Monitoring Solid Wastes Using Computer Vision Techniques. Under the Logistics 4.0 paradigm, a drone is utilized to decide solid waste in real-time, which will affect the determination of solid waste patterns by employing an artificial vision system for detection, categorization, and monitoring of solid trash in an intelligent drone.
3. Garbage Waste Segregation Using Deep Learning Techniques was proposed [4] to reduce human interaction and increase the efficiency of the trash separation process. Using a Convolutional Neural Network, the suggested study was to create an image classifier that recognizes the item and classifies the sort of waste material.
4. The Autonomous Quadcopter Docking System [5] project was presented to create the systems and algorithms that would allow a quadcopter to identify and settle on a station target autonomously. The goal of this system was to sketch out the foundation for a quadcopter-based data gathering or surveillance system that takes into account the highly mobile devices' limited battery life by landing the UAV securely in a chosen spot to be recharged.

## 3 UNMANNED AERIAL VEHICLE SPECIFICATIONS

Because of the large number and variety of UAV models available, the unique attributes of the UAV employed in the studies are worth discussing. In the experiments described in this paper, a quadcopter model with a 2.4 GHz remote control, a 433 MHz telemetry channel, a GPS receiver, a Pixhawk flight controller, an ESP-32 Cam, and a Raspberry Pi are used.

### 3.1 2.4 GHZ Remote Control

The UAV and the remote control communicate using the FlySky X8r receiver. This accessory allows the UAV to be flown manually. It captures and transfers the produced remote-control signals before sending them to the remote control. Furthermore, rudimentary information of UAV data is sent to the controller, keeping the user informed about the UAV's status. It achieves these goals by making use of the whole 2.4 GHz ISM band. [6]

### 3.2 433 MHz Telemetry

To provide data from the UAV's remote control to a base station, such as inclination,

direction, battery backup, velocity, elevation, flying mode, and much more is the task to be done. It can also be provided instructions on how to do a task.

### 3.3 Flight Controller

The Pixhawk 4 flight controller collects data from sensors and interprets it to operate the UAV at a basic level. An accurate picture of the UAV status is produced by combining; sensor output data from the GPS, accelerometer, and gyroscope. This information is then used to keep the unmanned aerial vehicle stable and steerable. Pixhawk flight controller is used (which includes an Ardupilot firmware implementation) because it is an open-source solution that allows new protocols to be created and deployed on actual UAVs. The pair of transmitter and receiver are used for the communication between the UAV and Pixhawk.

### 3.4 Raspberry Pi

Raspberry Pi is a low-cost, small-sized computer module that runs on Linux. It also provides a set of GPIO pins allowing control of electronic components for physical computing and exploring the Internet of Things (IoT). Here, it is neither mounted on the drone nor used in the drone section for processing data related to Autonomous flight control. It provides access to the server and uploads images on the server. With the help of the LAMP (Linux, Apache, MySQL, PHP) server, processing of the captured image would be done.

### 3.5 ESP-32 CAM

ESP-32 CAM module is used for image capturing and is an IoT Image Capturing Device. Here, in this project, ESP-32 CAM is paired with the OV2640 Camera Module that supports the highest Camera Resolution up to  $1600 \times 1200$ . The Camera module will capture Real-time dustbin images having a specific mark on its top. This mark will be detected using an Image processing algorithm later on.

### 3.6 GPS

GPS (Global Positioning System) is a radio navigation system that allows land, sea, and airborne users to determine their exact location. It is mounted on the drone and connected to the Pixhawk controller. With the help of the GPS module, coordinates are extracted in the mission planner software, and the exact location is determined. It plays an important role in Autonomous Flight Mode by deciding different locations as waypoints.

*Figure 1. Drone Images*

*(a) Top view*

*(b) side view*



*(c) Side view*



*(d) bottom view*



## 4 MISSION PLANNER

### 4.1 Prologue

Mission Planner is a drone, helicopter, and rover ground control station. It is only compatible with Windows. Any autonomous vehicle can employ Mission Planner as a setup tool or as a dynamic control supplement [7]. Mission Planner is used for a few things:

- Set up, configure, and optimize the vehicle for best results.
- Vehicle's status can be tracked in real time application.
- Simple spot-and-click way-point entry on Google may be used to plan, save, and load unmanned aerial operations into autopilot.

### 4.2 Connecting Mission Planner through Ardupilot

The first step in setting up a connection is establishing the communication protocol, followed by configuring the actual hardware and Windows system components. Following that, USB cables, Telemetry Radios, Bluetooth, IP connections, and other devices are connected to the PC.

The network and data rate are selected in Mission Planner. After the successful connection of USB or Telemetry Radio, A COM port number will be assigned by Windows,

which will appear in the drop-down selection.

To communicate with the autopilot, select the desired port and data rate and then press the Connect button. Following the connection, Mission Planner will collect autopilot parameters and the button will change to Disconnect.

### **4.3 Defining Mission**

A location is set to a home position, where the vehicle for the Copter, Plane, and Rover was armed. Required command is selected from the dropdown options for each row. The column header will change to reflect the information, which was given by the command. By clicking on the map, Lat and Long are given as input. The height is measured with the launch altitude and the position of the aircraft. While creating new waypoints, Default Alt is the default altitude. The Mission Planner will utilize Google Earth topological data to alter target altitude at each Waypoint to match the height of the ground underneath. Furthermore, various parameters such as elevation from the ground, WP radius are needed to be analyzed; before uploading the mission for the autonomous flight of UAV. [8]

### **4.4 Uploading and execution of mission**

After the completion of Mission planning, the data is transferred to APM and stored in EEPROM using the Write option. Multiple mission files can be saved to a local hard drive by selecting Save WP File in the right-click menu or read in by selecting Load WP File. Grid: This feature involves drawing a polygon (right-click) and having waypoints created for you automatically across the specified region. The command "Auto Grid" in Task Planner may automatically build a mission, which is ideal for mapping missions where the aircraft should travel back and forth in a "lawnmower" pattern over an area to take images.

## **5 FLIGHT METHODOLOGIES**

### **5.1 Manual flight mode**

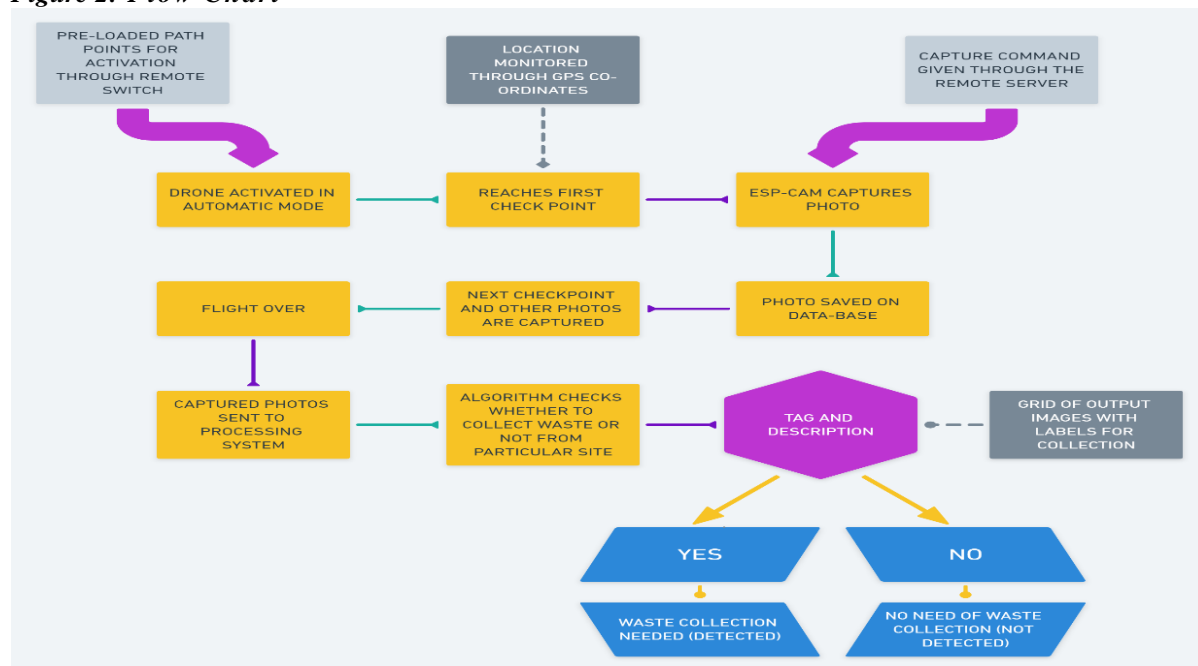
The drone has a Pixhawk flight controller mounted below it. It is connected to a receiver that receives the signal from the remote transmitter from the ground station. The flight controller controls the current flowing through the Electric Speed controllers (ESCs), which are responsible for the movement of the motors and consequently the propellers. A global positioning system mounted on top of the drone has been used to keep track of the position. To locate it, in case of an accident. All the above things are possible using the Mission Planner application. It helps in monitoring a plethora of parameters such as ground speed (m/s), vertical speed (m/s), altitude (m), yaw (deg), and many more. In Manual flight, there are multiple modes available: Loiter, Alt Hold and Stabilize, to name but a few. Each flight mode has its functionality. [9]

### **5.2 Automatic flight mode**

The autonomous mode is a vital part of our work. The main aim is for the drone to take photos simultaneously without any influence on a predetermined path. It is possible to use the auto mode of the Pixhawk Flight Controller (PFC) and the GPS; the combination of

both will pave the way for smooth automatic operation. The drone will make a stop at some coordinates; lower its altitude decided by us. Then it will take pictures while maintaining the current position and the height. After that, it will move to a different location and follow the same procedure until it is called to the ground station [10]. For safety purposes of the drone, a fail-safe mode is also deployed. In case of loss of contact or windy weather, the drone will land safely at a secure location using the Return to Land command (RTL) [11]. It provides proper landing of the drone and safety in case of discharged battery condition to avoid any devastating consequences.

Figure 2: Flow Chart



## 6 IMAGE CAPTURING

### 6.1 Capturing

AI-Thinker developed the ESP32 camera module. The controller is based on a 32-bit CPU has a combined WiFi + Bluetooth/BLE Chip. The module comes with the OV2640 Camera Module, which supports the highest Camera Resolution up to  $1600 \times 1200$ . It is used broadly in many IoT applications such as wireless video streaming, home smart devices, and many more. Camera module is connected to a router to command and run the ESP32-CAM web server; to capture the images. The router operates as an access point for the camera module, which acts as a station [12]. The webserver was designed with the help of HTML, JavaScript, and CSS. Furthermore, it contains three buttons: Rotate, Capture photo, and Refresh Page. Each photo-capturing process run different JavaScript functions: RotatePhoto, CapturePhoto, and Reload. The RotatePhoto button rotates the picture. The CapturePhoto button sends a request on the /capture URL to the ESP32, so it captures a new photo. On clicking the Refresh button, it will load the latest.



## 6.2 Uploading

A LAMP server will be used to process the image that is captured. The open-source Web development platform LAMP is well-known. It depicts a Linux-based operating system with an Apache web server, site data stored in a MySQL relational database management system, and dynamic content handled by PHP. [13] Between a client and a server, the Hypertext Transfer Protocol (HTTP) serves as a request-response protocol. An HTTP request is sent to a server by the ESP32 (client). The HTTP POST method is used to submit information to a server in order to create or update a resource. The ESP32 receives a response from the server (client). [14] Uploads.php is a distinct file that is responsible for receiving the images from the ESP32-CAM.

## 6.3 Storing

LAMP is a remote server, where jpeg/jpg images are stored, so that one can access it from anywhere in the Local Area Network. The LAMP server is hosted on the Raspberry pi, which works as a backend device to access/display the images on the webserver. After that, the images can be stored in a folder so that it can be accessed from a folder named gallery.php using the php script. Apache server is used to handle requests from clients to server by means of TCP/IP protocol. [15]

Furthermore, it will generate a document in the form of a php script. Images are stored on Raspberry-Pi by the means of upload.php file, which further facilitates the accessing of images through webserver-hosted using gallery.php script.

# 7 IMAGE PROCESSING

## 7.1 Computer vision

It is a field of science that works with computers to extract a high-level perception from images and videos. An open-source computer vision library named Open-CV is used to implement Computer Vision in Python. It enables a user to work at the pixel level in an image. Furthermore, it also allows extracting high-frequency and low-frequency data from the image; to get the desired output. For this, Computer Vision has various built-in functions and user-defined functions, such as edge detection algorithms, image denoising techniques, contour detection, and many more [16]. To retrieve paths, which match similar patterns, a library named glob is used. Consequently, to read the image, those paths are used. Moreover, these images can be pre-processed later.

## 7.2 Image Preprocessing

### 7.2.1 Hybrid algorithm

In this algorithm, the captured images are processed using two different techniques. Firstly, the obtained image in the RGB image model into the parameters of the HSV image model. The parameters are Hue, Saturation, and Value. [18] Hue is the dominant color plane, Saturation is the white light amount associated with Hue, and Value is the measurement of intensity, which refers to tone. Therefore, splitting an image into three different channels will produce three separate images with information in each. Out of these, the image obtained using the Value channel will contain information regarding the edges. Furthermore, the Adaptive Thresholding method on the image will eliminate noise and enhance the details of required edges by working on the pixel intensities of each region. [19] Secondly, to reduce the redundant data and to get the information from the captured images, it is convolved with the kernel, which changes the value of any given pixel by combining it with different amounts of the adjacent pixels. The convolution operation with this kernel has an averaging effect, which makes the resulting image smooth and sharp. As a consequence, the information extraction process becomes smooth. Furthermore, it is changed into a gray-scale format, and a Gaussian filter which is a low pass filter, is used for blurring the image, but here it is used twice, and then the resultant image is subtracted from the original image that will do the work of unsharp masking. It will facilitate the process of edge detection by removing noise and enhancing the edges. After this canny operator is applied to detect the edges, which helps in controlling the amount of detail that appears in the final image.

### 7.3 Contour Detector

It is a technique, which joins a curve to all the points (along with the boundary), having the same color or intensity. Contours are intellectual collections of points as well as segments that correspond to the edges or shape of the objects in an image. Due to this, one can count the number of contours and use them to categorize the shapes of objects. To ameliorate the accuracy of detecting the contours on the given image, the RGB image is converted into a single channel gray-scale image. [21] Furthermore, the contour approximation method is used to store all (x, y) coordinates of the boundary of a shape. To draw the contours, Area and Perimeter are defined to specify whether it is a closed contour or just a curve. After that, a built-in function from OpenCV is used to approximate the shape of polygonal curves to the specified precision. [22] The approximated contour, which is the same as the input curve. Finally, the determined shape of the contours is drawn on the original image to get user-friendly interface of the output.

## 8 RESULTS

The hybrid model produces two output images: hybrid output 1 and hybrid output 2, which are sent to the contour detector. It will perform the computations to find the symbol in the image to check whether there is a need for waste collection or not. Every image is sent to the contour detector for this purpose. Furthermore, the detector will return the labelled grid of images. These two grids are then combined to find the final sites, which need waste collection.

*Figure 3: Hybrid outcome-1*



*Figure 4: Hybrid outcome-2*



*Figure 5: Final Result*



## 9 ANALYSIS

The shape that is detected from captured images symbolizes the need to collect the waste from the location. This shape is mounted on the top of a dustbin, which will facilitate the process of automated waste assessment. The hybrid method is used here for preprocessing works on an image in two different methods for removing the different types of noise from an image. The combined method of deciding the outcome for waste collection enhances the accuracy of the overall model to a greater extent. Furthermore, this model works well with pictures that are taken not only in the low light environment as but also in the high light environment.

## 10 CONCLUSION

The paper defines an automated waste assessment system. The proposed drone system is integrated with a very low-power ESP-32 Camera module which significantly reduces the power consumption. The low power consumption increases the flight time to 25 minutes. Furthermore, the drone is made comparatively compact and lightweight due to the integration of the IoT-based ESP-32 camera module, which is controlled remotely with the help of WLAN protocols instead of mounting a microcontroller along with it. The drone can be operated in autonomous mode as well as manual mode. In autonomous mode, the drone can fly on its own, which includes landing and take-off. In case of a malfunction, the drone can be switched back to manual mode instantly to avoid any accidents. The image processing is done manually using a hybrid algorithm which is implemented in python. The algorithm tries to extract a symbol from the captured images, which is mounted on the top of a dustbin. The symbol signifies the need for waste collection. If the symbol is detected in the image, then the waste needs to be collected from that site.

