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Greetings!

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ANTICIPATING FAILURES IN SAFETY CRITICAL COMPLEX SYSTEMS WITH AN IOT-ENABLED SUPER WATCHDOG

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Abstract—Safety Critical Systems have high impact on failure, mostly resulting in heavy loss of human lives and damage to properties. Most Safety Critical Systems have a high degree of sophisticated technology that involve complex coupling of Digital, Electronic, Electrical, and Mechanical processes. Most systems have an element of manual interventions to set the parameters, or to effect manual override. Examples of Safety Critical Systems include Track Management in Railways, Aircraft systems and Air Traffic Management Systems, Nuclear Power plants, Chemical plants, Missile operations, etc. Due to the risks involved in failure, these systems are designed with redundancies to take care of failures and have fail safe modes of operations. They are extensively tested and put on trial before they are pressed into actual operations. However, we still see many Railways and Aircraft-related accidents, nuclear catastrophes, and chemical accidents, resulting in human tragedies of many lost lives. These incidents get into public limelight due to the huge loss of lives while many smaller-impact accidents occur and are reported, without much public outcry. This paper has a direct bearing on the recent triple-train accident in Odisha, India on June 4th, 2023, and in fact has been triggered by it.

There are several safety critical analysis models in vogue since the 1940s. Some of the better-known safe- ty-critical analysis methods are Hazard and Operabili- ty Studies (HAZOP), Fault Tree Analysis (FTA), Event Tree Analysis (ETA), Failure Modes and Effects Analy- sis (FMEA), Fault Hazard Analysis (FHA), Subsystem Hazard Analysis (SSHA), State Machine Hazard Analy- sis (SMHA), and Software Fault Tree Analysis (SFTA)[1].

These are more for a postmortem analysis after the ac- cident to find out what went wrong. Except to fix the cause as human error or technology failure, and that too not very convincingly, they have not proved useful in preventing fu- ture accidents. Causes or combinations of causes of failure in every accident are different and hence unanticipated. What is required is a model that can analyze the situation and anticipate incidents with a good degree of confidence.

IOT is an emerging technology and along with Artificial Intelligence and Machine Learning Techniques, has been adopted in several domains to digitally transform legacy processes[2]. Many of the current applications have been in areas like Healthcare, Logistics, Manufacturing, Asset Management, etc. Mostly IOT is used for Monitoring and control of smart devices that are part of an operational environment or orchestrating the process involved, end to end, in a large-scale operational use case[3]. Here, we propose an IOT-based Super Watch Dog to supervise and anticipate failures in the functioning of Safety Critical Systems that are complex and non-linear in their working.

Such systems cannot be designed perfectly, constructed without flaws or tested exhaustively before be- ing pressed into operations[4]. Moreover, the systems evolve over time as requirements and operating proce- dures change and unanticipated load increases on the system. External inputs and events, unanticipated hu- man behaviour, inadvertently or deliberately, give rise to too many imponderables to take care, and a com- bination of these is beyond the ken of human minds.

This paper discusses an IOT-based Super Watch Dog functionality. The Super Watch Dog incorporates AI and ML techniques not only for situational analytics of real time data to detect and address immediate anomalies but also continuously updates its operational model with the data to learn what situations can lead to failures. After all, for every failure there are thousands of success runs provid- ing Big Data with which the Operational model can be en- riched more and more to differentiate situations that would lead to success and those that might lead to failure. The Indian Railways system of Interlocking signals and points based on the location of a train in a particular section of the track is taken for discussing the Super Watch Dog system.

The central concept of this paper is that no automation designed by human beings can be exhaustively tested in a finite time and guaranteed not to fail.

There are too many imponderables and a list of all possible 'what if scenarios that might lead to failure' is almost infinite. The general tendency is to stop verifying/testing the fail- ure scenarios when time and money run out or when we conclude that the untested failure scenarios have very low probability of failure[5]. However, as it turns out, no finite probability, however small, can be ignored as most of the accidents resulting in huge loss of life have occurred when these low probability scenarios kick in.

This paper suggests that the emerging technology of IOT, coupled with AI and Machine Learning techniques can lower the risk of failure by orders of magnitude. If we de- ploy the combination of these technologies to keep build- ing and improving the 'success' model of operations from the data collected while there were no failures, deviations and outliers can be detected to check if they would lead to failure. If the system can anticipate possible failures based on the strength of the success model that it has built on a continuous basis, corrective actions can be taken to avert the failure. If it was a false alarm, the success model can be adopted to accommodate or ignore the false alarm.

This paper discusses in detail an IOT-based architecture to implement the above concept in the context of the Railway operations of Track Management. Rail- way accidents take place when some aspect of what should have happened in the normal course , does not happen or conversely when what should not happen , happens. This could involve the signal, the points, the train sensor on the track, the manual action that should or should not have been done, etc. As the sequence of events and activities happen correctly as predicted in thousands of successful journeys and do not hap- pen one way or another in the relatively small number of unsuccessful train journeys, resulting in failures, the IOT-based solution builds a success model and keeps learning from data obtained for every successful jour- ney. The predictive model uncovers patterns, ana- lyzes trends and continuously updates itself to improve its confidence levels in forecasting future scenarios.[6]

Introduction

Safety Critical Systems have a high impact on failure that mostly result in heavy loss of human lives and damage to properties. Most Safety Critical Systems have a high degree of sophisticated technology that involve complex coupling of Digital, Electronic, Electrical, Mechanical processes. Most systems have an element of manual interventions to set the parameters, or to effect manual override. Examples of Safety Critical Systems include Track Management in Railways, Aircraft systems and Air Traffic Management Systems, Nuclear Power plants, Chemical plants, Missile operations, etc.

These Systems carry out critical social, political, and business functions, and hence there is a trade- off between the risks involved and pressing these systems into service. Decisions to build such systems are undertaken based on the maturity of available technology, design and engineering competence, cost, and benefits. Sometimes the decisions themselves are hotly debated by experts based on one or the other criteria. A classic example is the Strategic Defence Initiative of President Regan, which was opposed by leading scientists. David Parnas, a leading computer scientist and a member of the advisory panel of the SDI resigned, ex- plaining why any software required for SDI would not be trustworthy.[7] This stand of his has led to the current practice of including safety as a core design requirement of complex systems with a major software component. However, most of the time, the systems are designed by competent persons and companies, and extensive tests and trials are undertaken before commissioning and certifying them for regular operational use. Due to the risks involved on failure, these systems are designed with redundancies to take care of failures and have fail safe modes of operations. They are extensively tested and put on trial before they are pressed into actual operations.

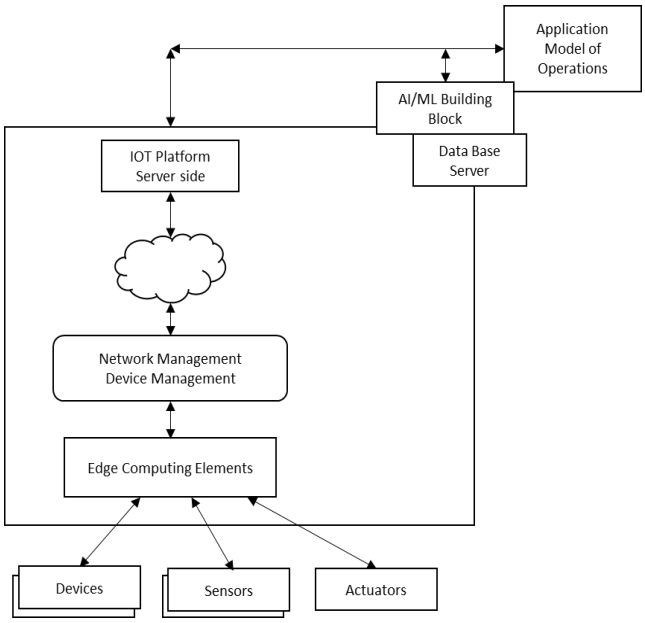
However, we still see many Railway and Aircraft related accidents, nuclear catastrophes like Chernobyl, and chemical accidents like the Bhopal gas incident, resulting in human tragedies of many lost lives. These incidents get into public limelight due to the huge loss of lives while many smaller impact accidents occur and are reported, without much public outcry. This is because it is impossible to test and guarantee safety for complex systems such as these. This paper has a direct bear- ing on the recent triple train accident in Odisha, India on June 4th, 2023, and in fact has been triggered by it.

No amount of Exhaustive testing of any automaton can guarantee that there are no defects. Watts Humphrey asserts from his experience that for a big complex system program of 2 million lines of code, after exhaustive testing, the percentage of all possibilities tested is only around 1%[8]

The way forward would be to understand these limitations and ensure safety by adding another layer of independent supervision that learns from all the scenarios that resulted in successful runs and be watchful of patterns of events and scenarios that could build up to a dangerous situation and raise alarms in time or take positive actions to avert the situation. Such an approach is possible due to the emergence of technologies such as IOT, AI, and ML.

Detailed Architecture of IOT-Based Systems

Typically, the IOT-Based system consists of an IOT platform on a server in the cloud connected through communication networks to edge computing elements on the ground to which various sensors and actuators are connected. The server-side platform supports an Application that embodies a set of business rules, The Application processes the data received, applies the Business Rules and sends back commands, if necessary, to the actuator devices to initiate action. It may further update a data model of the operational elements and their behavior as reflected by the data.[9]



In the above block diagram, the platform consists of the Computing elements on the server side and the edge computing side of the IOT network. The platform also provides micro services to the application. These micro services involve device management where de- vices on the ground irrespective of their form, data protocol, and interface characteristics enable data ex- change sessions between the Application and Devices.

The Application embodies the Business Model of the operational processes and applies it to the data obtained from sensors to monitor in real time the operational status and alerts, and takes or initiatives corrective action. The Business Model itself evolves and learns based on the operational data to arrive at more and more accurate scenario of 'success' operations. The Model thus becomes more adept at detecting deviations, alarming trends, possible failure scenarios based on the real time operational data received.