## 11 FUTURE WORK

There are few constraints of this system. Firstly, it is completely dependent on the symbol for waste detection. This can be solved by using deep learning modeling techniques, which can detect the waste irrespective of the symbol and the location of the waste. Secondly, the range of the camera depends upon the WLAN, which varies on a case-to-case basis. To overcome this, IoT-based protocols can be used which can mitigate the problem of dependency on the range of WLAN, and the capturing process can be done remotely.

## References

- [1]Doherty, P., Granlund, G., Kuchcinski, K., Sandewall, E., Nordberg, K., Skarman, E. and Wiklund, J., 2000, August. The WITAS unmanned aerial vehicle project. In ECAI (pp. 747-755).
- [2]Pradipbhai, A.A., Monisha, B.V., Manasa, P., Kumar, P.A., Shekhar, R. and Riyaz, S., 2019. Drone based Solid Waste Detection using Deep Learning & Image Processing. In Alliance International Conference on Artificial Intelligence and Machine Learning (AICAAM) (pp. 357-364).
- [3]Ramirez-Lopez, A., Cortes-González, A., Ochoa-Ruiz, G., Ochoa-Zezzatti, A., Aguilar-Lobo, L.M., Moreno-Jacobo, D. and Mata-Miquel, C., 2021. A Drone System for Detecting, Classifying and Monitoring Solid Wastes Using Computer Vision Techniques in the Context of a Smart Cities Logistics Systems. In Technological and Industrial Applications Associated with Intelligent Logistics (pp. 543-563). Springer, Cham.
- [4]Susanth, G.S., Livingston, L.J. and Livingston, L.A., 2021. Garbage Waste Segregation Using Deep Learning Techniques. In IOP Conference Series: Materials Science and Engineering (Vol. 1012, No. 1, p. 012040). IOP Publishing.
- [5]Mitra, S. and Land, B., 2013. Autonomous quadcopter docking system. Cornell University, pp.1-38.
- [6]Fabra, F.; Calafate, C.T.; Cano, J.C.; Manzoni, P. On the impact of inter-UAV communications interference in the 2.4 GHz band. In Proceedings of the 2017 13th International Wireless Communications and Mobile Computing Conference, Valencia, Spain, 26–30 June 2017; pp. 945–950.
- [7]Cavalcante, T.R.F., De Bessa, I.V. and Cordeiro, L.C., 2017, November. Planning and evaluation of UAV mission planner for intralogistics problems. In 2017 VII Brazilian Symposium on Computing Systems Engineering (SBESC) (pp. 9-16). IEEE.
- [8]Stecz, W. and Gromada, K., 2020. UAV mission planning with SAR application. Sensors, 20(4), p.1080.
- [9]Sabo, A., Kuljic, B. and Szakáll, T., 2019. Practical application of the drone technology in civil

- engineering. In Science in Practice Conference.
- [10] Vervisch-Picois, A., Samama, N. and Taillandier-Loize, T., 2017, November. Influence of gns spoofing on drone in automatic flight mode. In ITSNT 2017: 4th International Symposium of Navigation and Timing (pp. 1-9). Ecole nationale de l'aviation civile.
- [11] Yakovlev, K.S., Makarov, D.A. and Baskin, E.S., 2015. Automatic path planning for an unmanned drone with constrained flight dynamics. *Scientific and Technical Information Processing*, 42(5), pp.347-358.
- [12] Marek Babiuch and Jiri Postulka Babiuch, Marek Postulka, Jiri. (2020). Smart Home Monitoring System Using ESP32 Microcontrollers. 10.5772/intechopen.94589.
- [13] Wickham M. (2018) Uploading and Emailing. In: Practical Android. Apress, Berkeley, CA. [https://doi.org/10.1007/978-1-4842-3333-7\\_5](https://doi.org/10.1007/978-1-4842-3333-7_5)
- [14] Cameron N. (2021) Intranet camera. In: Electronics Projects with the ESP8266 and ESP32. Apress, Berkeley, CA. [https://doi.org/10.1007/978-1-4842-6336-5\\_2](https://doi.org/10.1007/978-1-4842-6336-5_2)
- [15] X. Zeng, H. Guo and W. Hu," Design and Implementation of Shipping Video Surveillance Equipment Based on Raspberry Pi," 2019 IEEE International Conference on Computational Science and Engineering (CSE) and IEEE International Conference on Embedded and Ubiquitous Computing (EUC), 2019, pp. 66-70, doi: 10.1109/CSE/EUC.2019.00022.
- [16] Pulli, Kari; Baksheev, Anatoly; Korniyakov, Kirill; Eruhimov, Victor (2012), "Real-time computer vision with OpenCV" *Communications of the ACM*, 55(6), 61-. doi:10.1145/2184319.2184337
- [17] M. H. Rahman and M. R. Islam," Segmentation of color image using adaptive thresholding and masking with watershed algorithm," 2013 International Conference on Informatics, Electronics and Vision (ICIEV), 2013, pp. 1-6, doi: 10.1109/ICIEV.2013.6572557.
- [18] P. Ganesan, V. Rajini, B. S. Sathish and K. B. Shaik," HSV color space-based segmentation of region of interest in satellite images," 2014 International Conference on Control, Instrumentation, Communication and Computational Technologies (ICCICCT), 2014, pp. 101-105, doi: 10.1109/ICCICCT.2014.6992938.
- [19] Derek Bradley Gerhard Roth (2007) Adaptive Thresholding using the Integral Image, *Journal of Graphics Tools*, 12:2, 13-21, DOI: 10.1080/2151237X.2007.10129236
- [20] G. Xin, C. Ke and H. Xiaoguang," An improved canny edge detection algorithm for color image," IEEE 10th International Conference on Industrial Informatics, 2012, pp. 113-117, doi: 10.1109/INDIN.2012.6301061.
- [21] J. Ni, Z. Khan, S. Wang, K. Wang and S. K. Haider," Automatic detection and counting of circular shaped overlapped objects using circular hough transform and contour detection," 2016 12th World Congress on Intelligent Control and Automation (WCICA), 2016, pp. 2902-2906, doi: 10.1109/WCICA.2016.7578268.
- [22] Bengtsson, A.; Eklund, J.-O. (1991). Shape representation by multiscale contour approximation., 13(1), 0-93. doi:10.1109/34.676

## **“The Impact of COVID-19 Pandemic on Online banking usage”**

**Key Words:** COVID - 19, Banking, Bank Users, Online Banking, Banking Services

**Dr. Ranjan Jaykant Sabhaya**  
**S. R. Luthra Institute of Management, Surat**

### **Abstract**

The COVID-19 pandemic has impacted the digital banking market positively. To support and meet the financial needs of the customers, banks have developed business models and now use various technologies such as AI and human resource to impact marketing, innovation and the digital delivery of products and services. This factor is significantly driving the adoption of digital banking and will impel the market growth during the COVID-19 outbreak. Moreover, increase in acceptance of online banking by consumers and use of online and digital banking substitutes has been increased during this outbreak.

This research paper is descriptive research study, in which e- survey has been conducted for the people who fall into the age group of 25 years to 60 years in Surat City. For survey, Questionnaire has been designed to collect the responses of the online banking services users during COVID – 19 Pandemic from Surat City, and a sample has been selected on the basis of non-probability convenience sampling and snow-ball sampling method. Questionnaire has been send through email and whatsapp and 305 responses have been collected for the study.

After collecting and analyzing data, the researcher has found that the respondents were agreed with the fact that during this pandemic the use of internet/online banking services has increased the quality and efficiency of their banking services. During this pandemic, their trust level was also high for doing online banking transactions. Respondents were using online banking because of having the fear of contacting the coronavirus through paper currency. 47.5% of the respondents said that during the covid-19 pandemic the usage of online banking services has been increased by them.

### **1. Introduction**

The banking industry’s collective response to the pandemic so far has been remarkable. It had been no easy achievement to travel fully virtual and execute an untested operating model during a matter of weeks. Despite some minor problem, many banking operations were executed smoothly. During this pandemic Customers were served with good efficiency, employees were productive, and regulators were working with full of their energy. Banks effectively employ technology and demonstrated unprecedented agility and resilience.

For the banking system, the economic consequences of the pandemic aren't on an equivalent scale as those during the worldwide Financial Crisis of 2008–10 (GFC), but they're still remarkable. Additionally, to the financial fallout, COVID-19 is reshaping the worldwide banking system on variety of dimensions, initiate during a new competitive landscape, stifling growth in some traditional product areas, prompting a

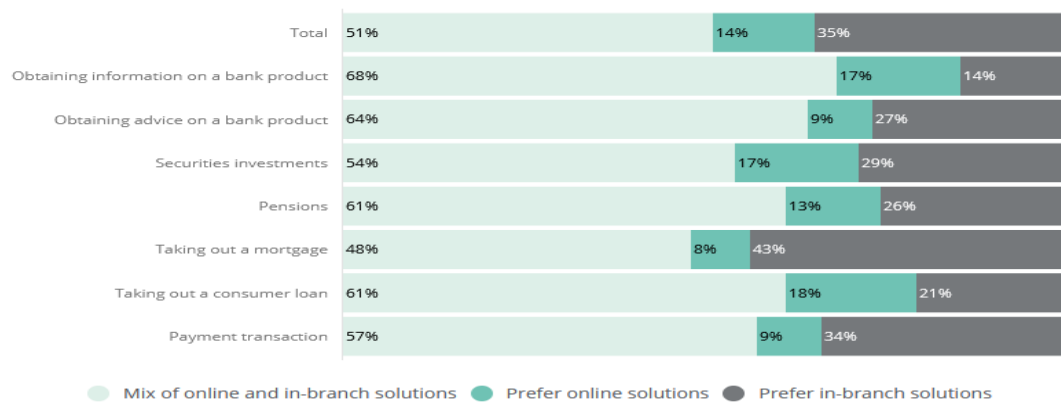
replacement wave of innovation, to perform the role of branches and to accelerate the efficiency with digitization in most of the sphere of the banking sector.

Internet Banking, in both the ways as a means of communication of banking services and as well planned tool for the business expansion, has received acceptance globally and it is fast developing in region of India with more and more banks into the fray. India is often said to get on the era of a vast banking revolution with banking having already been unveiled.

Some of the banks allow customers to interact with various branches and transact electronically with them. Some services include request for opening of accounts, request for cheque books, order of cheques book, downloading and printing statements of accounts, transfer of funds between accounts within same bank, inquiring on status of requests, information for opening of Letters of Credit and Bank Guarantees etc. The mentioned services are being facilitated by many banks like ICICI Bank Ltd., HDFC Bank Ltd., Citibank, Global Trust Bank Ltd., UTI Bank Ltd., Federal Bank Lt., Bank of Madura Ltd., etc. Recent players in Internet banking are Allahabad Bank (for its corporate customers through its ‘All net’ service) and Bank of Punjab Ltd. depository financial institution of India has announced that it'll be providing such services soon. Some of banks like ICICI Bank Ltd., have gone a one step ahead within the transactional stage of Internet banking by allowing transfer of funds by an account holder to the other account holder of the bank.

In Indian Banking industry there are 12 public sector banks, 22 private sector banks, 46 foreign banks, 56 regional rural banks, 1485 urban cooperative banks and 96,000 rural cooperative banks additionally to cooperative credit institutions. Till the month of August 2020, the entire number of ATMs in India increased to 209,110 and is further expected to extend to 407,000 by 2021. Asset of public sector banks are summarized at Rs. 107.83 lakh crore (US\$ 1.52 trillion) in FY20. During FY16-FY20, bank credit was grown at a CAGR of 57%. Till FY20, total credit extended surged to US\$ 1,698.97 billion. During FY16-FY20, deposits were grown at a CAGR of 13.93% and reached US\$ 1.93 trillion by the end of FY20. Credit to non-food industries raised at Rs. 102.80 lakh crore (US\$ 1.38 trillion) as of October 9, 2020.

### Use of services before and during the COVID-19 crisis<sup>1</sup>



<sup>1</sup> <https://www2.deloitte.com/ch/en/pages/financial-services/articles/corona-krise-digitalisierungsschub-im-retailbanng.html>

COVID-19 pandemics has changed the way and manner people shop, work, socialize, banking and make payments. As the pandemic continues, the new trend of work-from-home emerged due to the closing-down of most banking halls and branches altogether, many customers were left with no options other than to change their pattern of banking and payment. As a necessity, some customers were forced to embrace digital options as a means of payments, while others moved to digital options for the first time. Hence the influence of COVID-19 pandemics on customer's decision to use online banking and e-payment services is very high.

## 2. Literature Review

**Lelissa (2020):** The study highlights that how COVID-19 has impacted on private sector banking of Ethiopia. Taking remedial action and looking forward to the growth to boost the e-commerce services, digitalization, e-banking programs, etc. which will help for the speedy recovery. An intermediation approach of the input-output method has been used to select the variables over time and to examine their sensitivities to the stocks. It concludes that Ethiopian banks are censured for the use and adoption of technology like debit cards, real-time gross settlement, ATMs, core banking system mobile, internet banking, etc.

**Bishwas & Ashrafy (2020):** In this study, the author has stated that how this pandemic has affected very badly to the economy and many other industries and particularly the banking industry as banks are considered mainstream for the economic development of the country. The objective was as the internet is being a most important thing in the world and every important aspect is done with the help of internet and also many countries are building a cashless society. The discussion was made that as the world is facing the pandemic and people have to maintain the social distance so they were demanding for the digital banking services which include internet banking mobile banking etc. and is increasing during this pandemic.

**Haq & Awan (2020):** The study aimed to explore the service quality of e-banking and its impact on e-banking loyalty. The survey was undertaken with the help of the structured questionnaire from that it was found that because of COVID-19 more and more people started using the online banking services just because of reliability and website design proved that increase the loyalty and people will give more importance only when they feel it secure and private. Many theories were also used like CMR theory which helps to study the relationship between e-banking service quality and e-banking loyalty.

**SUDARSONO & NUGROHOWATI et al. (2020):** This study aims to look at the impact of perceived utility (PU), perceived ease of use (PEU), trust (TR), subjective norm (SN), and attitude (AT) on customer's intention to adopt Internet Banking at Muslim banks and traditional banks before and through the COVID-19 pandemic in country. The analysis model relies on the Theory of Planned Behavior (TPB) and therefore the Technology Acceptance Model (TAM). Data was analyzed with the help of partial least square (PLS) regression with the Structural Equation Model (SEM) method. The results confirm that before COVID-19 showed that AT and SN influence IAIB in Muslim banks.

**Thakor (2020):** The author says that the COVID-19 has impacted on the various banks all over the world which became very challenging for the banks and bank employees to do their task as the social distance and sanitizing was mandatory. This creates importance for the digitalization in banking which will



eliminate the paper and employee intervention within banks. This situation will not only gear up the adoption of technology but will renew the following features in an area of banking are taking advantage of new technologies, Channels of Digitization, Security, Privacy and Customer Trust, Policy and Compliance i.e., the focus should be made on digital payment infrastructure especially in rural areas.

**Moşteanu & Faccia (2020):** The study was undertaken to estimate the level of digitalization in the banking sector and to achieve the objective the author has work out in detail regarding changes in demand and supply of banking services, financial digitalization and digitalization changes in the banking sector on a global level, and the benefits of digitalization for individuals and businesses at the same level. Along with it they were making aware and educating the population in the use of new digital technologies.

**Perwej (2020):** The study highlights the pandemic impact on Indian Banking System where the Rating Agency Moody's has revised the Indian Banking system from stable to negative and there was due to disruption in economic activity caused by COVID-19. It was also mentioned that the quality of assets will decline across corporate, small, and medium enterprises and retail segments, which will cause pressure on profitability and capital for lenders.

**Lachhwani & Kanwar (2020):** This research paper was written in July 2020. The main objective of this study is to analyze the adoption of digital banking by consumer during COVID 19 pandemic. And the second objective is to understand the preference of customers with respect to digital service at Ahmedabad. The test applied in this research paper is chi-square and correlation. The total number of respondents was 101 and out of which 52 was female and 49 were male. It was found that 73% of the respondents started adopting digital banking during pandemic period.