The Devices is a set of all sensors and actuators, to monitor and control the operational Status on the ground. Depending on the functionality of the IOT system the de- vices and the application are determined and designed.

IOT-based platform for Different Functional Use Cases:

While the above architecture of an IOT-based platform facilitates any functional use to which it can be put to, the differentiation is in the devices deployed and the Application on the Platform.

We consider three different functional cate- gories of Applications that covers almost all the use cases addressed by IOT based systems.

These are :

1. Monitoring and control of single or a small number of processes
2. Orchestrating processes, end to end, in a large- scale Operational set up
3. Super Watch Dog surveillance of the working of Safety Critical Systems

1) Monitoring function.

For this, the devices could be an intrusion detector and an alarm in a simple case. Here the functionality is simple monitoring. If an intruder is detected as per data received, the IOT platform actuates the alarm. It could be doing this for thousands of installations across a region.

The strength of the IOT platform over a simple localized intrusion system is that the Big Data from thousands of Intrusion systems gives insights into the intrusion pattern.

2) Orchestrating end-to-end processes of large scale operations.

In the example of a farm to fork management of veg- etables produce, there are several processes starting from pre harvesting, post harvesting, curing and irra- diation, temporary storage under controlled condition, transportation to wholesale

markets at the right time, sale process, storage at retail outlets, storage at home and consumption. Current legacy processes are inefficient in terms of inter process coordination, communication, and hand over-takeover of responsibilities. Most often they are managed with manual interventions of Managers in charge of a set of operational processes.[3]

The devices in these cases could be smart cameras to monitor the crops, smart storage bins with dynamic control of temperature, humidity, controlled curing and irradiation processes, camera for detecting bad quality produce, smart storage spaces, etc,

The IOT Application has the business rules for appropriate time for harvesting based on camera inputs, post harvesting processes of curing, irradiation, grading and re- moving bad quality items etc based on data from devices such as thermometers, humidity sensors, cameras, and actuators such as temperature and humidity control, irradiators, sorters based on size, etc. The important aspect of such an IOT Application is that it has full control over all upstream and downstream processes based on the data it has collected and can orchestrate the sequence of the processes and take care of their dependencies. Starting from harvesting to post harvest processes to storage and time to market and providing information about the source of the produce to the consumer, the IOT Application ensures efficiency and eliminates redundancy.

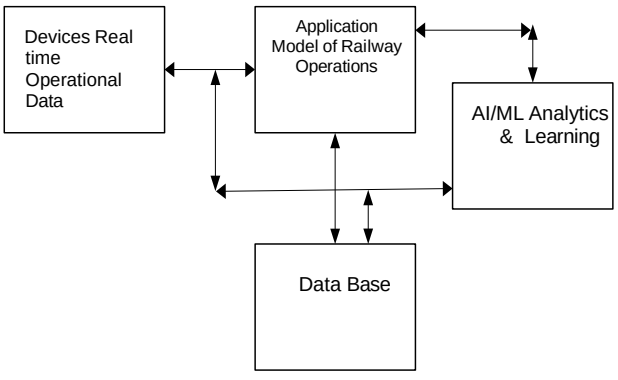
3) Super Watch Dog function for assuring safety in Safety Critical Systems

The concept of Watch Dog was first incorporated in Microprocessors, where, if the program running on it fails for whatever reason and is not able to resurrect itself within a predefined elapsed time, the control automatically passes to the watch dog which re-sets all aspects of the microprocessor to power on status so that it is now in a ready state of execution.[10]

The concept of a 'Supervisor' for Safety Critical Systems was proposed in 2002 by Levenson.[11] She proposed a supervisor layer above the automaton layer , receiving data from sensors in parallel and the ability to control actuators. A Human supervisor can observe the unfolding events and can be warned by the supervisor layer regarding threats on which to act. Our proposed Super Watch Dog is similar in the sense of having a Model of the Process and a Model of the Automation but differs from having a Human Supervisor. Our Super Watch Dog is an AI/ ML-powered supervisor that can in real time handle large amount of Data from the IOT sensors and can learn from the Data to keep enriching the model. Thus, it is important to keep the operational model in step with the evolving nature of operations on the ground. This is possible now after two decades due to the emergence of IOT, AI, and ML.

Taking the Indian Railways operations as an example, the Super Watch Dog IOT system has devices for monitoring the signal status, the Points status, location of trains on main and loop lines, parameter setting on the control circuits, access to the Relay room and other rooms housing the critical equipment, etc. The devices are connected to the platform to the edge computing elements of the plat-form. We take this up in detail here, with the Indian Railways Safety systems as an example, in the light of the recent Odisha Accident. But these are equally applicable to systems such as nuclear plants, (Chernobyl, Fukuyama),[12.13] Chemical plants (Bhopal Gas tragedy)[14]. Flight control systems (Malaysian Airlines)[15] and such alike.

The following block diagram depicts the Watch Dog Model. At the core is the Operations Model which is a Digital twin of actual operations on the ground. The Operational Model is fed with Real Data from the ground about all the relevant devices. The operational Model processes the Data against the Model that provides the paradigm for success. Deviant data and outliers are checked to see if there is a dangerous situation emerging. If so, alarms are raised, if not they either ignored or absorbed in the model as statistical aggregation. The AI/ML module further up- dates the Operational Model with the freshly received data.



Dynamic flow of Building the Success Model

The devices in this platform collect signal status, points status, train presence status on a track section etc periodically and send this data through the edge computing elements to the Application on the platform.

The Signalling Engineering Handbook of Indian Railways[16] suggests that these data are already collected and sent to a "Data Logger' that uses this data for predicting failure of devices. The Data Logger uses this data for predictive maintenance of devices to ensure they are serviced before they fail. This data along with any sensor data that is deemed necessary while building the Success Model can also be communicated to the IOT Server.

In its initialization state, the operational mode embodies the rules of the interlocking system logic, where signal status and points status are interlocked and the train sensor on the section of the rail shows absence of train. As data is received in subsequent time points, it is compared, in real time, with the initial model in or- der to identify outliers. Furthermore, the collected data also serves to train the initial model by introducing variability in the observed parameters for both successful and unsuccessful outcomes. Risk tolerance can be defined on the platform based on the application. Certain degree of deviant observation may only warrant a warning note while, others, farther away from the majority of observations, may require a larger multiple system warning of increased probability of imminent mishap.

Further, success models can be nested in a hierarchical model. For example, each section of the track can have a unique distribution of observations considered normal based on variables unique to that section. Thus, for each section, there can exist a unique success model and together these can form the lower level of the hierarchical success model. The higher layer would receive input from all the lower level success models and use the collective information to generate meaningful alarms for the entire system in advance.

This super watch dog has the status of every train under its supervision, which line it is now running on and to which line it is to be switched and after how much time and what is the current and future status of both lines, if another train is now on the other line, what is the relative status of the two and whether the relevant interlocking systems are set to operate correctly, what is time when the situation has to be critically monitored and alarms raised if there is a risk above a thresh-old or there is enough time for actions such as over-ride, abort, halt a train, change the signal, change the points etc. and if not, a default safety procedure kicks in.

The super watch dog thus has its eye on trains several hundred kilometres apart and monitors a critical moment when there is still time to avoid a disaster, if imminent and until the danger is over, after the trains cross over and go on their respective journeys. It does this for a large number of passenger and goods trains within the area under its 'watch'.

Benefits

1) The Super Watch Dog model will definitely increase the safety levels by several orders of magnitude.
2) Additionally, Super Watch Dog can provide in-sights into several operational parameters, such as a sections and times of peak traffic, the current risk index vs a risk index if a new train is introduced or an existing train speeded up.
3) It can also flag high-risk sections for the operational staff to be more vigilant.
4) If an accident does take place despite every precaution, the audit trail maintained by the super watch dog would be useful in postmortem analysis.
5) The super watch dog can run simulator models for training and evaluate the readiness for an operational staff to be assigned responsibility/
6) Checking out different scenarios for restructuring the timetable or introducing a new train.
7) Also, it can restrict access to signalling equipment, ensuring only authorized persons, perform authorized duties at permitted times.
8) Facilitates an Operational Dashboard depicting at any time all the trains, a time slice of their current locations and future locations and other details at various levels depending on the viewers interest and authorization.

Comparing the Super Watch Dog System with Kavach – The Indian Train Protection System[17]

The Kavach System broadly has three components.

1) RFID tags between the running rails,
2) Onboard locomotives Systems consisting of RFID readers, computer, brake interface equipment, UHF and GSM communication elements
3) Radio communications infrastructure such as towers and modems.

The Locomotives know their exact position while passing over the RFID tags installed between the rails. The Locomotive communicates periodically over GSM and Radio frequency its current known position. The Communication infrastructure facilitates the Communication.

The on-board computer receives the information trans- mitted by the other train, updates its details in its data- base regarding the location and the line on which the other train is running and verifies whether there is possibility of a collision and if the possibility exists it automatically applies the brake through the Brake interface equipment.

The project that was started in 2012 was titled “Train Collision Avoidance System “after studying and evaluating “The European Train Control System” and completed in 2022 after being renamed Kavach.[18]

Kavach has been certified for compliance with safety integrity level 4 (SIL-4) operations.[19] Kavach has been promoted as being the cheapest ATP system available in the world, costing roughly 50 lakh (five million) rupees per kilometer to operate compared to about two crore (20 million) rupees worldwide. The schedule is to implement 34000 km of the tracks and in all locomotives by 2027-28.[20]

Implementation of Kavach is a long drawn-out process over 34,000 km of rail. It has been declared that a target of 10,000 km per year has been set after the rail accident. This is so as a lot of implementation needs to be done all along the rails – installing RFID tags, and communication infra of GSM and RF towers. Implementing the onboard locomotive equipment will not contribute greatly to the timeline.

Kavach is a layer of protection between two trains at a local level. The important aspect of it is that trains within a local area can know each other’s position and can initiate automatic braking action if the situational analysis shows a possibility of collision. Even at Rs. 50 lakh per km, in comparison to systems around the world costing 4 times more, the implementation involves huge cost and effort. It should be remembered that the design work of Kavach has started in 2012 or earlier when the emerging technologies of IOT, AI, and ML were still very nascent.

The Super Watch Dog Model is a wide-area surveillance system covering several trains converging and diverging at various locations of interest. The situational analytics based on large volume of data is at a different level. The application of AI, ML techniques is far superior and comprehensive.

The communication infrastructure with the emergence of 5G and Lorawan and Railtel being available across 21000 plus kilometres can be leveraged to bring down the cost and effort of implementation by orders of magnitude. The location of the trains can be accurately determined by the locomotives themselves through GPS or more importantly NAVIC, the Indian GNSS system. The time-consuming installation of RFID tags on the rails can be obviated. With satellite communication systems, dependence on the availability of wireless networks can be brought down. Again, Indian Satellite can be used for Satcomm.

A pilot system can be tried out in 6 months to 1 year and the implementation across Indian Railways could be implemented in two to three years thereafter.

Conclusion

The IOT-based Super Watch Dog system for implementing safety levels of near zero risk for Railway operations will be first of its kind in the world and can serve India for several years to come, with its inherent self-learning model.

Acknowledgement

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CLOUD COMPUTING AND ITS APPLICATIONS

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ABSTRACT

Cloud Computing has come of age later Amazons introduce the first of its kind of cloud services in2006. It is particularly suitable to Hong Kong because of the unbelievable amounts of the data that are being processed here daily in several sectors, and there are signs that subscription to cloud services by the local companies will soon be on a skyrocket course, despite a slow start in beginning years. As a research theme, cloud computing now easily tops any schedule of topics in a computer science because of its far-reaching suggestion in many sector in computing, especially a big data which without cloud computing is at the great concept. Cloud computing, the life time dream of computing as a utility, has the capacity to convert a huge part of the IT industry, making software even more attractive as a service and shaping the way IT hardware is designed and purchased. Developers with new invention ideas for new Internet services no longer require the huge capital outlays in hardware to deploy their service or the human expense to operate it. They need not be worried about overprovisioning for a service whose popularity does not meet their predictions, thus wasting costly resources, or under provisioning for one that becomes wildly popular, thus missing potential customers and revenue. Without paying a premium for large scale, is unprecedented in the history of IT, by this elasticity of resources.

Keyword: Cloud,Cost,IT

1. INTRODUCTION TO CLOUD COMPUTING

Cloud computing is a revolutionary paradigm in the world of information technology that has transformed the way businesses and individuals access and utilize computing resources. Instead of relying solely on local hardware and software, cloud computing enables the delivery of various services over the internet. These services include storage, processing power, applications, and more, allowing users to access and manage data and applications remotely, on-demand, and at scale.

ADVANTAGES OF CLOUD COMPUTING

Cost: It reduces the huge capital costs of buying hardware and software.

Speed: Resources can be accessed in minutes, typically within a few clicks.

Scalability: We can increase or decrease the requirement of resources according to the business requirements.

Productivity: While using cloud computing, we put less operational effort. We do not need to apply patching, as well as no need to maintain hardware and software. So, in this way, the IT team can be more productive and focus on achieving business goals.

Reliability: Backup and recovery of data are less expensive and very fast for business continuity.

Security: Many cloud vendors offer a broad set of policies, technologies, and controls that strengthen our data security.

2. TYPES OF CLOUD COMPUTING

Public Cloud: The cloud resources that are owned and operated by a third-party cloud service provider are termed as public clouds. It delivers computing resources such as servers, software, and storage over the internet

Private Cloud: The cloud computing resources that are exclusively used inside a single business or organization are termed as a private cloud. A private cloud may physically be located on the company's on-site datacentre or hosted by a third-party service provider.

Hybrid Cloud: It is the combination of public and private clouds, which is bounded together by technology that allows data applications to be shared between them. Hybrid cloud provides flexibility and more deployment options to the business.

3. TYPES OF CLOUD SERVICES

Infrastructure as a Service (IaaS):

In IaaS, we can rent IT infrastructures like servers and virtual machines (VMs), storage, networks, operating systems from a cloud service vendor. We can create VM running Windows or Linux and install anything we want on it. Using IaaS, we don't need to care about the hardware or virtualization software, but other than that, we do have to manage everything else. Using IaaS, we get maximum flexibility, but still, we need to put more effort into maintenance.

Platform as a Service (PaaS):

This service provides an on-demand environment for developing, testing, delivering, and managing software applications. The developer is responsible for the application, and the PaaS vendor provides the ability to deploy and run it. Using PaaS, the flexibility gets reduce, but the management of the environment is taken care of by the cloud vendors.

Software as a Service (SaaS):

It provides a centrally hosted and managed software services to the end-users. It delivers software over the internet, on-demand, and typically on a subscription basis. E.g., Microsoft One Drive, Dropbox, WordPress, Office 365, and Amazon Kindle. SaaS is used to minimize the operational cost to the maximum extent.

CHARACTERISTICS OF CLOUD COMPUTING

There are many characteristics of Cloud Computing here are few of them :

On-demand self-services: The Cloud computing services does not require any human administrators, user themselves are able to provision, monitor and manage computing resources as needed.

Broad network access: The Computing services are generally provided over standard networks and heterogeneous devices.

Multi-tenancy: Cloud computing providers can support multiple tenants (users or organizations) on a single set of shared resources.

Virtualization: Cloud computing providers use virtualization technology to abstract underlying hardware resources and present them as logical resources to users.

Flexible pricing models: Cloud providers offer a variety of pricing models, including payper-use, subscription-based, and spot pricing, allowing users to choose the option that best suits their needs.

Security: Cloud providers invest heavily in security measures to protect their users' data and ensure the privacy of sensitive information.

Automation: Cloud computing services are often highly automated, allowing users to deploy and manage resources with minimal manual intervention.

4. DISADVANTAGE OF CLOUD COMPUTING

Downtime

Businesses receive cloud computing services only through the Internet. When there is an internet outage or weak connectivity, services get interrupted and this increases downtime. Therefore, one of the major criticisms of cloud computing is its high dependency on the Internet.

Security and Privacy

Data security and privacy threats are other disadvantages of cloud computing. According to a survey, nearly 98% of companies using cloud computing services experienced at least one data breach from 2020 to 2022.Hackers can also control how companies provide services to their customers or end-users. This leads to a loss of business opportunities and a decrease in revenue.

Vulnerability to Attacks

Private clouds are considered the most secure for businesses in terms of data security. However, the cost of setting up private clouds is higher in comparison to public, hybrid, and multiclouds.

Therefore, many businesses prefer public, hybrid, and multi-cloud computing services.

Limited Control and Flexibility

In public, hybrid, and community clouds, all cloud computing services are completely managed by cloud service providers. This offers limited control and flexibility to customers, restricting their access to various services and applications. Therefore, many companies enter into a separate enduser license agreements to gain control of the cloud's services and applications.

Vendor Lock-in

Vendor lock-in refers to a situation where companies using cloud computing services of a particular vendor are unable to switch to a different vendor. In case of vendor lockin, companies are forced to receive services from a particular vendor. This affects their operational workflow and efficiency.

Cost Concerns

Costs are both a significant advantage and disadvantage of cloud computing. While it helps small businesses avail quality services without investing large amounts to set up IT infrastructure, it can also increase expenditure for companies as there are several hidden costs involved which emerge at a later stage. These include data transfer, cloud utilization, and data migration costs.

5. APPLICATION OF CLOUD COMPUTING

Internet of Things (IoT): Cloud computing plays a crucial role in the IoT ecosystem by managing and processing vast amounts of data generated by connected devices, enabling real-time analytics and decision-making.

Big Data and Analytics: Cloud computing provides the computational power and storage required for processing and analyzing large datasets, making it an ideal platform for big data analytics.

Artificial Intelligence and Machine Learning: Cloud-based AI and ML services allow developers and data scientists to access powerful algorithms, frameworks, and computing resources for building and training models without the need for high-end hardware.

E-commerce: Cloud-based e-commerce platforms offer scalability and flexibility to handle peak loads during sales events while optimizing costs during slower period.

Healthcare: Cloud computing facilitates secure storage and sharing of patient data among healthcare providers, enabling better collaboration and improving patient care.

6. CONCLUSION

Cloud computing makes it very easy for companies to provide their products to end-user without worrying about hardware configurations and other requirements of servers. Cloud computing has revolutionized the way businesses and individuals access and manage their computing resources. Its transformative impact has been felt across various industries, and it continues to shape the future of technology.

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IMAGE PROCESSING A OVERVIEW

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Abstract
Image Processing includes changing the nature of an image in order to improve its pictorial information for human interpretation, for autonomous machine perception. Digital image processing is a subset of the electronic domain wherein the image is converted to an array of small integers, called pixels, representing a physical quantity such as scene radiance, stored in a digital memory, and processed by computer or other digital hardware. Interest in digital image processing methods stems from two principals applications areas: improvement of pictorial information for human interpretation; and processing of image data for storage, transmission, and representation for autonomous machine perception. Edges characterize boundaries and edge detection is one of the most difficult tasks in image processing hence it is a problem of fundamental importance in image processing. In this paper investigates different steps of digital image processing like, a high-speed non-linear Adaptive median filter implementation is presented. Then Adaptive Median Filter solves the dual purpose of removing the impulse noise from the image and reducing distortion in the image. The Image Processing Toolbox software is a collection of functions that extend the capability of the MATLAB numeric computing environment. The toolbox supports a wide range of image processing operations on the given image.

Keyword: Image,Matlab

INTRODUCTION

Image processing is a way to convert an image to a digital aspect and perform certain functions on it, in order to get an enhanced image or extract other useful information from it. It is a type of signal time when the input is an image, such as a video frame or image and output can be an image or features associated with that image. Usually, the AWS Image Processing system includes treating images as two equal symbols while using the set methods used. It is one of the fastest growing technologies today, with its use in various business sectors. Graphic Design forms the core of the research space within the engineering and computer science industry as well.