**Sudha & Sornaganesh et al. (2020):** This research paper was written in august 2020. The objectives of this paper are to seek out the effect of Covid-19 on Digital payments, to compare the respondents buying behaviour before lockdown and through the lockdown, to analyze the mode of payment done by the respondents before lockdown and through lockdown, to seek out the web payment site employed by the respondents and to analyze the issues faced by them while during online payment. Data from 220 respondents have been collected and they applied t-test, ANOVA and chi-square test to draw a right conclusion. They found that people are positively responding to the digital banking.

### 3. Gap of the Study

The Researcher has gone through the various literatures to come up with a specific title of the Study and to develop the variables of the study to frame the questionnaire. Research Gap shows that many studies have been undertaken during COVID 19 for Online Banking Services in many places but none of the study has been under taken to find out the impact of COVID 19 pandemic on usage of online banking for the bankers and people of Surat City. This kind of study will help banks to find out the impact of COVID 19 on online services usage which guide them for further expansion of their business.

### 4. Objectives of the study

- To know the preferences of consumer towards online banking
- To find out the factors affecting usage of online banking during Covid-19.

## 5. Hypothesis

H1: There significance difference in response across occupation category.

H1: There is significance difference in sum of rank between two independent groups, Male and Female.

H1: There is significance relationship between age group and current level of trust in online/internet banking services during the COVID19 pandemic.

## 6. Research Methodology

- Descriptive **Research design** is applied for this research paper to come at the conclusion.
- Non-Probability Convenient **Sampling Method** Snow-Ball Sampling Method have been used to select sample from Surat City, to collect data from the selected sample and to generalize the result for the population of Surat City.
- Contact number of respondents has been collected from various banks and through indirect contacts.
- Structured questionnaire is a **data collection tool** to survey the respondents from Surat City and collect the data. Survey period is October, 2020 – December, 2020.
- 305 responses have been collected as a **sample size** through Google a docs, which have been sent through whatsapp and email.
- Data has been formatted through MS-Excel and SPSS-20. Descriptive Statistics, Kruskal-Wallis Test, Chi Square Test and M1ann Whitney U Test was applied have been applied for data analysis and findings.
- 

## 7. Summary of Primary Data Collection

Demographic Profile of Respondents		Frequency	Total
Gender	Female	158	305
	Male	147	
Age	18-24	174	
	25-35	70	
	36-44	33	
	45 & above	28	
Annual Income	Below 2,50,000	104	
	2,50,001-5,00,000	101	

	5,00,001-10,00,000	71
	Above 10,00,000	29
<b>Education</b>	HSC or Below	49
	Graduate	163
	Post Graduate	82
	Diploma	11
<b>Occupation</b>	Private Sector	98
	Government Sector	21
	Retired	5
	Student	127
	Does not work	11
	Businessman	25
	Housewife	18

### Use of Internet/Online Banking through:

	Frequency	Percent
<b>Mobile</b>	186	61.0
<b>Desktop</b>	43	14.1
<b>Laptop</b>	42	13.8
<b>Tablet</b>	34	11.1
<b>Total</b>	<b>305</b>	<b>100.0</b>

**Reason behind using internet/online banking transaction during covid-19:**

	Frequency	Percent
No access of cash through ATM	153	50.2
Fear of contacting the coronavirus through paper currency	171	56.1
Convenience of cashless transactions	185	60.7
Availability of Digital Resource	126	41.3
<b>Total</b>	<b>635</b>	<b>208.3</b>

**Types of Services of online banking used most during pandemic (MCQ):**

	Frequency	Percent
Pay the bills	254	83.3
Pay rent and so on	159	52.1
Check the account	193	63.3
Transfer money between accounts	157	51.5
Requesting for credit cards	44	14.4
Stock transaction	47	15.4
For booking railway, airway reservation	139	45.6
Transaction history	88	28.9
Obtaining loans online	35	11.5
For online shopping	217	71.1
Payment of instalments due on loans held	63	20.7
Other	29	9.5
<b>Total</b>	<b>1425</b>	<b>467.3</b>

**8. Use of Statistical Tests**

**Kruskal Wallis Test**

H0: There is no significance difference in response across occupation category.

H1: There is significance difference in response across occupation category.

Statement No	Null Hypothesis	Sig.	Decision
1.	The distribution of online banking transaction procedures are simple and straightforward. It is the same across categories of Occupation.	0.092	Failed to reject the Null Hypothesis
2.	The distribution of online transactions are complex. It is the same across categories of Occupation.	0.518	Failed to reject the Null Hypothesis
3.	The distribution of online banking is easy service. It is the same across categories of Occupation.	0.575	Failed to reject the Null Hypothesis
4.	The distribution of Banks gives enough information about the internet/online banking service. It is the same across categories of Occupation.	0.197	Failed to reject the Null Hypothesis
5.	The distribution of Internet/online banking is more effective than branch about time saving. It is the same across categories of Occupation.	0.146	Failed to reject the Null Hypothesis
6.	The distribution of It is convenient because it eliminates the risk of carrying cash. It is the same across categories of Occupation.	0.101	Failed to reject the Null Hypothesis
7.	The distribution of If I have any problem about internet/online banking service, banks provide support. It is the same across categories of Occupation.	0.101	Failed to reject the Null Hypothesis
8.	The distribution of It is 24*7 available. It is the same across categories of Occupation.	0.109	Failed to reject the Null Hypothesis
9.	The distribution of Transaction cost is cheap. It is the same across categories of Occupation.	0.246	Failed to reject the Null Hypothesis
10.	The distribution of It ensures security and safety of transaction. It is the same across categories of Occupation.	0.721	Failed to reject the Null Hypothesis
11.	The distribution of Easy accessibility. It is the same across categories of Occupation.	0.729	Failed to reject the Null Hypothesis

### Mann Whitney U Test

H0: There is no significance difference in sum of rank between two independent groups, Male and Female.

H1: There is significance difference in sum of rank between two independent groups, Male and Female.

Statement No.	Null Hypothesis	Sig.	Decision
1.	The distribution of online banking service is less costly than other banking service. (Branch, ATM, Mobile banking) is the same across categories of Gender.	0.191	Failed to reject Null Hypothesis
2.	The distribution of online banking transaction procedures are simple and straightforward. It is the same across categories of Gender.	0.489	Failed to reject Null Hypothesis
3.	The distribution of online transactions are complex. It is the same across categories of Gender.	0.413	Failed to reject Null Hypothesis
4.	The distribution of online banking is easy service. It is the same across categories of Gender.	0.508	Failed to reject Null Hypothesis
5.	The distribution of I am satisfied with internet/online banking because I do not have to go bank. It is the same across categories of Gender.	0.742	Failed to reject Null Hypothesis
6.	The distribution of Banks gives enough information about the internet/online banking service. It is the same across categories of Gender.	0.267	Failed to reject Null Hypothesis
7.	The distribution of Internet/online banking is more effective than branch about time saving. It is the same across categories of Gender.	0.387	Failed to reject Null Hypothesis
8.	The distribution of It is convenient because it eliminates the risk of carrying cash. It is the same across categories of Gender.	0.131	Failed to reject Null Hypothesis
9.	The distribution of If I have any problem about internet/online banking service, banks provide support. It is the same across categories of Gender.	0.232	Failed to reject Null Hypothesis
10.	The distribution of It is 24*7 available. It is the same across categories of Gender.	0.781	Failed to reject Null Hypothesis

11.	The distribution of Transaction cost is cheap. It is the same across categories of Gender.	0.127	Failed to reject Null Hypothesis
12.	The distribution of It ensures security and safety of transaction. It is the same across categories Gender.	0.565	Failed to reject Null Hypothesis
13.	The distribution of Easy accessibility. It is the same across categories of Gender.	0.283	Failed to reject Null Hypothesis

### Chi Square Test

H0: There is no significance relationship between age group and current level of trust in online/internet banking services during the COVID19 pandemic.

H1: There is significance relationship between age group and current level of trust in online/internet banking services during the COVID19 pandemic.

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	38.897 <sup>a</sup>	9	.000
Likelihood Ratio	35.258	9	.000
Linear-by-Linear Association	26.361	1	.000
N of Valid Cases	305		

Symmetric Measures			
		Value	Approximate Significance
Nominal by Nominal	Phi	.357	.000
	Cramer's V	.206	.000
N of Valid Cases		305	

## 9. Interpretations and Findings from data analysis:

- 61% of the respondents use online banking via mobile and rest of them use it through desktop and the tablet. 47% of the respondents were agreed that during this pandemic the use of internet/online banking services has increases the quality and efficiency of their banking services and very few of the respondents disagree with this statement.
- 44.9% of the respondents were using ATMs only once a month whereas few of the respondents were never using ATMs during this pandemic and very few of the respondents were using ATMs more than once a week.
- 69.2% of the respondents were having a high level of trust in online/internet banking services during this Covid-19 pandemic and only few of respondents were having a low level of trust in online/internet banking services.
- 60.7% of the respondents were using online/internet banking because they felt the convenience of cashless transactions and some was having the fear of contacting the coronavirus through paper currency.
- 78% of the respondents said yes that online banking transaction was one of the factors that gave smooth functioning to day-to-day life during covid-19, some of the respondents said maybe to this statement and only few of the respondents said no to this statement.
- 47.5% of the respondents said that during the covid-19 pandemic the usage of online banking services has been increased by them and only few of the respondents said that it has not changed.
- 88.5% of the respondents were using online banking services for the payment of bills, for online shopping, for checking the account, transferring the money between accounts, and many other services while only a few respondents were obtaining a loan online.
- 68.9% of the respondents preferred banking cards i.e., debit or credit card, some of them preferred mobile payment, and other modes of payment while doing the online transaction and only few of the respondents preferred bank transfers while doing online transaction.
- It has been found that major factors responsible for the e-banking transaction are cheaper costs, easy online banking services, no need of travelling, Banks give enough information about the internet/online banking service, Internet/online banking is more effective than branch about time saving, convenient because of elimination of risk of carrying cash, 24\*7 services availability, ensures security and safety of transaction, and Easy accessibility.
- By applying Kruskal Wallis Test it can be found that there is no significance difference in response across category of occupation when it comes to online banking service and there is no significance difference in other response across occupation category during the COVID-19 pandemic.
- By applying Mann Whitney U Test it has been found that there is no difference in response across gender category for factors considered while selecting and using the online banking services during the COVID-19 pandemic.
- By applying Chi Square Test it is found that age of the online banking services users is affecting to the usage of the online banking services during COVID 19 pandemic period. It shows that old age people resist to use the online banking services because of lack of technological knowledge and lack of trust on online banking services.



## 10. Conclusion

It can be concluded that people used to prefer online banking during this COVID – 19 pandemic period and they prefer to use online banking transactions via mobile phones. The respondents were agreed with the fact that during this pandemic the use of internet/online banking services has increased and it has improved the quality and efficiency of their banking services. During this pandemic, their trust level was also increases for doing online banking transactions. Fear of contacting the coronavirus through paper currency, lower transaction cost, easy to use and good support from banks, and age of the online banking services users are the major factors responsible for increased usage of e-banking services during this COVID-19 pandemic. It has also been concluded that there is no difference in various types of occupation and gender on the usage of online banking services.

## 11. Recommendations

- Banking customers should use online banking services with proper precautions to avoid future dispute with e-banking service provider.
- Banks must improve the features of e-banking service to strengthen the trust of e-banking users and to build a good customer base.

## 12. Implication of the Study

- When Banks frame the future policy for business expansion, they should consider lower transaction cost, easy to use, good support from banks and age of the online banking services users are important factors.
- Types of occupations and gender are not considerable factors while offering any new or updated online banking service.

## 13. Bibliography

- Ashish Bagewadi, Devang Dhingra. "Analysis of Banking Sector in India: Post Covid-19." (September 2020): 299-308.
- Asli Demirguc-Kunt, Alvaro Pedraza, Claudia Ruiz-Ortega. "Banking Sector Performance During the COVID-19 Crisis." (August 2020): 1-49.
- Dr. Jitender Singh, Dr. B. S. Badola. "Impact of COVID-19 Pandemic and Lockdown on India's Banking Sector: A Systematic Literature." (2020).
- Dr. Narcisa Roxana Moşteanu, Dr. Alessio Faccia, Luigi Pio Leonardo Cavaliere, Saurav Bhatia. "Digital Technologies implimentation within financial and banking system during sociodistancing restrictions – Back to the future." (June 2020): 9.
- Heri SUDARSONO, Rindang Nuri Isnaini NUGROHOWATI, Yunice Karina TUMEWANG. "The Effect of Covid-19 Pandemic on the Adoption of Internet Banking in Indonesia: Islamic Bank and Conventional Bank." (2020): 12.

- Inzamam Ul Haq, Tahir Mumtaz Awan. "Impact of e-banking service quality on e-loyalty in pandemic times through interplay of e-satisfaction." (2020): 17.
- Kadam, Miss. Sarita Baburao. "Digital Payment : The Growing Trend By Youth." (March-2020): 61-67.
- Lelissa, Tesfaye Boru. "The Impact of COVID 19 on the Ethiopian Private Banking System." (2020): 26.
- Mayank Jindal, Dr. Vijay Laxmi Sharma. "Usability of Online Banking in India during Covid-19 Pandemic." (December 2020): 4.
- Perwej, Dr. Asif. "The impact of pandemic COVID – 19 on the Indian Banking System.” (October, 2020): 12.
- Prodip Chandra Bishwas, Shayma Ashrafy. "The Role of Alternative Banking Channels on Banks’ Sustainability through Customer Satisfaction in Bangladesh: Evidence from COVID-19 Pandemic." (November 2020): 10.
- Sudha.G., Sornaganesh.V., Thangajesu Sathish. M, Chellama A.V. "Impact of Covid-19 Outbreak in Digital Payments." (Aug – 2020): 159-164.

## **PHYTOCHEMICAL SCREENING AND NEUROPHARMACOLOGICAL EVALUATION OF ABRUS PRECATORIUS AND NEOLMARCKIA CADAMBA LEAF EXTRACT IN ANIMAL MODEL OF DEPRESSION.**

**Pritam Gokuldas Bhore**  
Mandsaur University, Mandsaur

**Dr.Swapnil Goyal**  
Mandsaur University, Mandsaur

### **Abstract:**

Abrus Precatorius and Neolmarckia Cadamba are Indian medicinal plants which referred in medicinal system of Ayurveda for treatment of various diseases. In the present study ethanol extract of Abrus Precatorius and Neolmarckia Cadamba leaves extract studied for its antidepressant activity in acute animal model of depression. Petroleum ether, chloroform, ethanol and aqueous extracts are freshly prepared from green shade dried leaves of Abrus Precatorius and Neolmarckia Cadamba. Ethanol extract of both plant subjected to phytochemical screening to detect active phytoconstituents. The phytochemical study reveals the presence of flavonoid, as flavonoid have diverse effects on improvement of mood. It plays important function in stress induced depression, hence in this study include pharmacological evaluation for antidepressant effect of ethanol extract of both plants which examined separately by using two animal behavior models which include rat Forced Swim Test (rFST) and mice Tail Suspension Test (mTST). Actophotometer use to examine effect of extract on locomotor activity rats. Comparative profile of the test formulation of flavonoid rich ethanol extracts of Abrus Precatorius (ApEe) and Neolmarckia Cadamba (NcEe) was assessed for effect on immobility time in rFST and mTST at dosages 100 mg/kg and 200mg/kg. Ethanol extract of Abrus Precatorius shows significant reduction of immobility time in rFST(Forced Swim Test) at 200 mg/kg, however it was significant with 100 mg/kg and 200mg/kg in mTST( Tail Suspension Test). Ethanol extract of Neolmarckia Cadamba shows significant immobility in rat forced swim test at 100mg/kg and 200 mg/kg body weight. However it significantly reduced immobility in tail suspension test only at high dose 200 mg/kg body weight. Locomotor activity in rat was evaluate by using actophotometer after acute oral administration of ApEe and NcEe test extract at dosage 100mg/kg and 200mg/kg. There is no change of motor dysfunction was observed in locomotor score. Phytochemical screening indicate presence of flavonoid in test formulation of ethanol extracts of Abrus Precatorius (ApEe) and Neolmarckia Cadamba (NcEe). As flavonoid play major role in stress induced depression. During neuropharmacological evaluation both extracts shows significant reduction of immobility time in rFST(rat Forced Swim Test) and mTST(mice Tail Suspension Test) at dosages 100 mg/kg and 200mg/kg respectively, hence the ethanol extract of both plant possess antidepressant activity in animal behavior model.

**Keywords:** Abrus Precatorius, Neolmarckia Cadamba, Phytochemical screening, Flavonoid, Locomotor activity, Antidepressant effect.

### **1. Introduction:**

The nervous system is one of the smallest and complex systems of human body which consist billion of nerve cells. Together with endocrine system, it maintains homeostasis as well as coordinates and regulates functions of human body. The nervous system is also responsible for behavior, memories, and perceptions

and initiates the voluntary movement<sup>1</sup>. The neurotransmitters like serotonin, acetylcholine, norepinephrine, etc. play an important role in the regulation of functions of the nervous system. The Monoamine oxidase (MAO) is a mitochondrial enzyme which is found in the nerve cell. This MAO acts as a safety valve because it deaminates and inactivates neurotransmitters like norepinephrine, dopamine, and serotonin etc. and causes the neurotransmitter deficiency. Neurotransmitter deficiency leads to major depression. Major depression is a complex neuropsychiatric disorder which refers to pathological changes in mood state and is characterized by symptoms like sad mood, psychomotor retardation, loss of interest etc.<sup>2</sup>. Today there are several synthetic antidepressant drugs available but these drugs have restrictions and limitations in clinical use due to adverse effects, hence to avoid or minimize the severe adverse effect and toxicity of a synthetic drug it is necessary to find out alternative antidepressants which are obtained from natural sources like herbal medicine which are used traditionally in Ayurveda. Ayurveda is a traditional medicinal system of India which consists of various types of medicinal herbs to prevent and treat various diseases or disorders. Today several studies have investigated and reported potential antidepressant activity of natural chemical compounds obtained from medicinal herbs. It is necessary to develop new and potential antidepressants from Ayurvedic medicinal herbs whose neuropharmacological potential has been assessed in a variety of experimental animal models<sup>3</sup>. *Abrus precatorius* and *Neolamarckia cadamba* are traditionally used medicinal plants as per Ayurveda. These plants were used traditionally to treat various diseases. The ethanol extract of both plants shows the presence of flavonoids after phytochemical testing. As flavonoids have central nervous system disorders which play an important role in stress-induced depression. Hence the present study was undertaken to investigate the effect of flavonoid-rich ethanol extract of *Abrus precatorius* and *Neolamarckia cadamba* in different animal models of experimentally induced acute depression. When results are significant and encouraging, the investigated product will be subjected to structural elucidation of flavonoids and its derivatives and the investigated product will be useful in the management of depression. The extracts of *Abrus precatorius* and *Neolamarckia cadamba* may have antidepressant activity, which shows their potential to be used as herbal antidepressant drugs.

## **2. Literature Review:**

### **2.1 *Abrus precatorius*<sup>5-10</sup>:**

In Sanskrit this plant is known as Gunja (Rati). In English it is called jequirity bean (rosary pea). This plant consists of flowers and it belongs to the family Fabaceae. Roots, leaves, and seeds of this plant are majorly used as Ayurveda medicine. White variety of this plant is used to prepare oil which is claimed to be an aphrodisiac. Tea from its leaves is used for fever, cough, and cold. Mixture of leaves and honey is used to treat swelling. In Ayurveda these plants are used to promote hair growth. Ethanol extract of *Abrus precatorius* was found to have analgesic, anti-inflammatory as well as antioxidant effects in animal studies. Methanolic extract of seeds shows reversible alteration in estrous cycle pattern and blocks ovulation in rats. Chloroform, methanol, and aqueous extracts of this plant show potent antibacterial activity. An antidiabetic activity of dried leaves of *Abrus precatorius* was developed by an in-vivo approach (Narendra Boggula, 2018). Mir Z. Gul et al. (2013) developed antioxidant and antiproliferative activity of *Abrus precatorius* leaf extracts – an in-vitro study. In-vitro antioxidant activity of ethanolic extract of Iraqi *Abrus precatorius* Linn. was stated by Zahraa Suhail Nassir, (2017). *Abrus precatorius* seed oil was proven for hair growth promotion in female wistar albino rats (Sukirti Upadhyay, 2013). *Abrus precatorius* seed extracts show potent antimicrobial activity (Varaprasad Bobbarala, 2009). Ethanol leaf extract of *Abrus precatorius* L. is useful in the management of pain, psychiatric and neurological conditions: an in-vivo study (Sumanta Mondal et al. (2007).

Antiasthmatic related properties of *Abrus precatorius* leaves on various model developed (Dnyaneshwar J.Taur et al. (2017). Studies on antidiarrheal activity of *Abrus precatorius* seeds stated by O.F.C.Nwodo et al. (1991).

## 2.2 *Neolamarckia cadamba*<sup>11-15</sup>:

Kadamb is Indian name of this plant. In English it is commonly known as bur flower tree. It is topical tree which consist scented orange flowers in dense globe shaped cluster. This plant is belonging to family Rubiaceae. These plants find its application in Ayurveda medicinal system. Paste obtain from its leaves use to treat mouth ulcer and dyspepsia. Decoction of leaves use for gargling in stomatitis. Dried powder of leaves use as anthelmintic. Alcoholic extract of leaves possess anti-inflammatory, antimicrobial, wound healing, antibacterial, antifungal activity. Antioxidant activity of *Anthocephalous cadamba* by using solvent extracts (Alekhya V, 2013). Bark extract of *Neolamarckia cadamba* (Roxb.) Bosse shows Diuretic and laxative property (Mondal S, 2009). Analgesic and anti-inflammatory activities of *Anthocephalus cadamba* Roxb leave in Wister rats proven by Bachhav RS *et al.* (2009). Membrane stabilizing, anthelmintic, antioxidant activity of *Neolamarckia cadamba* fruit extract developed by Tairin Islam *et al.* (2015). Stem bark of *Neolamarckia cadamba* shows Antidiabetic activity in alloxan induced diabetic rats (Bussa SK, 2010)

## 3. Objectives:

To perform preliminary phytochemical test for assessment of active phytoconstituents and screening of antidepressant potential of ethanol extracts of *Abrus precatorius* and *Neolamarckia cadamba* by using acute animal models of depression.

## 4. Material and method:

### 4.1 Collection, Authentication and Processing of plant material<sup>16-18</sup>:

Fresh leave of *Abrus precatorious* were collected in November-2020 from geographical region of Ahmednagar Districts (Maharashtra, India). Fresh leave of *Neolmaeckia cadamba* were collected in December-2020 from geographical region of Pune Districts of Maharashtra state. Both plant was authenticating from Botanical Survey of India, Pune. Leaves of plants were separated and cleaned by pure water. Collected leaves were subjected to shade dried for two weeks at room temperature.

### 4.2 Preparation of extract:

The powder material of *Abrus precatorious* and *Neolmaeckia cadamba* was subjected to batch extraction in Soxhlet's apparatus. The solvents used were Petroleum ether, Chloroform, Ethanol and Distilled water. Prepared extracts stored in well closed container.

### 4.3 Preliminary phytochemical screening<sup>18-19</sup>:

Prepared ethanol extract of *Abrus precatorious* and *Neolmaeckia cadamba* was subjected for preliminary phytochemical investigation by using qualitative chemical tests. Preliminary phytochemical test of ethanol extracts of both plants shows presence of alkaloids, flavonoids, saponin glycosides, carbohydrates, steroid, terpenoids etc. (Table 1). The powder material of *Abrus precatorious* and

*Neolmaeckia cadamba* was subjected to batch extraction in Soxhlet's apparatus. The solvents used were Petroleum ether, Chloroform, Ethanol and Distilled water. Prepared extracts stored in well closed container. Prepared ethanol extract of *Abrus precatorious* and *Neolmaeckia cadamba* was subjected for preliminary phytochemical investigation by using qualitative chemical tests.

4.3.1 *Test for carbohydrates:*

**Molisch's test (General test):** To 2-3 ml of extract add few drop of  $\alpha$ -naphthol, shake it well and to it add concentrated  $H_2SO_4$  from side of test tube. At junction of two liquid observe for violet ring.

4.3.2 *Test for alkaloids:*

- a. **Dragendroff's test:** To 2-3 ml filtrate added few drops Dragendroff's reagent and was observed for orange brown precipitate.
- b. **Mayer's test:** 2-3 ml filtrate with few drops Mayer's reagent was observed for precipitate.
- c. **Hager's test:** 2-3 ml filtrate with Hagers reagent was observed for yellow precipitate.
- d. **Wagner's test:** 2-3 ml filtrate with few drops of Wagner's reagent was observed for reddish brown precipitate.

4.3.3 *Test for glycosides:*

- a. **Baljet's test:** A thick section shows yellow to orange color with sodium picrate.
- b. **Legal's test:** Add 1ml pyridine and 1 ml of sodium nitroprussides to aqueous or alcoholic extract, observe pink to red coloration.
- c. **Raymond's test:** Test solution hot with methanol alkali solution and observe for violet coloration.

4.3.4 *Test for flavonoids:*

- a. **Shinoda test:** Add 5 ml 95% ethanol to dry powder of extract, to it add 1-2 drop of conc. HCL and 0.5 gm. magnesium turnings. Observe orange, pink and purple color for flavonols, dihydro derivative and xanthene.
- b. **Heat test solution with zinc and HCL and observe for red coloration.**
- c. **To small quantity of residue add lead acetate solution till formation of yellow color precipitate.**

4.3.5 *Test for fats and oils:*

- a. Solubility test: oils are soluble in ether, benzene and chloroform but insoluble in 90% ethanol and water.
- b. Filter get paper permanently stained with oil.

4.3.6 *Test for tannins and phenolic compounds:*

- a. Add following reagents to 2-3ml of extract:
  - i. **Lead acetate solution:** Deep blue color appears.
  - ii. **Bromine water:** Discoloration of bromine water.
  - iii. **Acetic acid solution:** Red color appears.
  - iv. **Dilute iodine solution:** Transient red color appear.

## 5. Pharmacological evaluation<sup>20</sup>:

### 5.1 Experimental animals:

Albino Wister rat (160-180gm), Albino Swiss mice (18-30 gm.) were used for experiment. IAEC approval obtained from IAEC of B. R. Nahata College of Pharmacy, Mandsaur, M.P as project proposal no. IAEC/BRNCOP/2020/004.

## 5.2 Force Swim Test in rats:

Forced swim test in rats was performed (according to Porsolt et al. 1977, 1978) at laboratory condition, one day before experiment rats are brought to laboratory. Rats use during experiment individually forced to swim inside acrylic cylinder which contains water at 25<sup>0</sup> ° temperature. Rat forced swim test was conduct for 15 min. test session. Change in duration of immobility time was observed and record for individual rat. Ethanol extracts which obtained from leaves of *Abrus precatorious* and *Neolmaeckia cadamba* use for acute study.to perform forced swim test rats of either sex weigh about 160-180gm were divided into four groups (n=6).First group(control/vehicle) administered saline solution(0.2ml/animal),second group administered Imipramine (15mg/kg) ,third group administered test extract of low dose (100mg/kg),fourth group administered test extract of high dose (200mg/kg).Oral route of drug administration was employed for experiment. Rat forced swim test consist two parts, part one is pretest and part two is main test.During pre-test ,rats force to swim for fifteen minutes at constant temperature in water, after fifteen minutes of test session animal were dried by using clean cloth and place into clean cage. After 24 hours of pretest main test was conducted. During main test session last six minutes are considering to observe and measure immobility parameter in rats. Immobility defines as floating in water without struggling and trying to climbing movement to escape from water.

## 5.3 Mice Tail Suspension Test:

This test use to evaluate antidepressant activity (described by Steru et al. 1985) .In this test animal was hanged by tail to horizontal bar and distance from floor maintains about 50cm from floor).Ethanol extract of *Abrus precatorious* and *Neolmaeckia cadamba* tested to evaluation of antidepressant activity by using tail suspension test in mice of either sex and weigh about 20-27 gm. All test animals divide into four groups (n=6).Oral route of drug administration was preferred during experiment. Control group receive saline solution (0.2ml/animal), second group administered imipramine (15mg/kg), and third group administered ethanol test extract at low dose (100mg/kg). Fourth group administered ethanol test extract (200mg/kg). After one hour of administration mice tail suspension test was performing as per procedure and record duration of immobility (in seconds) during last four minutes of test session. Immobility parameter was considered when mice passively hang without any movement and motions.

## 5.4 Assessment of locomotor activity<sup>21</sup>:

Drugs act on central nervous system affect the loco motor activities in human as well as animals. Locomotor activity check to determine wakefulness of mental activity; hence actophotometer test was perform to determine the effect of test extract on locomotor activity in rats. During this activity animals treated with test extract at dose 100mg/kg and 200mg/kg and compare activity with control (saline) and standard (imipramine) treated group of animal. During experiment individual animal placed into actophotometer for 10 minutes. Locomotor activity score recorded as on digital display of actophotometer.

## 6. Statistical analysis:

Statistical analysis was done by using ANOVA (One way Analysis of Varriance) followed by Dunnet's test. Level of significance was fixed at \*P<0.05. All data express as mean ± standard error mean (SEM)

## 7. Results and discussion:

### 7.1 Phytochemical screening:

The phytochemical screening of ethanol extract of *Abrus Precatorius* (ApEe) and *Neolmarckia cadamba* (NcEe) leaves shows the presence of flavonoid, glycoside, alkaloids, carbohydrates, etc. is shown in table-1. (Marked as '+' and '-' signs.)

Table: 1 Preliminary phytochemical testing of ethanol extract of leaves of *Abrus precatorius* and *Neolmarckia cadamba*.

Sr.No	Test for Phytoconstituents	Ethanol extract of <i>Abrus precatorius</i> (ApEe)	Ethanol extract of <i>Neolmarckia cadamba</i> (NcEe)
1	Carbohydrates	+	+
2	Fats and oil	-	+
3	Alkaloids	++	+++
4	Glycosides	+	++
5	Flavonoids	+++	++
6	Tannin and phenolic compounds	+	+

### 7.2 Acute effect of ethanol extract of *Abrus precatorius* leaves on duration of immobility in rat force swim test:

After 24 hours of preliminary test immobility parameter was recorded for test extract at dose 100mg/kg and 200mg/kg. In low dose of ApEe (100mg/kg) treated animals there is no significant reduction in duration of immobility as compare to control/saline group. Imipramine (Standard) and high dose of ApEe (200mg/kg) treated animal shows more significant ( $P < 0.0001$ ) reduction in duration of immobility time when compare to control/saline treated group. Statistically significant reduction in duration of immobility time was observed and record in low and high dose of ethanol extract of *Abrus precatorius* treated group of animals. The result shows dose dependent effect. In experiment high dose (200mg/kg) of ethanol extract shows significant effect as compare to standard treated (imipramine (15mg/kg) animal. Imipramine shows superior effect as compare to 100mg/kg (Low dose) of ethanol extract, hence high dose (200mg/kg) of extract can be considered as antidepressant dose. Immobility time parameter is explained in table -2 and graphical presentation of experiment as shown in figure-1.

Table: 2 Comparative profile of immobility parameter (sec.) in rat forced swim test after acute treatment of ApEe-1(100mg/kg) and ApEe-2 (200mg/kg) of ethanol extract of *Abrus precatorius*.

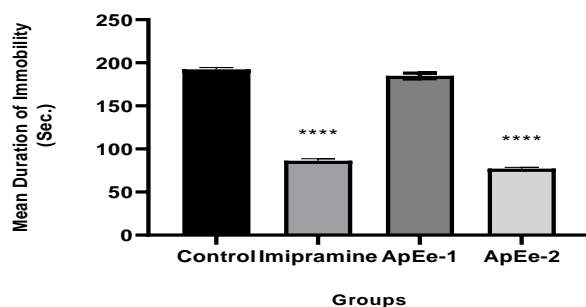
Sr. No	Treatment	Mean Duration of Immobility Time(sec.)
1	Control	192.3±2.076
2	Imipramine(15mg/kg)	86.33±2.305****



3	ApEe-1 (100mg/kg)	132.2±8.968 <sup>ns</sup>
4	ApEe-2 (200mg/kg)	77.17±1.537 <sup>***</sup>

One way ANOVA test followed by Dunnet’s test, all observed values express mean ± SEM in sec. (n= 6), P<0.0002<sup>\*\*\*</sup>, P<0.0003<sup>\*\*\*</sup>

**Figure-1. Comparative profile of Immobility Parameter in Rat Forced Swim Test after acute treatment of 100mg/kg and 200 mg/kg of ethanol extract of *Abrus precatorius*.**



### 7.3 Tail Suspension Test in mice:

#### Acute effect of ethanol extract of *Abrus precatorius* leaves on duration of immobility time in mice tail suspension test.