WHAT IS AN IMAGE?

Before we jump into image processing, we need to first understand what exactly constitutes an image. An image is represented by its dimensions (height and width) based on the number of pixels. For example, if the dimensions of an image are 500 x 400 (width x height), the total number of pixels in the image is 200000.

This pixel is a point on the image that takes on a specific shade, opacity or color. It is usually represented in one of the following:

- Grayscale – A pixel is an integer with a value between 0 to 255 (0 is completely black and 255 is completely white).
- RGB – A pixel is made up of 3 integers between 0 to 255 (the integers represent the intensity of red, green, and blue).

RGBA – It is an extension of RGB with an added alpha field, which represents the opacity of the image.

WHAT IS AN IMAGE PROCESSING?

Image processing is the process of transforming an image into a digital form and performing certain operations to get some useful information from it. The image processing system usually treats all images as 2D signals when applying certain predetermined signal processing methods.

TYPES OF IMAGE PROCESSING

There are five main types of image processing:

- Visualization – Find objects that are not visible in the image
- Recognition – Distinguish or detect objects in the image
- Sharpening and restoration – Create an enhanced image from the original image
- Pattern recognition – Measure the various patterns around the objects in the image
- Retrieval – Browse and search images from a large database of digital images that are similar to the original image

COMPONENTS OF IMAGE PROCESSING

Computer

A general-purpose computer, which may be anything from a PC to a supercomputer, is used in an image processing system. Sometimes, specifically built computers are utilized in specialized applications to reach a specified degree of performance.

Hardware for Specialized Image Processing

It comprises the digitizer and hardware that can carry out basic operations, including an Arithmetic Logic Unit (ALU), which can carry out simultaneous arithmetic and logical operations on whole pictures.

Massive Storing

In applications involving image processing, the skill is essential. The three main types of digital storage for image processing applications are as follows: Three types of storage exist (1) short-term storage, (2) online storage for quick recall (3) archive storage, which is characterized by rare access.

Sensors

It alludes to perception. The image sensor's primary function is to collect incoming light, transform it into an electrical signal, measure that signal, and then output it to supporting electronics. It consists of a two-dimensional array of light-sensitive components that convert photons into electrons. Images are captured by equipment like digital cameras using image sensors like CCD and CMOS. Two components are often needed on image sensors to collect digital pictures. The first is an actual tool (sensor) that can detect the energy emitted by the object we want to turn into an image. The second is a digitizer, which transforms a physical sensing device's output into digital form.

Image Display

The pictures are shown.

Software

The image processing software comprises specialized modules that carry out particular functions.

Hardcopy Equipment

Laser printers, film cameras, heat-sensitive equipment, inkjet printers, and digital equipment like optical and CDROM discs are just a few examples of the instruments used to record pictures.

Networking

To send visual data through a networked computer, it is a necessary component. The most important factor in picture transmission is bandwidth since image-processing applications require vast amounts of data.

FUNDAMENTALS OF IMAGE PROCESSING

Image Acquisition

Image acquisition is the first step in image processing. This step is also known as preprocessing in image processing. It involves retrieving the image from a source, usually a hardware-based source.

Image Enhancement

Image enhancement is the process of bringing out and highlighting certain features of interest in an image that has been obscured. This can involve changing the brightness, contrast, etc.

Image Restoration

Image restoration is the process of improving the appearance of an image. However, unlike image enhancement, image restoration is done using certain mathematical or probabilistic models.

Color Image Processing

Color image processing includes a number of color modeling techniques in a digital domain. This step has gained prominence due to the significant use of digital images over the internet.

Wavelets and Multiresolution Processing

Wavelets are used to represent images in various degrees of resolution. The images are subdivided into wavelets or smaller regions for data compression and for pyramidal representation.

Compression

Compression is a process used to reduce the storage required to save an image or the bandwidth required to transmit it. This is done particularly when the image is for use on the Internet.

Morphological Processing

Morphological processing is a set of processing operations for morphing images based on their shapes.

Segmentation

Segmentation is one of the most difficult steps of image processing. It involves partitioning an image into its constituent parts or objects.

Representation and Description

After an image is segmented into regions in the segmentation process, each region is represented and described in a form suitable for further computer processing. Representation deals with the image's characteristics and regional properties. Description deals with extracting quantitative information that helps differentiate one class of objects from the other.

Recognition

Recognition assigns a label to an object based on its description.

CONCLUSION

You have seen a few of the features of a good introductory image processing program. There are many more complex modifications you can make to the images. For example, you can apply a variety of filters to the image. The filters use mathematical algorithms to modify the image. Some filters are easy to use, while others require a great deal of technical knowledge. The software also will calculate the ra, dec, and magnitude of all objects in the field if you have a star catalog such as the Hubble Guide Star Catalog (although this feature requires the purchase of an additional CD-ROM).

The standard tricolor Images produced by the SDSS are very good images. If you are looking for something specific, you can frequently make a picture that brings out other details. The "best" picture is a very relative term. A picture that is processed to show faint asteroids may be useless to study the bright core of a galaxy in the same field.

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MOBILE COMPUTING AND APPLICATIONS

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Abstract
Mobile Computing defines that a device which permits the flow of transmission of data from one computer to another by never been connected to the Physical link layers. Mobile voice communications which is in demands all over the world is having a great increment of the user subscribers to many networks protocols from last two to three years. This concept is normally called as the Principle of the mobile computing. This has become very interesting in the growth of the technology which allows the users to transmit the information details of data. The protection attributes of the mobile computing are User Authentication which corrects the identity of the user which has been subscribed to this service. User anonymity which is the international mobile subscriber identity abbreviated as the IMSI which is normally used to the networks to properly use for the identification for the user subscribers. Fraud Prevention is for the prevention of hackers who attack the sites. Protection of user data prevents the data of user which is used to protect the saved information of the end users. Applications related to this device are for the Estate agents to work on home as well as on the construction sites too. Emergency time to inform the others about the emergency condition that has taken place. In justice courts to take a proper straight decisions against the criminals. In industries for the directors to work on computers using a mobile system. Stock related issues for new latest updates of the shares going on. Card verification to verify the card in banks and other placestoo. These increments in the virtual technology, circuits and system speed the mobile computing in the future will be at the developed stage from today. The demand for the mobile computations will be on large scale in the coming future days and these devices will generate a bright flash in future.

Keyword : Mobile,Iphone,Network

INTRODUCTION TO MOBILE COMPUTING

A lot of significance and demands a lot of reflection today, but just two decades ago, this question didn't exist. These dramatic lifestyle changes that occurred over the years are due to advancements in a field called mobile computing. Creating portable devices that allowed network communication changed the world in quite a big way. Today, smartphones are ubiquitous, every other house has an Alexa, and laptops are getting thinner and lighter by the day without compromising on processing power. Personal computers are losing their popularity as the limitations of mobile computing are slowly becoming overcome. So from the early days of chunky laptops to the paper-thin screens of the present and future, mobile computing is an evolving field of great relevance.

WHAT IS MOBILE COMPUTING?

Mobile Computing is a technology that allows us to transmit data, audio, and video via devices that are not connected with any physical link. The key features of mobile computing are that the computing devices are portable and connected over a network. Mobile computing began with the first laptops developed in 1980, and from there, rapidly grew in capability with the 640*640 portable laptops from Apple in 1990, the development of the first PDA in 1993, the first smartphone from IBM released in 1994, network connectivity enabled smartphones in 2000, the first iPhone released in 2007, and the first android smartphone in 2009.Today there is great variety among mobile computing devices, and their capabilities are increasing with each new model released. The major elements of mobile computing are mobile communication, mobile hardware, and mobilesoftware.

- Mobile Communication: This refers to the communication infrastructure
- Wireless network infrastructure, protocols, data formats, bandwidths, and portals necessary to ensure seamless connectivity and communication.
- Mobile Hardware: The hardware is the mobile computing devices and sup
- Capabilities required to perform their required operations and connect to networks.
- Mobile Software: The most important software component is the operations of any computing system.

CHARACTERISTICS OF MOBILE COMPUTING

1. Portability – The Ability to move a device within a learning environment or to different environments with ease.
2. Social Interactivity – The ability to share data and collaboration between users.
3. Context Sensitivity – The ability to gather and respond to real or simulated data unique to a current location, environment, or time.
4. Connectivity – The ability to be digitally connected for the purpose of communication of data in any environment.
5. Individual – The ability to use the technology to provide scaffolding on difficult activities and lesson customization for individual learners.
6. Small Size – Mobile devices are also known as handhelds, palmtops and smart phones due to their roughly phone-like dimensions. A typical mobile device will fit in the average adult's hand or pocket. Some mobile devices may fold or slide from a compact, portable mode to a slightly larger size, revealing built-in keyboards or larger screens. Mobile devices make use of touch screens and small keypads to receive input, maintaining their small size and independence from external interface devices. The standard form of a mobile device allows the user to operate it with one hand, holding the device in the palm or fingers while executing its functions with the thumb. Netbooks and small tablet computers are sometimes mistaken for true mobile devices, based on their similarity in form and function, but if the device's size prohibits one-handed operation or hinders portability, then it cannot be considered a true mobile device.
7. Wireless Communication – Mobile devices are typically capable of communication with other similar devices, with stationary computers and systems, with networks and portable phones. Base mobile devices are capable of accessing the Internet through Bluetooth or Wi-Fi networks, and many models are equipped to access cell phone and wireless data networks as well. Email and texting are standard ways of communicating with mobile devices, although many are also capable of telephony, and some specialized mobile devices, such as RFID and barcode.