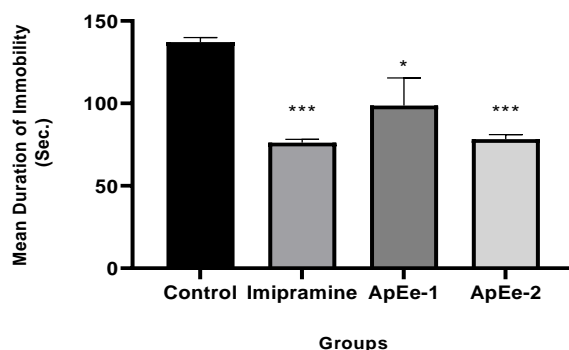
Acute effect of 100mg/kg 200mg/kg of extract is summarized in table -3. Immobility time was observed for last 4 minutes of test session. Both doses significantly reduced immobility time (P<0.0138, P<0.0003). The effect of high dose (200mg/kg) was nearly equivalent as compared to imipramine (Standard treated animal). Effect of low dose (100mg/kg) also shows significant reduction in duration of immobility in mice but minimum as compared to high dose. Decrease in immobility time parameter is explained in table -3 and graphical presentation of experiment as shown in figure-2.

**Table: 3 Comparative profile of immobility parameter (sec.) in mice tail suspension test after acute treatment of ApEe-1(100mg/kg) and ApEe-2 (200mg/kg) of ethanol extract of *Abrus precatorius*.**

Sr. No	Treatment	Mean Duration of Immobility Time (sec.)
1	Control	137.2±2.750
2	Imipramine(15mg/kg)	76.17±2.056 <sup>***</sup>
3	ApEe-1 (100mg/kg)	98.67±16.77*
4	ApEe-2 (200mg/kg)	78.33±2.716 <sup>***</sup>

One way ANOVA test followed by Dunnet’s test. All values express mean ± SEM in sec. (n= 6), P<0.0138<sup>\*\*\*</sup>, P<0.0003\*

Figure-2. Comparative profile of Immobility Parameter in Mice Tail Suspension Test after acute treatment of 100mg/kg and 200 mg/kg of ethanol extract of *Abrus precatorius*.



#### 7.4 Assessment of locomotor activity in rat after acute treatment of ethanol extracts of *Abrus precatorius*.

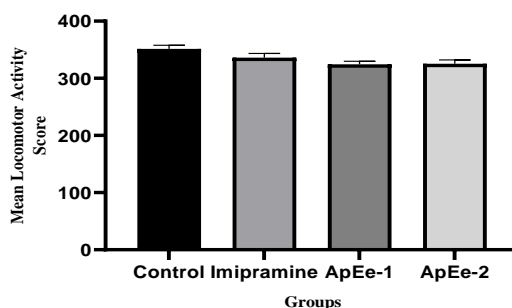
Locomotor activity score observed and recorded after single dose of administration by using actophotometer. Locomotor activity was assessed for ten minutes test session during experiment test animals receiving vehicle (saline solution), imipramine (15mg/kg), and ethanol extract (200mg/kg). As per locomotor activity score there is no any significant effect on animal was observed as compare to vehicle treated animal. Results of activity shown in table-4 and figure-3.

Table: 4 Assessment of locomotor activity of ethanol extracts of *Abrus precatorius*.

Sr. No	Treatment	Locomotor Activity Score
1	Control	351.3±6.505
2	Imipramine(15mg/kg)	336.2±7.181 <sup>ns</sup>
3	ApEe-1 (100mg/kg)	324.3±5.445 <sup>ns</sup>
4	ApEe-2 (200mg/kg)	325.3±6.712 <sup>ns</sup>

One way ANOVA test followed by Dunnet’s test. All values express mean ± SEM in sec. (n= 6), P<0.0214, P<0.0271.

Figure-3:Comparative profile of change in locomotor activity in rats after acute treatment of 100mg/kg and 200mg/kg ethanol extract of *Abrus precatorius*.



### 7.5 Acute effect of ethanol extract of *Neolmarckia cadamba* leaves on duration of immobility in rat force swim Test,

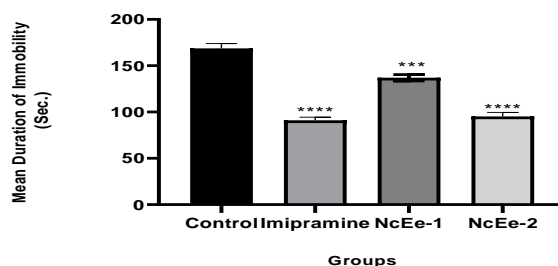
Statistically significant decrease in immobility time was observed at minimum and maximum dose of ethanol extract of *Neolmarckia cadamba* treated group of animals. Ethanol extract at 100mg/kg and 200mg/kg significantly reduce duration of immobility time in rats. After administration of high dose of test extract (200mg/kg) shows significant decrease in duration of immobility time which is equivalent to imipramine (standard) treated animals. Duration of immobility time is shown in table-5 and figure-4

**Table: 5 Comparative profile of immobility parameter (sec.) in rat force swim test after acute treatment of NcEe-1(100mg/kg) and NcEe-2 (200mg/kg) of ethanol extract of *Neolmarckia cadamba*.**

Sr. No	Treatment	Mean Duration of Immobility Time (sec.)
1	Control	168.7±5.296
2	Imipramine(15mg/kg)	91±3.425*****
3	NcEe-1 (100mg/kg)	137±3.347***
4	NcEe-2 (200mg/kg)	95.17±4.475*****

One way ANOVA test followed by Dunnet's test. All value express in mean ± SEM in sec. (n= 6), P<0.0001, P<0.0001.

**Figure-4. Comparative profile of Immobility Parameter in Rat Forced Swim Test after acute treatment of 100mg/kg and 200 mg/kg of ethanol extract of *Neolmarckia cadamba*.**



### 7.6 Acute effect of ethanol extract of *Neolmarckia cadamba* leaves on duration of immobility time in Tail Suspension Test.

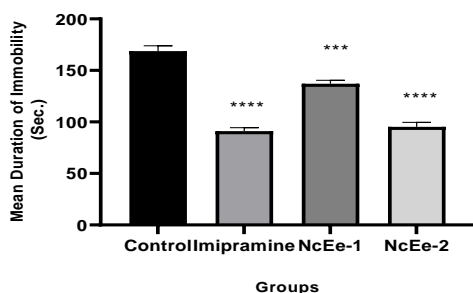
There is no significant decrease in duration of immobility time seen after treatment of low dose (100mg/kg) of test extract but after administration of high dose (200mg/kg) animal's shows statistically significant reduction in duration of immobility time. Hence tail suspension test in mice only at high dose (200mg/kg) of test extract shows significant result as compare to imipramine (15mg/kg) treated animals. Results of reduction of immobility parameter shown in table-6 and figure-5

**Table: 6 Comparative profile of immobility parameter (sec.) in mice tail suspension test after acute treatment of NcEe-1(100mg/kg) and NcEe-2 (200mg/kg) of ethanol extract of *Neolmarckia cadamba*.**

Sr. No	Treatment	Mean Duration of Immobility (sec)
1	Control	152.0±5.323
2	Imipramine(15mg/kg)	79.83±3.554****
3	NcEe-1 (100mg/kg)	91.33±3.913****
4	NcEe-2 (200mg/kg)	80.50±2.778****

One way ANOVA test followed by Dunnet’s test. All value express mean ± SEM in sec. (n= 6), P<0.0001, P<0.0001.

**Figure-5. Comparative profile of Immobility Parameter in Mice Tail Suspensuin Test after acute treatment of 100mg/kg and 200 mg/kg of ethanol extract of *Neolmarckia Cadamba*.**



### 7.7 Assessment of locomotor activity in rat after acute treatment of ethanol extract of *Neolmarckia cadamba*.

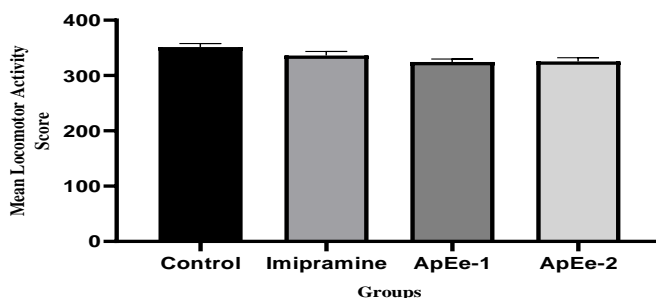
Locomotor activity score observed and recorded after single dose of administration by using actophotometer. Laocmotor activity was assessed for ten minutes test session during experiment. Test animals receiving vehicle (saline solution), imipramine (15mg/kg), and ethanol extract (200mg/kg).As per locomotor activity score there is no any significant effect on animal was observed as compare to vehicle treated animal. Results of locomotor activity score shown in table-7 and figure-6.

**Table: 7 Assessment of locomotor activity of ethanol extract of *Neolmarckia cadamba*.**

Sr. No	Treatment	Locomotor activity score
1	Control	371.2±7.922
2	Imipramine(15MG/KG)	359.5±4.766 <sup>ns</sup>
3	NcEe-1 (100mg/kg)	347.2±3.027 <sup>ns</sup>
4	NcEe-2 (200mg/kg)	358.3±8.593 <sup>ns</sup>

One-way ANOVA followed by Dunnet's test, all values mean  $\pm$  SEM in sec. (n= 6),  $P < 0.0429$ ,  $P < 0.3837$ .

**Figure-6: Comparative profile of change in locomotor activity in rats after acute treatment of 100mg/kg and 200mg/kg ethanol extract of *Neolmarckia cadamba*.**



## 8. Conclusion:

Ethanol extracts of *Abrus Precatorius* (ApEe) and *Neolmarckia Cadamba* (NcEe) consist flavonoid, glycoside, alkaloids, carbohydrates, tannins, fats, and oil. During experiment both plants extracts significantly decrease in immobility time in rFST and mTST at low dose (100 mg/kg) and high dose (200mg/kg) of body weight, hence the flavonoid-rich ethanol extract of both plant possess antidepressant activity in animal behavior model.

## 9. Acknowledgement:

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## References:

1. Barar FSK. Essentials of Pharmacotherapeutics (2006), 4<sup>th</sup> ed; S.Chand Publications, New Delhi.:62.
2. Tripathi KD.Essentials of Medical Pharmacology (2008), 6<sup>th</sup> Ed; Jaypee Publications, New Delhi, pp.423-438.
3. Kokate CK, Purohit AP, Gokhale SB. Text book of Pharmacognosy (2006), 36<sup>th</sup>ed; Nirali Publication, Pune, pp.36,126.
4. Indian Materia Medica (2007), Volume-I, Dr.K.M.Kulkarni, pp.05-07 & 1278-1280.
5. V.S.Sangetha et.al. (2017).Identification and isolation of chemical constituents from extracts of *Abrus precatorius* by GCMS technique, 12(7b), pp.1621-1632.
6. Zahraa Suhail Nassir et.al. (2017). Phytochemical Analysis and *in-vitro* Antioxidant Activity of Ethanolic Extract of Iraqi *Abrus precatorius* Linn. of Leguminosae Family, 46(1), pp.134-138.
7. Narendra Garaniya, Atul Bapodra (2014). Ethno botanical and Phytopharmacological potential of *Abrus precatorius* L.: A review, 4(1), pp.27-34.
8. Amit Saraf et.al. (2018). Phytochemical Analysis and Chemical Fingerprinting of Seeds of *Abrus Precatorius* L.7 (1), pp.63-70.
9. T. Rajeshwar et al. (2015). Investigation & study of Pharmacognostical and phytochemical features of leaves of *Abrus precatorius*. *Linn* (Leguminosae) An unexplored medicinal plant of India, 5(3), pp1-11.
10. Supriya Dwivedi (2017). Phytochemical, antimicrobial and antifungal properties of seeds of *Abrus precatorius*, 7(1), pp.760-761.

11. Rubi Verma et.al (2019). Pharmacognostical Evaluation and Phytochemical Screening of *Neolamarckia Cadamba*, 9(2), p-1-4.
12. Nay Soe Moe et.al (2020). A Study on Physicochemical Properties and Antimicrobial Activities of Phytochemical Constituents Extracted from the Stem Bark of *Neolamarckia cadamba* (Roxb.) Bosser (Ma-u), 11, pp.162-172.
13. Dr. Garima Bartariya (2017). Qualitative and quantitative analysis of phenols and flavonoids in foliar extract of *Anthocephalus cadamba* (roxb.), 4(10), pp.3664-3669.
14. Suranjana Das (2016). HPTLC fingerprinting, cytokine estimation, evaluation of analgesic, anti-inflammatory and membrane stabilizing activities of *Anthocephalus cadamba* miq. Root bark, 3(1), P-18-33.
15. Vishal Khandelwal, Pradeep Kumar Choudhary (2020). Antioxidant and anticancer potential of *Neolamarckia cadamba* (roxb.) bark extract, 8(3), pp.1-5.
16. Azwanida NN (2015). A review on the extraction methods use in medicinal plants.principal, strength and limitation, 4(3), pp.1-6.
17. Dr.C.K. Kokate et al. Cultivation of Medicinal Plants; Second edition: Nirali Prakashan, pp-21-22.
18. Dr.K.R Khandelwal, Dr.Vrunda Sethi (2013).Practical Pharmacognosy Techniques and Experiments; 23rd edition: Nirali Prakashan, pp.23.1-23.17, 25.1-25.9.
19. C.K.Kokate (2018).Practical Pharmacognosy; 5th edition: Vallabh Prakashan, pp.108-112.
20. Vogel HG, Vogel WH. Drug Discovery and Evaluation (2002).2<sup>nd</sup> ed.Germany: Springer, pp.546-558.
21. S.K.Kulkarni.Handbook of Experimental Pharmacology (2005).3<sup>rd</sup> Edition: Vallabh Prakashan, pp.117-119.

# **THE POTENTIAL ANTIOXIDANT BIOACTIVITY OF JASMINUM ELONGATUM EXTRACT AGAINST ACETAMINOPHEN INDUCED HEPATOTOXICITY IN MALE ALBINO RATS**

**Sabeena Hussain Syed**  
**School of Pharmacy, Vishwakarma University**

## **ABSTRACT:**

The present study was envisaged to evaluate the antioxidant effect of methanolic extract of *Jasminum elongatum* (*J. elongatum*) extract against acetaminophen induced hepatic toxicities in male albino rats. Extracts of *J. elongatum* was given in doses of 100 mg/kg, 200mg/kg and 400 mg/kg for 7 d and toxicity was induced by acetaminophen (2 mg/kg) on Day 8. Silymarin (50 mg/kg) was used as reference standard. After 24 h of toxicity induction, blood samples were collected from retro-orbital plexus and analyzed for antioxidant and serum parameters. Prior administration of *J. elongatum* extracts restored the elevated levels Malondialdehyde levels and increased the levels of Glutathione and Superoxide dismutase antioxidant parameters. The serum parameters also restored as compared to toxic group in dose dependent manner. The present study showed that extracts of *J. elongatum* possess hepatoprotective action against acetaminophen induced hepatotoxicity

**Keywords: Polyherbal, Hepatoprotective, Serum markers, Histopathology**

## **1. INTRODUCTION**

The liver is an essential organ of the body, which regulates various physiological functions like synthesis, secretion, and metabolism of xenobiotics. In this process, liver is exposed to many free radicals which can be neutralized by endogenous antioxidants. But, if natural protective mechanism are saturated it will lead to liver fibrosis or cirrhosis<sup>1</sup>. Morbidity and mortality resulting from liver diseases is a major public health problem worldwide especially in developing countries.

Liver treatment by allopathic medicines like corticosteroids and immunosuppressive agents still a challenge as they suffer with several adverse effects. This has led to increased dependence on alternative system of medicine especially herbal drug therapy. Herbal medicines are now in great demand in the developing world for primary health care not because they are inexpensive but also for minimal side effects and easily availability in nature<sup>2</sup>.

*Jasminum elongatum* is a shrub and traditionally powder of its twigs and leaves has been used as a hydragogue, febrifuge and in the treatment of dysentery, jaundice, diarrhoea and bellyache in China. The leaves and the stems of the plant contain some secoiridoid glucosides like jasamplexoside A, B and C along with 10-hydroxylogstroside and jasminoside. The leaves also reported to contain jaslaceosides B and E., jasminoside, isojasminoside. The methanolic extract of the plant reported for analgesic and antidiarrhoea activities.<sup>3</sup> The objective of the present study is to scientifically validate traditional use of *J. elongatum*

## **2. MATERIALS AND METHODS**

### **2.1 Collection and Preparation of Methanolic extract of *J. elongatum***

Plants of *J.elongatum* were collected from local gardens of Pune, Maharashtra, India. A specimen of the plant submitted to Botanical Survey of India (BSI), Pune and authenticated by the same. The dried twigs of the plant were powdered and extracted by cold maceration technique by using methanol as solvent. The process is continued for seven days with intermittent shaking and the last trace of the solvent was removed by Rota evaporator and finally dried in vacuum. The percentage yield of leaves of methanolic extract of *J.elongatum* (MEJE) was found to be 15.67%.

### **2.2 Preliminary Phytochemical Screening.**

The preliminary phytochemical screening was done by following standard qualitative chemical methods<sup>4</sup>. The methanolic extract of *J.elongatum* screened for the presence of carbohydrates, alkaloids, triterpenoids, saponins, phenols, sterols and flavonoids.

### **2.3 Assessment of Hepatoprotective activity<sup>5</sup>**

Healthy white male Wistar rats, body weight 180–200g were used in this study. All the animals were placed in clean polypropylene cages comprising of sterile paddy husk, which act as a bedding agent and fed with standard pellet diet and water ad libitum. The animals are maintained under standard conditions of temperature  $24\pm 2^{\circ}\text{C}$  under 12 h light/dark cycles All experimental procedures were carried out according to Animal Ethics Committee Guidelines.

In the acetaminophen induced liver toxicity model, total thirty six animals were divided into six groups containing six animals in each group. Group I animals considered as normal and administered 2ml/kg p.o of gum acacia (2%) for 8 days. Group II considered as toxic and received 2% gum acacia p.o for seven days and single dose of acetaminophen (2mg/kg) p.o on 8<sup>th</sup> day. Group III administered with silymarin, as a standard drug (50mg/kg) p.o for seven days. Group IV-VI received plant doses 100mg/kg, 200mg/kg and 400mg/kg for seven days. Silymarin, acetaminophen and plant extract were dissolved in 2% gum acacia.

On the 8<sup>th</sup> day all the groups (III-VI) received acetaminophen (2mg/kg) except Group-I, after 24 hrs of induction of toxicity by acetaminophen blood samples were collected from the retroorbital plexus. The collected blood is centrifuged at 2500 rpm for 15 min to separate serum which is used for analysis of biochemical parameters like SGPT, SGOPT, ALP and TB.

### **2.4 Measurement of GSH, SOD and MDA in liver homogenate**

Livers were isolated and a homogenate was prepared by using 0.05M sodium phosphate buffer (pH 7.0), which further centrifuged to obtain supernatant liquid. This is used to determine oxidative stress markers like MDA, GSH and SOD<sup>6</sup>.



### 3. RESULTS

#### 3.1 Preliminary Phytochemical Analysis

Preliminary phytochemical analysis of powdered drug showed the presence of phytoconstituents like carbohydrates, phenols, flavonoids, triterpenoids and saponins.

#### 3.2 Hepatoprotective assessment

The results obtained from the hepatoprotective study of methanolic extract of *J.elongatum* are summarized in Table 1. Biochemical parameters SGPT, SGOT, ALP and Total bilirubin are present at higher levels in wistar rats treated with acetaminophen (2mg/kg p.o) alone as compare to control group indicating development significant hepatotoxicity. Prior administration of methanolic extract of leaves of *J.elongatum* at doses 100mg/kg, 200mg/kg and 400mg/kg, caused a significant reduction in the values of SGPT, SGOT, ALP and TB almost comparable to that of silymarin.

#### 3.3 Oxidative stress Analysis

The concentration of Malonaldehyde (MDA) significantly increased in the acetaminophen treated group along with reduced levels of antioxidants (GSH and SOD) compared to normal group, whereas there is significant decrease in MDA and increase in antioxidants (GSH and SOD) in methanolic extract of *J.elongatum* indicating the possible antioxidative mechanism (Table 2).

### 4. CONCLUSIONS:

Pretreatment of methanolic extract of *J.elongatum* attenuated the increased levels of biochemical parameters in dose dependent manner indicating that extract could maintain the functional and structural integrity of liver cell membrane against acetaminophen toxicity. Hepatoprotective effects were also apparent through the increased levels of antioxidant enzymes and decreased lipid peroxidation.

### 5. FUNDING SOURCES

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**Table 1:** Effect of methanolic extract of *J.elongatum* on acetaminophen induced toxicity

Groups	AST(U/L)	ALT(U/L)	ALP(U/L)	TB(mg/dL)
Control	27.11±2.17	107.07±2.64	92.98±3.94	0.61±0.03
Toxic	109.62±1.95 <sup>#</sup>	211.01±1.53 <sup>#</sup>	169.34±2.01 <sup>#</sup>	1.59±0.04 <sup>#</sup>
Standard	81.42±1.29 <sup>***</sup>	171.40±1.97 <sup>***</sup>	122.34±2.19 <sup>***</sup>	0.89±0.01 <sup>***</sup>
MEJE (100 mg/kg)	100.71±2.06 <sup>*</sup>	202.45±2.46 <sup>*</sup>	158.40±3.31 <sup>**</sup>	1.41±0.02 <sup>*</sup>
MEJE (200 mg/kg)	97.73±3.45 <sup>**</sup>	199.28±2.02 <sup>**</sup>	148.33±1.93 <sup>***</sup>	1.37±0.09 <sup>**</sup>
MEJE (400 mg/kg)	85.39±1.58 <sup>***</sup>	170.70±2.22 <sup>***</sup>	121.52±2.07 <sup>***</sup>	1.02±0.07 <sup>***</sup>

**Table 2:** Effect of methanolic extract of *J.elongatum* on MDA (nmole/mg of protein), GSH (nmole/mg of protein), SOD (unit/mg of protein)

Groups	MDA	GSH	SOD
Control	0.46±0.01	15.57±0.56	7.25±0.22
Toxic	1.77±0.02 <sup>#</sup>	4.09±0.27 <sup>#</sup>	2.16±0.30 <sup>#</sup>
Standard	0.88±0.01 <sup>***</sup>	11.48±0.88 <sup>***</sup>	6.07±0.30 <sup>***</sup>
MEJE (100mg/kg)	1.66±0.03	6.15±0.20	4.37±0.12
MEJE (200mg/kg)	1.59±0.33 <sup>*</sup>	6.77±0.29	5.11±0.17
MEJE (400 mg/kg)	1.49±0.03 <sup>*</sup>	7.86±0.22	5.86±0.08 <sup>*</sup>

Values are the mean±SEM of six rats. Symbols represent statistical significance

# P<0.001 as compared to control group, \*p<0.05 compared to acetaminophen intoxicated group,\*\*P<0.01 as compared to acetaminophen intoxicated group.\*\*\*P<0.001 as compared to acetaminophen intoxicated group using one way ANOVA followed by Bonferroni's multiple comparison test

## 6. REFERENCES

- 1) Pramod, K., Deva R.G., Lakshamayya., Ramachandra S.S (2008). Antioxidant and hepatoprotective activity of tubers of *Momordica tuberosa* Cogn against CCl<sub>4</sub> induced liver injury in rats. *Indian Journal of Experimental Biology* 46, 510-13.
- 2) Mitra, S.K, Venkataranganna, M.V, Sundaram, R., Gopumadhavan S (1998). Protective effect of HD-03, a herbal formulation against various hepatotoxic agent in rats. *Journal of Ethnopharmacology* 63, 181-86.
- 3) Jain, A., Sharma, R., Kumar A and Sharma S (2011) "Jasminum species: An overview" *International Journal of Institutional Pharmacy and Life Sciences* 1(1), 251-256.
- 4) Khandelwal K.R. (2008) "Practical pharmacognosy – Technique and Experiments" 19th edition Pune Nirali Prakashan p. 160.
- 5) Eesha B.R., Mohanbabu, A.V., Meena Kumari, K., Sarath Babu., Vijay M., Lalit M., et al. (2011). Hepatoprotective activity of *Terminalia paniculata* against paracetamol induced hepatocellular damage in wistar albino rats. *Asian Pacific Journal of Tropical Biomedicine* 466-469.
- 6) Morgan, M.S., Depirre, J.W., Mannervik B (1979). Levels of glutathione, glutathione reductase and glutathione S-transferase activities in rat lung and liver. *Biochemica et Biophysica Acta*, 582, 67-78.

## **A COMPREHENSIVE STUDY OF HERBAL COSMETICS PREPARED FROM FLAXSEED**

**Sakshi K. Fale**  
**Smt. Kishoritai Bhoyar**  
**College of Pharmacy Kamptee**

**Dr. Renuka Das**  
**Smt. Kishoritai Bhoyar**  
**College of Pharmacy Kamptee**

**Prof. Milind J. Umekar**  
**Smt. Kishoritai Bhoyar**  
**College of Pharmacy Kamptee**

**Mr. R. N Alaspure**  
**Smt. Kishoritai Bhoyar**  
**College of Pharmacy Kamptee**

### **ABSTRACT**

The word cosmetics is known since ages. Natural beauty is a blessing and human uses cosmetic to look good and attractive. Number of herbal plants are used to treat various diseases and skin conditions naturally. Herbs are used in cosmetic formulation as they are having natural ingredients or constituents. Nowadays, herbal cosmetics are widely used as they have good activity and lesser side effects. Herbal cosmetics are used for daily purpose including cleanser, moisturizer, toner, lotions, creams etc. Herbal products improve the various functions of skin by boosting growth of collagen and thus eradicating harmful effects of free radicals, and maintaining keratin structure and making skin healthy. Essential oils are concentrated liquids and complex mixture of volatile compounds and can also be extracted from some plant organs. Flaxseed is used as traditional medicine and in formulation of skin products which helps in reducing acne and wrinkles and also gives antiaging effect and makes skin glowing and flawless. Flaxseed is used in formulation of hair oil, hair gel which helps in moisturizing and nourishes the hair. Flaxseeds are also used as nutritional additive and used in preparation of some dietary items.

**Keywords: Cosmetics, Herbal, Collagen, Antiaging effect**

### **1. INTRODUCTION**

The word "cosmetic" comes from the Greek word "kosmtikos," which means "power, arrangement, or ability in beautifying. Individuals' skin and hair beauty is determined by their health, lifestyle, regular job, climatic conditions, and care. Excessive exposure to heat causes the skin to dry, resulting in wrinkles, freckles, blemishes, pigmentation, and sunburns. Cracks, wounds, maceration, and infections are all common side effects of the harsh winter. Skin illnesses affect people of all ages and can be caused by exposure to bacteria, chemical agents, biological toxins in the environment, and, to some extent, starvation. Herbal cosmetics are products that contain

phytochemicals derived from a variety of botanical sources to affect skin functions and give nutrients for healthy skin and hair. Herbal cosmetics are natural plants and their products that are utilised in cosmetic preparations for their aromatic value. The health, habits, routine, environmental factors, and upkeep of the skin all have a role in its beauty. During the summer, skin becomes dry, resulting in wrinkles, freckles, flaws, pigmentation, and sunburn. Cracks, wounds, macerations, and infections are common throughout the winter months. Skin diseases affect people of all ages and are caused by germs, chemicals, toxins, microbes, chemical agents, and biological toxins found in the environment, as well as malnutrition. Plants' natural content has no negative effects on the human body; rather, it enriches it with nutrients and other beneficial minerals.

Flax (*Linum usitatissimum*) is a linaceae family annual plant. This plant can reach a height of 60 cm and has slender, fibrous stems, lanceolate leaves with three veins that are up to 4 cm long and 4 mm wide, and bright blue blooms that are up to 3 cm in diameter. Flaxseed or linseed is a seed found in the fruit. Flaxseed has been ingested by humans since the beginning of civilisation. Flaxseed has the greatest Omega 3 fatty acid (alpha-linolenic acid) concentration of any seed. This important fatty acid, which should be taken in a typical diet, accounts for about 48% of all lipids. Flax is a functional food or a source of functional nutrients since it includes alpha-linolenic acid, lignans, and polysaccharides (other than starch), all of which have anti-inflammatory properties. Despite the fact that scientific data supports flaxseed use, many people are unaware of the benefits of this substance and its potential applications in food production.

## **2. FLAXSEED CHEMICAL COMPOSITION**

The seed includes roughly 40% lipids, 30% dietary fibre, and 20% protein. The chemical makeup of plants varies greatly between kinds and is also influenced by the environment in which they are cultivated. The seed contains 76 percent of the protein and 75 percent of the lipids found in the cotyledons. Only 23% of the lipids and 16% of the protein are found in the endosperm. Flaxseed's lipid makeup makes it a good source of Omega 3 fatty acids, particularly -linolenic acid (ALA), which can account for up to 52% of total fatty acids. Flaxseed is also a good source of phenolic compounds known as lignans, a colloid gum, and high-quality protein.

### **2.1 Lipids**

The oil in flaxseed is the most important component, accounting for 39 g 100 g<sup>-1</sup> dry matter, and it is this that has been processed. Oil is mostly stored in cotyledons, which include the highly sought-after -linolenic, linoleic, and oleic acids. Triacylglycerols make up 98 percent of flaxseed oil, with phospholipids (0.9 percent) and free fatty acids (0.1 percent) making up the rest. Oil extraction yield and fatty acid content (linolenic acid, omega 3; linoleic

acid, omega 6; oleic acid, omega 9) differ slightly among writers, and both are influenced by oil extraction technology that they are found in various sections of the seed. As a result, digesting it poses significant difficulties.

## **2.2 Protein**

Flaxseed has an average protein level of 22 g per 100 g of seed. The protein content of a product is affected by the conditions in which it is processed, such as dehusking or defatting. Because the husk contains a minimal amount of protein, meal made from dehusked and defatted seeds yields a high-protein isolate. The primary proteins in flax, as in other seeds, are globulins, which account for 18.6% of total protein in flax and 17.7% of total protein in other seeds. The limiting aminoacids include lysine, methionine, and cysteine, whereas flax protein is relatively rich in arginine, aspartic acid, and glutamic acid.

## **2.3 Fibre**

Fibre, the component that gives volume and form to the majority of foods, is not hydrolyzed in the digestive tract, thus it retains water and prevents cholesterol absorption during digestion. Insoluble fibre is made up of compounds like cellulose, hemicellulose, and lignin; soluble fibre is made up of substances like cellulose, hemicellulose, and lignin. This type of fibre is found in the highest concentration in whole-grain cereals. In the presence of water, soluble fibre forms a gel, which contains gums, pectins, and sugars, forming mucilage (8 percent dry weight of flaxseed).

## **2.4 Lignans**

Flaxseed's high presence of complex phenols like lignans is one of its most intriguing features. Secoisolariciresinol (SDG) is the most notable, but isolariciresinol, pinoresinol, matairesinol, and other ferulic acid derivatives are also found. Consumption of lignans lowers cardiovascular risk and prevents the onset of some forms of diabetes. Flax lignans have antioxidant properties as hydroxyl radical sequestrators, as well as estrogenic properties due to their structural resemblance to 17--estradiol. SDG's antioxidant capacity is linked to the reduction of oxidative conditions caused by oxygen species.

## **3. FLAXSEED BENEFITS FOR SKIN**

Polyunsaturated fatty acids (FA)-rich oils are essential for human health. Flaxseed contains linoleic acid (LA), -linolenic acid (ALA), and -linolenic acid (GLA). Dry and sensitive skin is treated with topical applications of oils containing n-6 FA, LA, or GLA. Although there is a wealth of information on the effects of LA and GLA on skin

disorders, there is little information on the relationship between plasma FA concentrations and skin function. The current study looks on the effects of flaxseed oil intake on sensitive skin.