MOBILE COMPUTING APPLICATIONS

There are different types of real life applications which are used in the Mobile computing, such as:

•Traffic: During traveling in traffic if we require to know road situation, latest news and when if feel more stress in driving then can play music and other important broadcast
data are received through digital audio broadcasting(DAB). If we forget the road then we can know our exact location with the help of global positioning system(GPS).In case if
got accident then can to inform police and ambulance via an emergency call to the service provider, which help to improve organization and save time & money.

•Use in Business: As per business point of view CEO help of this computing system can represent the presentation at the front of their clients while can access hot news of the market. Help of video conference could be discuss at the topic without hindrance any time. Another side if traveling salesman wants to access the company database as per requirement then can be retrieved data on his wireless device and maintain the consistency company's database. Cause of these every employee are updated up to date.

•Credit Card Verification: Credit card verification using this computing most secure. In respect of Sale terminals(POS) when customer buy items in malls and other small shops when and pay bill in the form of swap credit card for transactions then need to establish network in between POS terminal and bank central computer then over protected cellular network verify the credential information of card fastly, if match it then proceed further otherwise denied get boost up speed of transaction process and relieve the burden at the POS network.

• Tour and Travel: Today, truism is making a largest industry in pan world. Most of tourist spots are at remote location from the developed areas. Therefore with using of wireless communication, you can easily to connect for people who are joying their tour. They are easily to make connect along with family and relatives and finding out for travel service, hotel services food services and more.
•Transaction: Few mobile applications let the facility of transaction like as pay bills, recharge mobile and so on.

MOBILE COMPUTING DEVICES

Usually, a mobile computing device would have a body- made of metal or plastic, a RAM, a CPU, a hard drive, a motherboard, a keyboard and a mouse- which could be separate components in the body or touch-based, a screen, a video card, an operating system, software applications, and finally, a network connection. This is around the same as the components of a personal computer, which isn't a mobile device. But mobile devices may have other components too, to make them portable, and certain characteristics that make them different-
•Size: The portability of mobile devices demand a smaller size. Reduction in size without reducing capabilities have also always been a challenge when developing mobile devices.
•Power Source: Mobile devices are usually powered by rechargeable batteries. Improving the battery life of mobile devices is another significant area of research.
•Operating System: Laptops run on more or less the same OS as PCs, but for smartphones and other devices, the OS is significantly different. They are powerful but scaled-down and made specifically for particular devices.
•Connectivity: Mobile computing devices have capabilities that allow access to the internet. Also, mobile devices like smartphones have access to mobile broadband networks that allow you to make and receive phone calls.
•Applications: Applications meant for mobile devices are specifically designed for running on a particular OS. These applications are what extends the capabilities of devices beyond just connecting to the internet or making calls.
Other features generally found in mobile computing devices include GPS capability, accelerometer, compass, microphone, camera, and so on.

Mobile computing devices have evolved greatly over time. A lot of the devices that existed in the past have been phased out, like the Personal Digital Assistant (PDA). We live now in the age of the smartphone, but there are several other categories of mobile computing devices –
•Laptop: Laptop computers are portable personal computers. It is meant to offer the same functionality as a PC, so the same OS, applications, and files can run on this.
•Smartphone: A smartphone is a mobile phone with powerful capabilities. They typically have a touchscreen interface, have internet access, can run various applications, and include features like a camera and GPS.
•Tablet computer: Tablets have touchscreens and virtual keyboards, and are often thought of as an intermediary between a laptop and a smartphone. They have better processing power, functionality, and screen resolution than smartphones. Some models may also have a stylus meant for navigating the touch screen better.
•Wearable: A more recent addition, wearable computers like smartwatches offer limited features similar to a smartphone within a watch.
•E-reader: E-readers are devices that are similar to tablets, but their main purpose is to read digital documents.
Other devices include scanners, carputers, handheld gaming consoles, advanced digital cameras, smart speakers, and so on.

MOBILE COMPUTING SERVICES

Software as a service is best platform with the help of rendering the many utilities and applications on the internet world in the form of services. Cloud Computing help to optimize your resources and scale up while control your cost. Suggest the best mobile hardware and software for your using utilities and applications. In arbitrary wireless network service help to connect freely network, and with the help of this concept, you can access data anywhere without time and place limitation. Mobile terminal phases are Provide the current and appropriate O/S and other software. Examine the loading time of particular software Setup the wireless networks such as WAN and LAN.

TYPES OF MOBILE COMPUTING

There are two types of mobile computing, such as: Portable Computing, Mobility Computing, Future of Mobile Computing. The enhancement in Artificial Intelligence, increasing the speed to computing terminals So the future of Mobile computing is more brightness. Increasing the technology in portability and light weighted devices, so as per this statement mobile computing devices are improving in portability and small in size.

CONCLUSION

Today mobile computing is ever changing, and it has involved drastically over years and will keep continue to evolve as we go into the future. Therefore, through this article we have been revealed all possible stuffs about what is mobile computing and its applications, history, future, characteristics, features, services, types of mobile computing devices, security and architecture and structure.

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ARTIFICIAL INTELLIGENCE AND ITS APPLICATION

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Abstract

Artificial intelligence (AI) refers to what information about the language structure being transmitted to the machine: It should result in a more intuitive and faster solution, based on a learning algorithm that repeats patterns in new data.

Keyword : AI, Human, pattern

INTRODUCTION

Artificial Intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think and act like humans. It involves the development of algorithms and computer programs that can perform tasks that typically require human intelligence such as visual perception, speech recognition, decision-making, and language translation. AI has the potential to revolutionize many industries and has a wide range of applications, from virtual personal assistants to self-driving cars.

History of Artificial Intelligence

Artificial Intelligence was first proposed by John McCarthy in 1956 in his first academic conference on the subject. The idea of machines operating like human beings began to be the center of scientist's mind and whether if it is possible to make machines have the same ability to think and learn by itself was introduced by the mathematician Alan Turing. Alan Turing was able to put his hypotheses and questions into actions by testing whether "machines can think"? After series of testing (later was called as Turing Test) it turns out that it is possible to enable machines to think and learn just like humans. Turing Test uses the pragmatic approach to be able to identify if machines can respond as humans. ("Smith", (n.d.)).

Description Artificial Intelligence

Artificial Intelligence is: the field of study that describes the capability of machine learning just like humans and the ability to respond to certain behaviors also known as (A.I.). The need of Artificial Intelligence is increasing every day. Since AI was first introduced to the market, it has been the reason for the quick change in technology and business fields. Computer scientist are predicting that by 2020, "85% of customer interactions will be managed without a human". ("Gartner", (n.d.)). This means that humans simple request will depend on computers and artificial intelligence just like when we use Siri or Galaxy to ask about the weather temperature. It is very important to be prepared for AI revelation just like UAE have by installing a state minister for AI in Dubai.

Pros and Cons of Artificial Intelligence

AI offers reliability, cost- effectiveness, solve complicated problems, and make decisions; in addition, AI restricts data from getting lost. AI is applied nowadays in most fields whether business or engineering. One of the great tools in AI is called "reinforcement learning" which is based on testing success and failure in real life to increase the reliability of applications. Unfortunately, AI is limited with its capability and functionality. ("Sadek", (n.d.)) Although Artificial Intelligence made our lives much easier and saved us more time than Scientists are predicting that by the huge dependency on AI humanity could extinct.

Scientists argue that by having a AI machines, people will be jobless and that will conclude in losing the sense of living. Since machines are learning and doing things more efficiently and effectively in a timely manner, this could be the reason for our extinction.

AI Algorithms and Models

AI is mainly based on algorithms and models as a technique which is designed based on scientific findings such as math, statists, and biology (Li& Jiang, (n.d.)). AI works based on several models such as: Ant Colony Algorithm, Immune Algorithm, Fuzzy Algorithm, Decision Tree, Genetic Algorithm, Particle Swarm Algorithm, Neural Network, Deep Learning and in this report, I will discuss some of the most known models which are: Support Vector Machine, and the Artificial Neural Network.

Support Vector Machine (SVM) where it is used to build a classification model by finding an optimal hyperplane based on a set of training examples as shown in (figure A-1). It is also have been used for pattern classification and trend prediction lots of applications for instance: power transformer fault diagnosis, disease diagnosis and treatment optimization. (Li& Jiang, (n.d.)).

Figure A-1 Describes how SVM algorithm being represented in AI

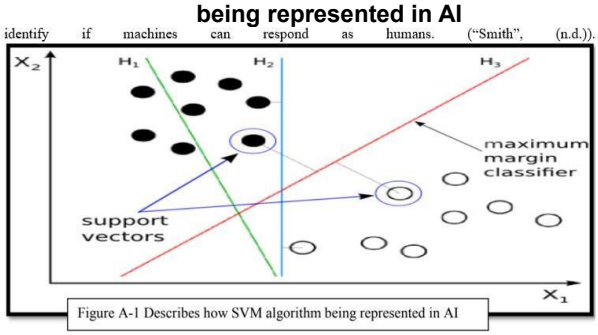
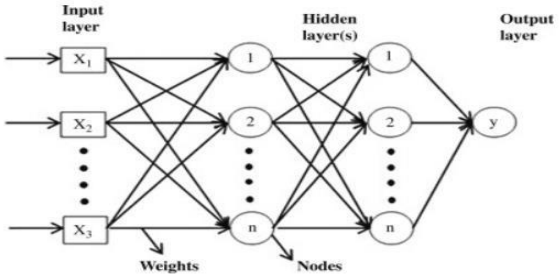


Figure A-1 Describes how SVM algorithm being represented in AI

Artificial Neural Network (ANN) is a representative model of understanding thoughts and behaviors in terms of physical connection between neurons. ANN has been used to solve variety of problems through enabling the machine to build mathematical models to be able to imitate natural activities from brains perspective as shown in (figure A- 2). By using this algorithm, the machine will be able to identify the solution of any problem just like a human's brain.