## **4. PHARMACOLOGICAL EFFECT**

### **4.1 Antioxidant effect**

Omega -3 fatty acids suppress oxygen free radical from neutrophils and monocytes, it also suppress production of interleukin-1, tumor necrosis factor, leukotriene B4 (LTB4). Lignans are platelet activating factor receptor antagonist and inhibit the production of oxygen free radicals by neutrophils. Secoisolariciresinol diglycoside (SDG). Flaxseed also contains small quantity of lignin matairesinol which can be converted into mammalian lignans by colonic bacteria.

### **4.2 Flaxseeds biological actions**

The inclusion of good quality omega-3 unsaturated fatty acids, alpha-linolenic acid (ALA), antioxidants such as phenolics, lignin, carotenoids, and tocopherols in flaxseed is linked to its nutritional and protective characteristics.

### **4.3 Lignans biological functions**

Flaxseed, whether whole or ground, is high in lignans (also known as phytoestrogens), such as secoisolariciresinol and matairesinol. These lignans have been found to have cell reinforcement and phytoestrogenic properties. Microscopic organisms in the colon convert them to the dynamic metabolites enterodiol and enterolactone. These metabolites are thought to have stronger cancer-prevention (antioxidant) and antiplatelet effects than the parent lignan secoisolariciresinol diglucoside, and to have either a weak estrogenic or antiestrogenic effect, depending on estradiol's natural dimensions.

## **5. COSMETICS PREPARED FROM FLAXSEED**

### **5.1 Hair gel**

Flax seed gel can be used as a moisturiser on the scalp and hair to help encourage hair growth and strengthen existing hair. Oils, creams, ointments, pastes, and gels are examples of topical formulations. Gels are becoming more popular these days since they are more stable and may provide controlled release than other semisolid preparations. Gel formulations can improve drug bioavailability by improving absorption properties. Pure Flaxseed Hair Gel will elongate and define curls, no matter what hair type or curl type, and give "wet curly look"

while hair is dry. This light weight natural flaxseed gel is created for curly, oily and wavy hair. It is enriched with flaxseeds and castor oil that provide a natural source of vitamin E. Flaxseed offers a natural remedy for hair regrowth and helps keep your hair strong, shiny and free from any crunch, frizz or flakes.

## **5.2 Facial gel**

Flax Seed Gel from Herbal Botanica has flax seed characteristics that help maintain the skin firm and reduce drooping with age. Flax seeds are high in lignin and antioxidants, which assist to prevent wrinkles and fine lines on the face. Flax seeds also contain fatty acids that aid to keep the skin hydrated and smooth.

## **5.3 Hair oil**

Flaxseed oil is created from flax seeds that have been ground and pressed to extract their natural oil, also known as flax oil or linseed oil. Omega 3 fatty acid is abundant in One Life Flaxseed Oil. It aids in the improvement of general health. Flaxseed is an anti-inflammatory food. Flaxseed extract nourishes the skin and keeps it supple. It's suitable for all skin types (normal, dry, and oily). Flax seed oil moisturises damaged hair, soothes sensitive scalps, and gives limp, lifeless hair volume.

## **6. LITERATURE REVIEW**

Herbal cosmetics have always drawn a lot of attention due to their high activity and less adverse effects than synthetic cosmetics. Herbal cleansers, moisturisers, toners, and other herbal cosmetics are created and used on a regular basis. Herbal cosmetics offer medical properties that influence skin's biological activity, depending on the components they contain. These products help the skin operate better by promoting collagen production, reducing free radical damage, maintaining keratin structure, and making the skin healthier.

Essential oils are concentrated liquids made up of a complex mix of volatile chemicals that can be collected from a variety of plant organs. Aromatic herbs and oils have been utilised as fragrances, cosmetics, and culinary ingredients for thousands of years. Essential oils are now widely used as a source of a variety of bioactive chemicals with antioxidative and antibacterial activities. Some essential oils have also been utilised as medicine. Flaxseed has a lot of antioxidant properties.

Skin sensitivity is a prevalent issue in the Western population, and it is linked to changes in skin qualities such as barrier function, hydration, and physiology. Dietary fatty acids (FA), particularly polyunsaturated FA, can influence skin characteristics.

Traditional medicine is well-known in India. Herbs are an old kind of Indian medicine devised by ancient sages whose keen observations led to the establishment of constitutional medicine. Herbal cosmetics are products that are used to improve one's look. The goal of this study was to develop and test a flaxseed herbal gel for hair moisturization and nourishment. Flaxseed (also known as linseed) is high in fatty acids and antioxidants, which help the scalp eliminate toxins and dead cells.

Although scientific data supports flaxseed eating, a huge portion of the population remains unaware of the advantages of flaxseed consumption and its potential usage as a functional food ingredient in foods. Flaxseed is well recognised for its high alpha-linolenic acid content, but it also contains lignans, soluble fibre, and protein, all of which are biologically active in the prevention of some non-communicable chronic diseases. For the cultivation of this crop, Southern Chile has a comparative advantage. This crop, when combined with full processing, has the potential to enhance the regional economy.

Flaxseed has long been prized for its oil, which has been used in paints and coatings, printing inks, soap, core oils, brake linings, and herbicide adjuvants. This review article aims to bring together the most recent extraction methodologies and fractionation strategies for isolating bioactive components from flaxseed essential oils. Oil extraction methods include solvent-free microwave extraction, supercritical fluid extraction, direct steam distillation, hydro distillation, and simple steam distillation, while bioactive component isolation can be accomplished using fractional distillation, vacuum distillation, and high-speed counter current chromatography.

## CONCLUSION

In the personal care system, the usage of herbal cosmetics has expanded by a factor of ten, and there is a high demand for herbal cosmetics. Bioactive chemicals in cosmetics alter the skin's biological functions and give the nutrients required for healthy skin and hair. Plants provide a variety of vitamins, antioxidants, oils, essential oils, hydrocolloids, proteins, terpenoids, and other bioactive compounds in general. There is plenty of room to launch a slew of herbal cosmetics with bioactive elements that aren't appropriate, such as fatty oils, essential oils, proteins, and appropriate additions. Despite the fact that flaxseed has been known since ancient times, it is not widely employed in food formulations today; nonetheless, recent research have enhanced its popularity. Flaxseed is high in substances with functional and bioactive qualities, including as alpha-linolenic acid, lignans, soluble fibre, and protein, which have been shown to help prevent certain non-communicable diseases.



## REFERENCES

1. Fathima, A., Varma, S., Jagannath, P., & Akash, M. (2011). General review on herbal cosmetics. *International journal of drug formulation and research*, 2(5), 140-165.
2. Rubilar, M., Gutiérrez, C., Verdugo, M., Shene, C., & Sineiro, J. (2010). Flaxseed as a source of functional ingredients. *Journal of soil science and plant nutrition*, 10(3), 373-377.
3. Neukam, K., De Spirt, S., Stahl, W., Bejot, M., Maurette, J. M., Tronnier, H., & Heinrich, U. (2011). Supplementation of flaxseed oil diminishes skin sensitivity and improves skin barrier function and condition. *Skin pharmacology and physiology*, 24(2), 67-74.
4. Manjula, D., Jenita, J. J. L., Premakumari, K. B., & Shanaz, B. (2018). Formulation and evaluation of flaxseed hair gel: a natural hair tamer. *International Journal of Research in Pharmacy and Chemistry*, 8(3), 487-491.
5. SanjanaPatil, Adiksha Mishra, Rashmi Kate, PradnyaSapkal, Dr. Ganesh Deshmukh A review article on herbal cosmetics for skin ISSNNO.2455-2631. September 2020 *International Journal of scientific development and Research*.
6. Shim, Y. Y., Gui, B., Arnison, P. G., Wang, Y., & Reaney, M. J. (2014). Flaxseed (*Linum usitatissimum* L.) bioactive compounds and peptide nomenclature: A review. *Trends in food science & technology*, 38(1), 5-20.
7. Basch, E., Mphil, S. B., Collins, J., Dacey, C., Harrison, M., & Szapary, P. (2007). Flax and flaxseed oil (*Linum usitatissimum*): a review by. *J Soc Integr Oncol*, 5(3), 92-105.
8. Neukam, K., De Spirt, S., Stahl, W., Bejot, M., Maurette, J. M., Tronnier, H., & Heinrich, U. (2011). Supplementation of flaxseed oil diminishes skin sensitivity and improves skin barrier function and condition. *Skin pharmacology and physiology*, 24(2), 67-74.
9. Shim, Y. Y., Gui, B., Arnison, P. G., Wang, Y., & Reaney, M. J. (2014). Flaxseed (*Linum usitatissimum* L.) bioactive compounds and peptide nomenclature: A review. *Trends in food science & technology*, 38(1), 5-20.

## EFFECT OF GREEN SYNTHESIZED FENUGREEK METAL-ION NANOPARTICLES ON RESISTANT MICROORGANISM

**Divya Zambre**  
Smt. Kishoritai Bhoyar  
College of Pharmacy

**Neha Raut**  
Smt. Kishoritai Bhoyar  
College of Pharmacy

**Shweta Raut**  
Smt. Kishoritai Bhoyar College  
of Pharmacy

**Rashmi Zode**  
Smt. Kishoritai Bhoyar  
College of Pharmacy

**Dr. Milind Umekar**  
Smt. Kishoritai Bhoyar College  
of Pharmacy

### ABSTRACT

The present research work is based on Characterization and Evaluation of green synthesized Fenugreek metal ion complexes. The metal ion complexes such as Fenugreek-palladium, Fenugreek-cadmium, Fenugreek-Zinc, Fenugreek-Nickel, Fenugreek-silver were synthesized and characterized by melting point, UV, SEM, EDS, FT-IR Spectrophotometry. The antimicrobial activities of all complexes using the Disc diffusion method were screened against normal and resistant strains of Escherichia coli and Klebsiella pneumoniae. The minimum inhibitory concentration of the metal ion complexes was determined by the broth dilution method. The antibacterial activity of 1:1 ratio of Fenugreek Palladium Chloride was carried out to study the effect of green synthesized complexes. The melting point of complexes was above 300°C. Scanning Electron Microscope showed that the 1:1 ratio of Fenugreek-Palladium complexes has a different shape in the range from 369nm to 914nm. UV spectra showed a change in absorbance which confirm the formation of complexes. The result of energy dispersive spectrophotometry confirmed the presence of elements Pd, Cl, O, C, N, Pt in the Fenugreek-Palladium complex. The FTIR spectra of all the compounds were scanned in the region of 4000-700 cm. The data showed a change in wavenumber as compared to the standard drug due to the formation of a metal ion complex. Antimicrobial activity studies revealed that complexes showed better activity against resistant organisms than normal organisms. The minimum inhibitory concentration result showed strong antimicrobial activity for all complexes at low concentrations. The present study provides that the combination of Fenugreek-metal ion would be having better antimicrobial activity against resistance strain of bacteria.

**KEYWORDS:** Fenugreek-metal ion, Nanoparticles, Antimicrobial activity, Resistant Microorganism

### 1. INTRODUCTION

Despite the diversity of antimicrobial agents, including antibiotics, multidrug resistance has been steadily emerging in past few years. However, because of the unacceptable side effects they cause, as well as adaptation and new resistance mechanisms of microorganisms that emerged and spread globally, researchers have turned to bioactive compounds in the form of plant extracts with antimicrobial properties for treatment. Fenugreek, *Trigonella foenum-graecum* L. is an annual herb that is widely used as a food, feed additive, and traditional remedy in herbal medicine around the world. Fenugreek contains a high concentration of phytochemicals such as flavonoids, steroids, and alkaloids, which have been found and isolated by pharmaceutical companies or industries for use in the manufacture of hormonal and therapeutic drugs. (Basch et al., 2003) Depending on the concentration of extract,

fenugreek seeds powder extract is effective against bacteria like *Bacillus cereus*, *Staphylococcus aureus*, methicillin-resistant *E. coli*, *Staphylococcus aureus*, and *Pseudomonas aeruginosa*, as well as fungi like *Candida albicans*, *Trichophyton rubrum*, and *Aspergillus flavus*. (Benyagoub et al., 2021) Researchers have been concentrating their efforts in recent years on developing efficient green chemistry methods for the synthesis of metal nanoparticles. Metallic nanoparticles such as silver, gold, platinum, zirconium, palladium, iron, cadmium, and metal oxides such as titanium oxide, zinc oxide, and others are synthesized by a variety of microorganisms, including prokaryotes and eukaryotes. (Rizwana et al., 2021) Plants appear to be the best choices among these organisms, as they are well-suited to large-scale nanoparticle biosynthesis. Plant-produced nanoparticles are more stable and have a higher rate of synthesis than microorganism-produced nanoparticles. Plant extracts are favoured for the synthesis of nanoparticles because of their environmental friendliness. The plants serve as a source of both reducing and stabilising agents for nanoparticles, which would otherwise have to be added externally through other means. Recent studies have shown that the therapeutic effects of the plants from which the nanoparticles are derived can also be infused upon the particles, providing us with ideal vehicles for therapeutic materials to act upon the site of action and nullifying the need to develop a drug for that specific ailment artificially. Taking this into account, the present work aimed to study the effect of green synthesized fenugreek metal-ion nanoparticles on resistant microorganism.

## 2. LITERATURE REVIEW

**Fatima A. I. Younis et al.**, (2018) reported a green synthesis and characterization of Gold Nanoparticles using Fenugreek seeds extract. In present research, cost effective and environmentally friendly gold nanoparticles were synthesized. Biosynthesis of gold nano particles was carried out using the aqueous extract of fenugreek seeds. (Fatima A. I. Younis, 2018)

**Nabila H. Hussein et al.**, reported a green synthesis of silver nano particles using Fenugreek seeds extract. The results confirmed that, the morphology of the prepared nano silver were of spherical shape with smooth surface and average diameter of 17nm. Produced nano silver was tested as antibacterial agent and it is successful against *E-coli* and *staphylococcus aureus* due to the increase of the inhibition zone than using 1 molar silver nitrate alone. (Hussein et al., 2018)

**Sharma V et al.**, (2015) reported the antimicrobial activity of *trigonella foenum-graceum* L. (Fenugreek). It was concluded that out of three solvent extract (methanol, acetone and aqueous) the order of antibacterial activities of solvent extract of fenugreek is methanol>Acetone>Aqueous.

## 3. OBJECTIVES

The objective of present work was to synthesize and characterized fenugreek seed extract metal ion complexes and to study the antibacterial activity of synthesized product and its comparative effect on antibiotic resistant micro-organisms.

## 4. EXPERIMENTAL WORK

### 4.1 Fenugreek seed extract

The seeds were pulverized and the he powder was further utilized to make an aqueous extract with a concentration of 10g/L. This extract was filtered and stored at 40°C until it was needed for the current study. (Deshmukh et al., 2019)

### 4.2 Synthesis of Fenugreek-metal ion complex

#### 4.2.1 Synthesis of silver chloride fenugreek complex

At 40°C, 50ml of 1mM  $AgCl_2$  solution was stirred continuously with 50ml of aqueous extract. After 30 minutes, the reaction mixture's color changed from transparent yellow to light green, indicating the

formation of AgNPs. After multiple washes with distilled water, the product sample was collected and dried in an oven at 60°C. The silver nanoparticles made with fenugreek extract were dried and ground before being stored in an airtight container for further analysis.

#### *4.2.2 Synthesis of nickel chloride fenugreek complex*

In a 250 ml Erlenmeyer flask, 10 ml of fenugreek seed extract was added to 100 ml of 1 mM aqueous nickel chloride solution. After adding fenugreek seed extract and stirring the resulting solution for homogenous mixing, the colour of the solution changed from green to pale yellow. Ni nanoparticles separated out and settled at the bottom of a mixed solution of nickel chloride and fenugreek seed extract after being maintained at room temperature overnight. Using a Buchner funnel, the extract was filtered. Ni nanoparticles were then dried at 80°C in an oven.

#### *4.2.3 Synthesis of Palladium chloride fenugreek complex*

At 40°C, 50ml of 1mM PdCl<sub>2</sub> solution was stirred continuously with 50ml of aqueous extract. After 30 minutes, the reaction mixture's colour changed from yellowish green to dark brown, indicating the formation of PdNPs. After multiple washes with distilled water, the product sample was collected and dried in an oven at 60°C. Palladium nanoparticles made with fenugreek extract were dried and ground before being stored in an airtight container for future analysis.

#### *4.2.4 Synthesis of zinc chloride fenugreek complex*

At 40°C, 50ml of 1mM ZnCl<sub>2</sub> solution was stirred continuously with 50ml of the aqueous extract. After 30 minutes, the reaction mixture's colour changed from yellow to dark green, indicating the formation of ZnNPs. After multiple washes with distilled water, the product sample was collected and dried in an oven at 60°C. Zinc nanoparticles made with fenugreek extract were dried and ground into powder before being stored in an airtight container for further analysis.

#### *4.2.5 Synthesis of cadmium chloride fenugreek complex*

In a 250 mL Erlenmeyer flask, 10 ml fenugreek seed extract was added to 100 ml 1 mM aqueous cadmium chloride solution. After adding fenugreek seed extract and stirring the resulting solution for homogenous mixing, the colour of the solution changed from green to light brown. Cd nanoparticles separated out and settled at the bottom of a mixed solution of cadmium chloride and fenugreek seed extract after being maintained at room temperature overnight. Using a Buchner funnel, the extract was filtered. The Cd nanoparticles were then dried at 80°C in an oven.

### **4.3 Characterization Fenugreek metal ion complexes**

Characterization of Fenugreek metal ion complexes was done using UV, SEM and EDS

### **4.4 Antimicrobial activity**

The antibacterial activity of the complexes was assayed using the following bacterial species E. coli, Resistance E. coli, K. Pneumonia, Resistance K. Pneumonia. This was done using disc diffusion method in distilled water.

## 5. RESULT AND DISSCUCION

### 5.1 Organoleptic properties of fenugreek-metal ion complexes:

#### 5.2 UV visible studies:

The Visual Study of metal complexes production from Fenugreek seed extract in methanol was confirmed by UV Visible spectrophotometer by recording the absorbance from 200-500 nm.

#### 5.3 Antimicrobial activity of Fen-M against bacterial species *K. Pneumoniae* and Resistance *K. Pneumoniae*

The activity Fen-M complex against Resistance *K. Pneumoniae* was higher than in *K. Pneumoniae*.

#### 5.4 Antimicrobial activity of Fen-M against bacterial species *E. coli* and Resistance *E. coli*

The activity Fen-M complex against Resistance *K. Pneumoniae* was higher than in *K. Pneumoniae*.

#### 5.5 SEM Diagram and Elemental Detection (EDS) of Palladium chloride Complex

SEM confirmed the shape and size of Synthesized complex. SEM image of palladium complex clearly indicates that synthesized palladium complex has average size less than 914 nm with irregular, polygonal, cylindrical and crystalline in nature The elemental composition of various particles observed in the colloidal samples were analysed by Energy Dispersive X-Ray spectroscopy (EDS) and it confirmed the presence of Pd, Cl, O, C, N and less amount platinum.

## 6. CONCLUSION

The study provides a simple, cost effective and efficient route for synthesis of fenugreek-metal ion complexes. The synthesized complexes were confirmed by UV, SEM, EDS characterization techniques. Antimicrobial studies were done on different bacterial species which included *E. coli*, *Resistance E. coli*, *K. Pneumonia*, *Resistance K. Pneumonia*. The antimicrobial effect of fenugreek-metal ion complexes was observed more in resistant bacteria when compared to Fenugreek. Fen -Cd Complex showed maximum antimicrobial effect.

Table 1: Organoleptic properties of fenugreek-metal ion complexes

Sr. No.	Compounds	Colour	Melting Point	Percentage Yield
1.	Fen-Ag Complex	Yellowish	271-275 <sup>o</sup> C	70.46%
2.	Fen -Ni Complex	Light brown	260-263 <sup>o</sup> C	69.15%
3.	Fen -Cd Complex	Yellow	275-280 <sup>o</sup> C	76.21%
4.	Fen -Pd Complex	Brownish	286-290 <sup>o</sup> C	81.31%
5.	Fen -Zn Complex	Green	282-285 <sup>o</sup> C	80.01%

Table 2: Antimicrobial activity of Fen-M against bacterial species *K. Pneumoniae* and Resistance *K. Pneumoniae*

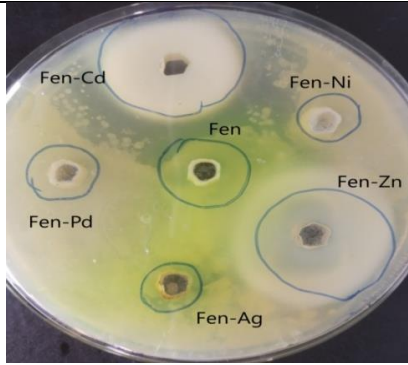
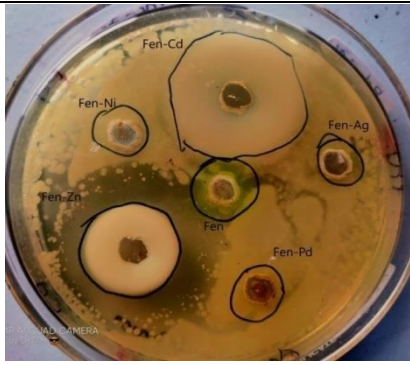
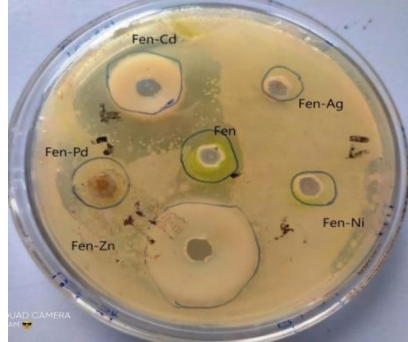

Complex	<i>K. Pneumoniae</i>	Resistance <i>K. Pneumoniae</i>
Fen-M		

Table 3: Antimicrobial activity of Fen-M against bacterial species *E. coli* and Resistance *E. coli*

Complex	<i>E. coli</i>	Resistance <i>E. coli</i>
Fen-M		

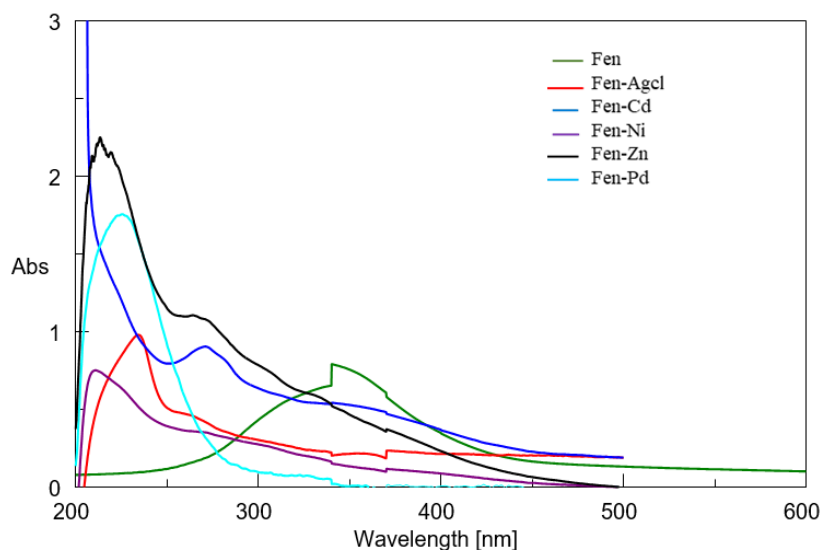


Figure 1: UV-Visible spectra of Fen, Fen-Ag, Fen-Cd, Fen-Ni, Fen-Pd, Fen-Zn complexes in Methanol

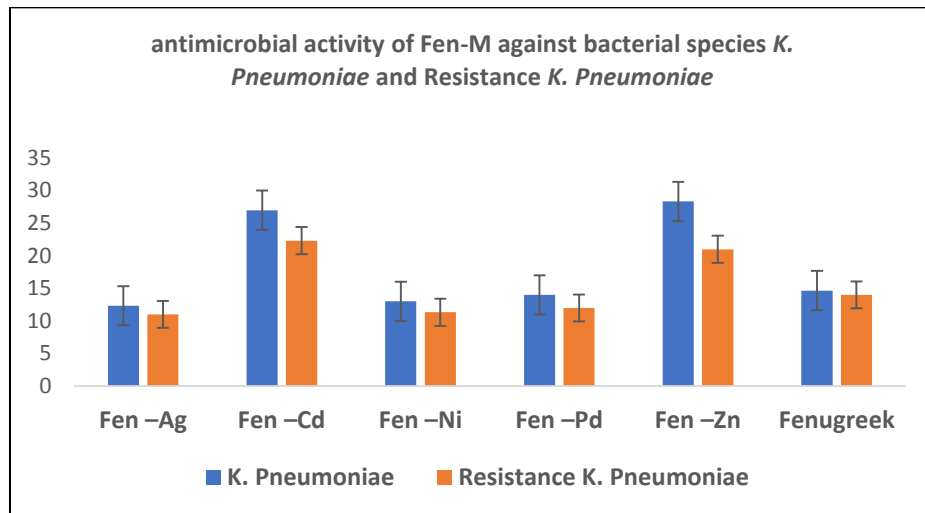


Figure 2: Antimicrobial activity of Fen-M against bacterial species K. Pneumoniae and Resistance K. Pneumoniae

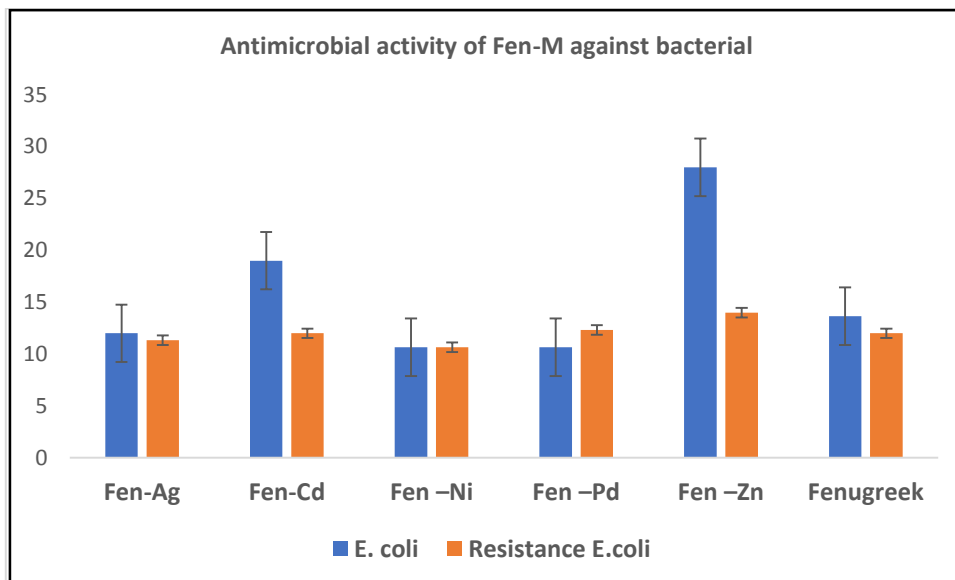


Figure 3: Antimicrobial activity of Fen-M against bacterial species E. coli and Resistance E. coli

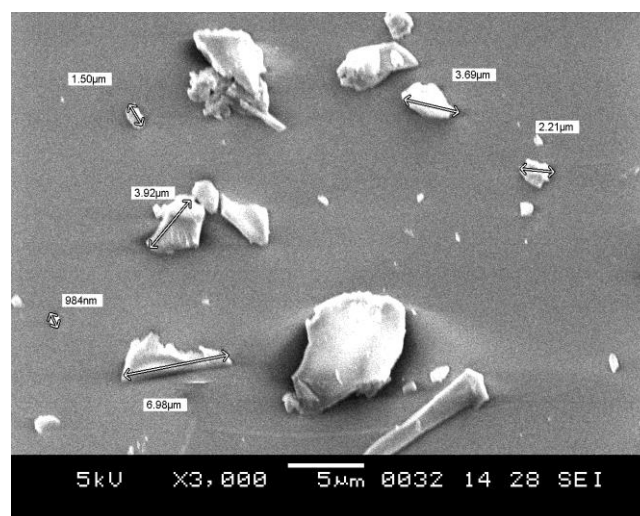


Figure 4: SEM Diagram of Palladium chloride Complex

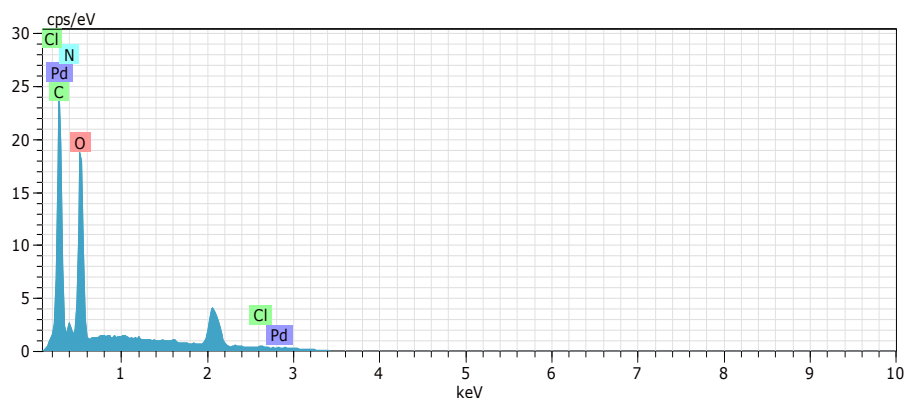


Figure 5: Elemental Detection (EDS) of Palladium chloride Complexes

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## 9. REFERENCES

1. Basch, E., Ulbricht, C., Kuo, G., & Szapary, P. (2003). Fenugreek Review Therapeutic Applications of Fenugreek. In *Alternative Medicine Review* ♦ (Vol. 8, Issue 1).
2. Benyagoub, E., Nabbou, N., Aguid, A., Alkudhairy, M. K., & Bendada, F. (2021). In vitro Antibacterial Activity of Fenugreek Seeds' Phytoconstituents from Taghit Region (Southwest of Algeria) Against the Bacterial Strains Responsible for UTI. *Current Bioactive Compounds*, 17(4), 339–355. <https://doi.org/10.2174/1573407216999200703123154>
3. Deshmukh, A. R., Gupta, A., & Kim, B. S. (2019). Ultrasound Assisted Green Synthesis of Silver and Iron Oxide Nanoparticles Using Fenugreek Seed Extract and Their Enhanced Antibacterial and Antioxidant Activities. *BioMed Research International*, 2019, 1–14. <https://doi.org/10.1155/2019/1714358>
4. Fatima A. I. Younis, H. A. M. A. F. M. A. R. M. A. and M. G. (2018). GREEN SYNTHESIS AND CHARACTERIZATION OF GOLD NANOPARTICLES (AUNPS) USING FENUGREEK SEEDS EXTRACT (TRIGONELLA FOENUM-GRAECUM). *European Journal of Biomedical AND Pharmaceutical Sciences*, 5(4), 100–107.
5. Hussein, N. H., Shaarawy, H. H., Hawash, S. I., & Abdel-Kader, A. E. (2018). GREEN SYNTHESIS OF SILVER NANO PARTICLES USING FENUGREEK SEEDS EXTRACT. 13(2). [www.arpnjournals.com](http://www.arpnjournals.com)
6. Rizwana, H., Alwhibi, M. S., Aldarson, H. A., Awad, M. A., Soliman, D. A., & Bhat, R. S. (2021). Green synthesis, characterization, and antimicrobial activity of silver nanoparticles prepared using *Trigonella foenum-graecum* L. leaves grown in Saudi Arabia. *Green Processing and Synthesis*, 10(1), 421–429. <https://doi.org/10.1515/gps-2021-0043>



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### Contact Person

**DR. PANKAJRAY PATEL**  
Director & Managing Editor  
Graduate School of Management Studies  
Gujarat Technological University

**DR. SARIKA SRIVASTAVA**  
Assistant Professor & Section Editor  
Graduate School of Management Studies  
Gujarat Technological University

### Correspondence Address

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
Nr. Vishwakarma Government Engineering College  
Nr. Visat Three Roads, Visat - Gandhinagar  
Highway Chandkheda, Ahmedabad, Gujarat  
(INDIA)  
Pin code – 382424  
Phone: (079) 23267590 / 554  
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