- Voice recognition
- Virtual agents
- Machine learning platform
- AI optimized hardware
- Decision management
- Deep learning platform
- Biomatters
- Robotic process automation
- Text analytics and NLP

Figure A-2 Describes how ANN algorithm being represented in AI



Some Applications on Artificial Intelligence

AI can be designed using lots of algorithms. These algorithms help the system to determine the expected response which will basically tell the computer what to expect and work accordingly. Here are some of the greatest AI applications that we are probably using in our daily life without knowing:

AI Design Models

AI application are a lot around us and in this paper, will discuss some of the most common application of AI that we always use nowadays which is Virtual Assistants such as Siri, Cortana...etc. Over the past few years smart assistants are becoming a very common technology in most of the smart devices and most importantly, that these assistants are getting smarter than ever. In addition to the awesome help, they provide us with, is that every one of these apps has unique features. Artificial Intelligence works according to the following phases: getting the data, clean/manipulate/ prepare the data, train model, test data, and improve the data as mentioned in (Figure A-3). Before accessing the data, a business must verify the quality of the data to ensure that it meets the requirement.

Figure A- 3 Describes Phases of Developing Artificial Intelligence

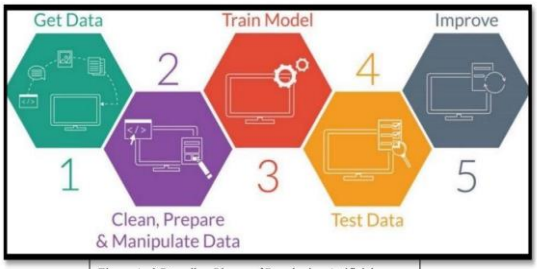


Figure A- 3 Describes Phases of Developing Artificial

Adaptive Manufacturing

Machines that are "able to learn a multitude of tasks from demonstrations, just like their human counterparts can." ("Yoa",2017))

Siri Virtual Assistant

Siri is the well-known virtual assistant which uses voice recognitions and typed command in order to perform a certain task within a device. Siri is considered one of AI most used applications. The application simply takes the input from the user such as (e.g., Call dad) and try to find the most related keywords used in this command. Siri tries to eliminate inconsistent result through using the language pattern recognizer and from there to active ontology by searching through the contacts, then it tries to relate the contact named "Dad" and perform the task which is in this case is "Calling" and finally the output of this action will be "calling dad" and to consider all the possible situations referred to (figure A-4).

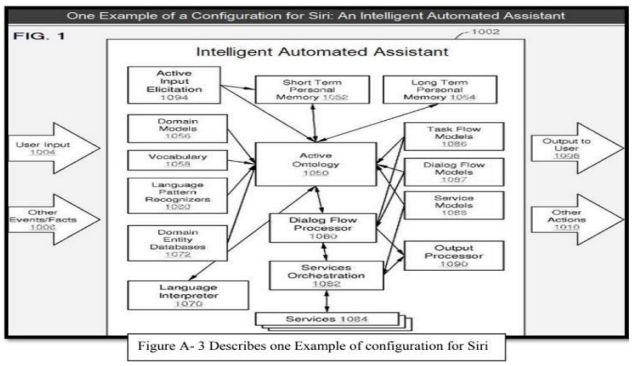


Figure A- 3 Describes one Example of configuration for Siri

In another scenario the architecture of the virtual assistant is shown in (figure A – 5) as we can see the flow of the system starts by taking the input from the user, after that the system decide the conversation strategy module to be used which is a respond from the dialog management module, meanwhile a classification module response to an NLP module. Finally, using the conversation history database is used to analyze the knowledge base construction module which will response back to the domain knowledge based as explained in detail in (figure A- 5)

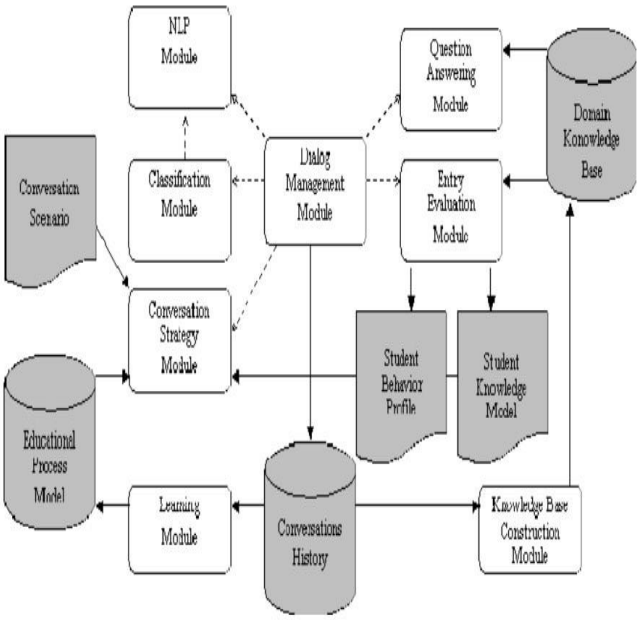


Figure A-5 Describes Proposed conversational agent architecture

Conclusion

AI nowadays is being implemented in almost every field of study through several models such as SVM and ANN. We should be able to proceed with knowing and understanding the consequences of every technological trend. In my opinion, we are in the AI revolution era and therefore; we should adopt into this change and welcome it too by embracing AI and moving toward a better society.

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STUDY OF ARTIFICIAL INTELLIGENCE

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Abstract

As the hype around AI has accelerated, vendors have been scrambling to promote how their products and services use AI. Often what they refer to as AI is simply one component of AI, such as machine learning. AI requires a foundation of specialized hardware and software for writing and training machine learning algorithms. No one programming language is synonymous with AI, but a few, including Python, R and Java, are popular. In general, AI systems work by ingesting large amounts of labeled training data, analyzing the data for correlations and patterns, and using these patterns to make predictions about future states. In this way, a chatbot that is fed examples of text chats can learn to produce lifelike exchanges with people, or an image recognition tool can learn to identify and describe objects in images by reviewing millions of examples. AI programming focuses on three cognitive skills: learning, reasoning and self-correction.

Keyword : AI, Network, Skills

1. INTRODUCTION

Artificial intelligence (AI) is the ability of machines to replicate or enhance human intellect, such as reasoning and learning from experience. Artificial intelligence has been used in computer programs for years, but it is now applied to many other products and services. For example, some digital cameras can determine what objects are present in an image using artificial intelligence software. In addition, experts predict many more innovative uses for artificial intelligence in the future, including smart electric grids.

AI uses techniques from probability theory, economics, and algorithm design to solve practical problems. In addition, the AI field draws upon computer science, mathematics, psychology, and linguistics. Computer science provides tools for designing and building algorithms, while mathematics offers tools for modeling and solving the resulting optimization problems. Although the concept of AI has been around since the 19th century, when Alan Turing first proposed an “imitation game” to assess machine intelligence, it only became feasible to achieve in recent decades due to the increased availability of computing power and data to train AI systems.

KEY TAKE AWAYS

- Pattern Recognition
- Problem Solving
- Automation
- Neural
- Network
- Automation
- Algorithm

2. MOST IMPORTANT APPLICATIONS

These are some of the most important ways digital forensics can be used and applied:

Healthcare

One of the foremost deep-lying impacts which AI has created is within the Healthcare space. A device, as common as a Fitbit or an iWatch, collects a lot of data like the sleep patterns of the individual, the calories burnt by him, heart rate and a lot more which can help with early detection, personalization, even disease diagnosis. This device, when powered with AI can easily monitor and notify abnormal trends. This can even schedule a visit to the closest Doctor by itself and therefore, it’s also of great help to the doctors who can get help in making decisions and research with AI. It has been used to predict ICU transfers, improve clinical workflows and even pinpoint a patient’s risk of hospital-acquired infections.

Automobile

At this stage where automobiles changing from an engine with a chassis around it to a software-controlled intelligent machine, the role of AI cannot be underestimated. The goal of self-driving cars, during which Autopilot by Tesla has been the frontrunner, takes up data from all the Tesla’s running on the road and uses it in machine learning algorithms. The assessment of both chips is later matched by the system and followed if the input from both is the same. AI are often witnesses working its magic through robots

producing the initial nuts and bolts of a vehicle or in an autonomous car using machine learning and vision to securely make its way through traffic.

Banking and Finance

One of the early adopter of Artificial Intelligence is the Banking and Finance Industry. From Chatbots offered by banks, for instance , SIA by depository financial institution of India, to intelligent robo-traders by Aidya and Nomura Securities for autonomous, high-frequency trading, the uses are innumerable. Features like AI bots, digital payment advisers and biometric fraud detection mechanisms cause higher quality of services to a wider customer base.

The adoption of AI in banking is constant to rework companies within the industry, provide greater levels useful and more personalized experiences to their customers, reduce risks as well as increase opportunities involving financial engines of our modern economy.

Surveillance

AI has made it possible to develop face recognition Tools which may be used for surveillance and security purposes. As a result, this empowers the systems to monitor the footage in real-time and can be a path breaking development in regards to public safety.

Manual monitoring of a CCTV camera requires constant human intervention so they're prone to errors and fatigue. AI-based surveillance is automated and works 24/7, providing real-time insights. According to a report by the Carnegie Endowment for International Peace, a minimum of 75 out of the 176 countries are using AI tools for surveillance purposes. Across the country, 400 million CCTV cameras are already in situ, powered by AI technologies, primarily face recognition .

Social Media

Social Media is not just a platform for networking and expressing oneself. It subconsciously shapes our choices, ideologies, and temperament.

All this due to the synthetic Intelligence tools which work silently within the background, showing us posts that we "might" like and advertising products that "might" be useful based on our search and browsing history.

For example, recently Instagram revealed how it's been using AI to customize content for the Explore Tab.

This helps with social media advertising because of it's unprecedented ability to run paid ads to platform users based on highly granular demographic and behavioral targeting.

AI tools that will actually write Facebook and Instagram ads for us. Another huge benefit of AI in social media is that it allows marketers to analyze and track every step that they take.

Entertainment

The show business, with the arrival of online streaming services like Netflix and Amazon Prime, relies heavily on the info collected by the users.

This helps with recommendations based upon the previously viewed content. This is done not only to deliver accurate suggestions but also to create content that would be liked by a majority of the viewers.

With new contents being created every minute, it is very difficult to classify them and making them easier to search.AI tools analyze the contents of videos frame by frame and identify objects to feature appropriate tags. AI is additionally helping media companies to form strategic decisions.

Education

In the education sector also, there are a number of problems, which will be solved by the implementation of AI.

A few of them being automated marking software, content retention techniques and suggesting improvements that are required.

This can help the teachers monitor not just the academic but also the psychological, mental and physical wellbeing of the students but also their all-round development. This would also help in extending the reach of education to areas where quality educators cannot be present physically.

For Example, Case-based simulations offered by Harvard graduate school is one such use.

3. FUTURE SCOPE

Artificial Intelligence's future scope, with lots of organizations opting for AI automation. It is necessary to understand the recent developments in AI to find a suitable job role depending on your competencies. Artificial Intelligence scope is limited to household and business purposes as the medical and aviation sector is also using AI to betterment their services. If AI is outperforming human efforts, then opting for AI automation will slash costs in the long run for a business. Automation in operating vehicles has created a buzz in the logistics industry as it is expected that automated trucks/vehicles can be used soon. Due to the bright Artificial Intelligence future scope, many AI start-ups are expected to rise

in number in the coming years. The number of AI start-ups in India has significantly increased in recent years, giving a hint of the opportunities. Also, India's talent gap for expert AI developers is huge, and there is a need for AI experts by businesses more than ever. Businesses are not looking to miss out on any type of technology that can revolutionize their business processes. The use of data analytics by businesses/firms has also increased in recent years, and AI can enhance the accuracy & speed of the data analytics process. Investors and stakeholders are also investing more in AI start-ups, thus signifying the bright future scope of Artificial Intelligence.

4. CONCLUSION

The impact of AI is already being felt in a wide range of industries, from banking and retail to farming and manufacturing. Essentially, this means that, without AI, we wouldn't have achieved the amazing recent advances seen in areas like virtual reality, chatbots, facial recognition, autonomous vehicles, and robotics. AI really is going to change the world, let's end with this simple fact: AI is the foundation on which many other technology trends are built.

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ENERGY EFFICIENT CLUSTER BASED ROUTING PROTOCOL FOR MANETS

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Abstract - Mobile Adhoc networks (MANETs) are vital to the advancement of wireless networks. MANETs generally inherits the conventional problems of wireless and mobile communications. Energy is an inadequate factor in case of Ad-hoc networks. The life of a node is straightly relative to the battery in the device operating at the node. Maximize the use of power and maximize the life of a network is still the key challenge of Mobile Adhoc network. Various routing protocols for mobile adhoc networks could be contrast depending upon the network design and the purpose. This system proposed to develop cluster based energy efficient AODV routing protocols based on EEPRR-AODV routing protocol.

Keywords : MANET, Energy Efficient Routing Protocol, Node Energy, Energy Consumption

.1. INTRODUCTION

The aim of the proposed method is to minimize transmission delay, energy consumption, and increase overall throughput of the network. Apart from this the proposed method facilitates the detection of colluding nodes and prevention of internal attacks from such nodes. Broadcasting is used in cluster approach for communication. The MANET described here is a collection independent node that are mobile in nature and thus the whole network strives to save the bandwidth and other resources.

2. ENERGY-EFFICIENT CLUSTERING FOR MANETS

An energy-efficient clustering mechanism based on distance estimation broadcasting is used for MANETs . A sensor node can in any of the three states, namely, ideal, cluster head, and cluster member. The sensor nodes in this node are mobile and every node uses different transmission power levels. Two tables are maintained, namely, adjacent cluster (AC) table and immediate neighbor (IN) table. The AC table records the information of every node's neighboring CHs, ID of adjacent CH(Cluster Head), CH's approximate location, and the corresponding gateway node to reach the sensor node. The IN table contains the information of a node's one-hop neighbors like, 1-hop neighbor's ID, cluster head ID, sensor state, approximate location, and residual energy. The Hello packet is always transmitted with a constant power level.

3. FORWARD NODE SELECTION

A node which is one hop neighbor of cluster head is known as forward node. For routing purposes within clusters the forward nodes are used. In order to route between the clusters Gateway nodes are used [1]. Broadcasting of data is performed by cluster heads. Every forward node has two things known as cover set and neighbor set. One hop neighbors are known as cover sets while other forward nodes are known as neighbor set.

When a node transmits a packet, first of all cluster receives packet and then the packet is broadcasted to forward nodes. The path is discarded when the destination id is not found in the cover set of a forward node. The routing information is retrieved by neighbor set and forward set from the cluster head and forwarding nodes. the route detection is one of the important tasks that are somehow related with trust value computation, energy efficiency and also the clustering mechanism. The forwarding nodes and cluster head are involved in computation of trust. However, the approach following for hexagonal cluster formation results in energy efficient way of activities such as route discovery, trust management and other communications involved[2].

4. LIFETIME PREDICTION

Each node tries to estimate its battery lifetime based on its past activity. This is achieved using a Simple Moving Average (SMA) predictor by keeping track of the last N values of residual energy and the corresponding time instances for the last N packets received/relayed

by each mobile node. This information is recorded and stored in each node. It is carefully compared the predicted lifetimes based on the SMA approach to the actual lifetimes for different values of N and found N=10 to be a good value. Motivation in using lifetime prediction is that mobility introduces different dynamics into the network. In the lifetime of a node is a function of residual energy in the node and energy to transmit a bit from the node to its neighbors. This metric works well for static networks for which it was proposed. However, it is very difficult to efficiently and reliably compute this metric when node mobility since the location of the nodes and their neighbors constantly change.

5. METHODOLOGY

In order to reduce the control overhead, it is proposed to use the M-AODV and AODV protocols. The whole routing operation has turned into two phases. First, there is the similar idea of AODV algorithm, which uses the alternative route in data packet or node, and if it does not find any alternative route or if the alternative one has expired, it goes to the second phase. The second phase is based on the ABL protocol's idea, which has local repair (LR) or uses the alternative route's neighbors at a distance of one hop (ABR). In this case, sending control messages is avoided as far as possible.

In the proposed method the source node starts the route request process by broadcasting a RREQ. Then each node broadcasts the RREQ to its neighbor. The destination has two RREPs. Nodes listen to both RREPs and put the best one on the main route table and the other one goes to alternate route table. Then it will compare the overheard information with the main route table and if the information was better, then the routing entry will transfer from main table to the alternative one and the past alternate route entry will be deleted. So eventually the new discovered route will be put in the main route table. But if the route breaks, the local repair will happen and it tries to find an alternate route[3].

Overhearing every data packet, the node is convinced to pay attention to hop counts to source and destination as well as the sequence number of source and destination. Then, this information is compared with the corresponding information in the routing table and if the new information is optimal, it will be transferred from alternate table to the main one of the former alternate element is removed.

Afterwards, the newly discovered direction will immediately be replaced with the corresponding element in the main table.

5.1 Two approaches of Energy Efficient Routing Protocol

1. To minimize activity Communication Energy Transmission Power Control Load Distribution
2. Minimize inactivity Energy Sleep/Power down mode

To minimize energy consumption of individual nodes, the main goal of the load distribution method is to balance the energy usage among the nodes and to maximize the network lifetime by avoiding over-utilized nodes when selecting a routing path. Power management technique is used to reduce the energy consumed in the wireless ad-hoc network interface of battery powered mobile devices.

The design of best possible power management policies needs to explicitly account for the dissimilar performance requirements posed by different application scenarios such as latency, throughput and other performance metrics. The main idea is to switch devices to the low-power state in periods of inactivity as compared with traditional techniques in operating systems, power management in communication devices requires distributed coordination between two communicating entities, as all the entities have to be in the active mode for a successful communication[4].

5.2 Delay Elimination Protocol

The Delay Elimination Protocol is the delay optimization protocol that implements the SNCP-Sub network control protection for mobile nodes. This protocol maintains the list of all the nodes that communicate or come across the range of a particular transmitting node and then on the basis of shortest path and least energy, it selects the most suitable node for relaying purpose. The ring formation is the similar to that which is being applied in the cellular network, but the major difference is that the nodes in this case are mobile and it requires the dynamic node management system that could manage and select the dynamic path such that there are zero delays during the switching process. The results obtained clearly show the formation of clusters and the delay factor that can be clearly noticed in the below animator snapshots taken from the analysis of trace files to form the graphs that could clearly suggest the actual values for delay optimization[5][6].

5.4 Energy Consumption

M-AODV does not perform too well in the beginning as compared to AODV, but it improves later. Initially, it is not better than AODV because, initially, all the energy of the nodes are equal. AODV does not wait for time and is thus better performing in the beginning. But at a later stage, as time increases, there is some imbalance of energy that comes into play and then our algorithm's effect comes into play[7].

5.5 Remaining Node Energy

Remaining node energy defines the amount of remaining energy of all nodes at the end of simulation. Simulation results from the graph show that in M-AODV energy consumed from each node is almost same, whereas in case of AODV, energy consumed at various nodes has very large variations. Some nodes are almost exhausted, whereas some nodes have large amount of energy remained, in case of AODV. This happens because AODV chooses the same node every time, whereas M-AODV tries to find an optimal energy efficient path every time[8].

6. CONCLUSION

The proposed energy model M-AODV for MANET, which involves an Energy efficient maximization of network Lifetime. The efficiency of the energy model is enhanced due to a progressive search for the most energy-efficient path. The existing energy models for MANET are based on AODV protocol and ABL protocol with features like QoS optimization, accuracy of energy states, distributed clustering, and energy-efficient clustering. The M-AODV model consumes lesser energy compared to the existing energy models, with respect to nodal speed, packet size, average connection arrival rate, number of nodes, grid size and packet inter-arrival time.

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THE ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN HIGHER EDUCATION SECTOR

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Abstract
The purpose of this paper is to emphasise the importance of ICT in higher education in the twenty-first century. The study specifically argues that although ICTs have had a relatively minor impact on educational practise to date, that impact will rise significantly over the next several years and that ICT will become a powerful force for change across a wide range of educational activities. The report clearly shows that ICT use in education is rising quickly across different Indian states. Making decisions based on technological possibilities rather than educational needs is one of the most frequent issues when employing information and communication technologies (ICTs) in education. There is growing demand to ensure that technological potential are examined in the context of educational needs in developing nations where higher education is beset with major issues at numerous levels. ICT in education encourages more student-centered learning environments, which frequently causes friction between some professors and students. But as the world quickly transitions to digital media and information, the importance of ICT in education is only going to increase over the course of the twenty-first century. As a result, the article contends that ICT in higher education not only contributes to educational advancement but also to the country's socioeconomic development.

Keywords - E-learning, ICT, Online education, Higher education

1. INTRODUCTION

In many nations, ensuring universal service and access to ICT is a primary government priority that is frequently embodied in legislation that regulates the industry. Information acquisition is one of the characteristics that sets humans apart, and man's capacity to "impact" that knowledge on others ensures that it continues to flourish. One of the cornerstones of learning is the transfer of knowledge, which is also one of humanity's most fundamental social accomplishments.

Faculty usually cites the development of deep relationships with students as one of the reasons they enjoy the challenges of working at a small university. Many teachers who are used to the face-to-face interaction of the traditional classroom find the idea of switching from the traditional classroom with desks, notebooks, pencils, and a chalkboard to an online forum of computers, software, and the Internet intimidating. Online institutions like University of Phoenix Online and Athabasca University (Canada) as well as on-campus universities like Harvard University and University of Toronto that offer online courses and degrees are signs of how popular online education has become over the past ten years. Online education is the only choice for many students who find it challenging to travel to campus due to employment, family obligations, health conditions, and other time constraints.

The extensibility, interoperability, and scalability of e-learning technologies have significantly increased as a result of developments, standards, specifications, and subsequent adoptions. Fast emerging as a significant learning method is e-learning. Multimedia on computers provides the best means of developing and delivering graphically enhanced learning environments. In the not-too-distant future, cutting-edge virtual reality technology will also be crucial.

The use of technology in collaborative group work, problem-solving, and decision-making as an essential part of education has been attempted by management institutes and educators. It goes without saying that using technology-based tools properly, in accordance with knowledge learning, and as a part of a cogent educational approach can improve students' cognitive performance and results.

Computer-based systems have a lot of possibilities for distributing educational content. One of the most exciting things defining the

Information Age is the Internet's rapid development in Information and Communication Technology (ICT). ICT facilitates new kinds of communication, fuels our access to information, and supports numerous online services in the fields of business, culture, entertainment, and education.

Support for the use of technology in teaching and learning in higher education has increased during the past ten years in the United Kingdom (HE). The Teaching and Learning Technology Programme (TLTP), in particular, has supported the development of technology-based resources for use across the HE sector since 1993.

2. WHAT IS ICT?

The diverse group of technological tools and resources that are used for communication is referred to as information and communication technologies (ICTs). They are also used to produce, transfer, gather, and manage information.ICT has significantly altered several facets of how we live. Information and communication technologies include the networks, media, hardware, software, and related services that are used to gather, store, process, transmit, and present information (voice, data, text, and images).

ICT has been widely accessible for almost as long as the idea of a "Digital Divide" has existed. Although it has generally been understood to refer to a social division based on socioeconomic factors, this does not "present the complete picture."

Since the late 1990s, introducing ICT as a tool to aid the education sector has sparked extensive discussion. Ten years ago, teacher training and technical and vocational education and training were prioritized. A growing number of international development organizations have recently recognized ICT's promise to help the education sector.

To fully utilize the potential of ICT, UNESCO has played a significant role in leading the Education for all programme. These technologies (ICTs) have significant promise for knowledge dissemination, effective learning, and the development of more efficient education systems, according to the widely adopted Dakar Framework for Action. When examining the integration of ICT to support the attainment of educational objectives, it is clear that even after almost a decade of utilizing ICT to stimulate development, awareness raising is still necessary because it is not yet fully integrated in development activities.

The paper's primary goals are to assess the value of ICT in higher education and to examine government actions to advance ICT in this sector. The main issues with teaching and learning in higher education are related to student diversity, which includes, among other things, differences in academic aptitude, linguistic background, and educational experiences.

The use of information and communication technologies (ICTs) as a teaching tool to enhance women's advancement has enormous potential. Education is undoubtedly the most crucial area of intervention for the empowerment of girls and women in any culture. The use of ICTs as a tool to improve learning, teaching, and educational management spans the whole educational spectrum, including early childhood development, primary, secondary, and postsecondary education, as well as basic education and further education and training.

3. ICT IN RESEARCH

ICT applications are particularly effective and uncontested in the research function of higher education. Four aspects in particular are crucial: The availability of more processing power and bandwidth has steadily increased, enabling the use of massive data sets for the execution of sophisticated calculations.

Research teams can now be dispersed throughout the world rather than being centralized at a single institution thanks to communication links. Research opportunities for smaller universities and those outside the major cities are considerably enhanced by the combination of communications and digital libraries, which is equating access to academic resources.

National policies for ICTs in higher education and the construction of collaborative information systems connecting all higher education institutions are necessary to fully capitalize on these trends and create new dynamics in research.

4. ICT IN TEACHING

The use of computers in the classroom has been embraced by academics far more readily than earlier audio-visual materials. This is thus because the core of scholarly endeavor—and the strength of computers—is their ability to manipulate words and symbols.

There is a movement to include online learning, or eLearning, into both on-campus and distance learning courses. Distance learning and e-learning aren't always the same thing, and their cost structures might vary greatly. Depending on the specific situation, eLearning might increase quality or cut costs. The entry hurdles into the higher education industry have been lowered by ICTs in general and eLearning in particular.

The failures of a number of virtual universities can serve as a lesson for nations and those hoping to establish new HEIs. They demonstrate that ICTs should be implemented methodically so that cost-benefit assessments can clarify the business model.

According to a variety of observers, ICT improves instruction, research, and learning from both instructivist and constructivist learning philosophies. However, the implicit acceptance of technology as neutral and autonomous, neutral and human controlled, autonomous and value laden, or human controlled and value laden, by many observers, lays behind this growing faith in the function of technology in higher education.

5. BENEFITS AND CHALLENGES OF ICT

The Internet of Things relies on sensor technology and the implementation of several protocols that enable communication between devices. Some significant problems are found after doing a literature review, such as the communication-affecting device connectivity concerns. Device compatibility is another problem. Security of communication channels and links, as well as security of equipment used for communication, is a serious problem. There is still much work to be done for the advancement and improvement of this industry; more standardisation of hardware, software, and protocols is needed to create an Internet of Things that is 100 percent dependable and secure. For this, several general rules should be applied.

6. CONCLUSION

As we enter the twenty-first century, numerous causes are exerting significant pressure on the adoption of ICTs in education, and current trends indicate that as a result of the opportunities and affordances of ICT, significant changes in the way education is organized and delivered will soon occur. It is thought that integrating ICT into school will open up more options for learning. Modern teaching techniques can serve to improve learning outcomes, raise the standard of education, and facilitate system reform or better management.

As we enter the twenty-first century, numerous causes are exerting significant pressure on the adoption of ICTs in education, and current trends indicate that as a result of the opportunities and affordances of ICT, significant changes in the way education is organised and delivered will soon occur. It is thought that integrating ICT into school will open up more options for learning. Modern teaching techniques can serve to improve learning outcomes, raise the standard of education, and facilitate system reform or better management

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IMAGE PROCESSING BY PARTIAL DIFFERENTIAL EQUATIONS AND INVARIANTS

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Abstract- Image Processing is a very important one of the current years. Image Processing is used in many areas like images passes in one area to another area in Military, Traffic Signals, Animals and Birds behaviors in Zoos, Photography, Photo clearance, etc. Partial Differential Equations have been successfully solving many problems in image processing and computer sides.

Key words: Aeolotropic Diffusion, Energy Functional, Blurring an Image, Indicator function, Lie Group, Linear Combination, Image Segmentation, Edge Detection

1. INTRODUCTION

Partial Differential Equations generally need high mathematical quality and skillsvision to the problems. I propose a basic structure for studying a system ofPartial Differential Equations. Compare to the traditional approaches like Edge Detection,Segmentation and Blurring to making the Partial Differential Equations, our framework requires much less human intelligence. I assume that the system be composed of two Partial Differential Equations. One controls the development of the output and the otherone is for a characteristic function that helps collect the global details. As the Differential Equations should be transfer and spinning invariables, these must be functionsof differential invariables they are transfer and spinning invariable. I assume that the PDEs are simply linear integrations of the fundamental differential invariables up to second order. The integration coefficients can be learned from real data via an optimal control technique.

In general, there are three types of modes used to make the Partial Differential Equations (PDEs).The first kind of methods, PDEs are written downward directly, some mathematical understandings on the establishment of the PDEs (e.g., Aeolotropic spread[6], Shock filter [5] and curve development based equations [4,7,2,3]). Basically the second kind of methods defines energy functional first;Collets the output image then calculate the Euler-Lagrange equation of the energy functional. The third methods are axiomatic approaches, which first define the premises, (e.g.,Alvarez et al.'s axiomatic formulation of the scale-space theory [1]). All of these methods need to both good insight to premises to hold and mathematical techniques, in order to acquire the wanted Partial Differential Equations. These plenty limit the claim of PDEs to broad and more complex scopes. This prompts as to explore whether there is an easier way to making Partial Differential Equations.

In this Paper, we show that study Partial Differential Equations from input-output givensample image pairs may be a possible way to making Partial Differential Equations in a slow manner. Assume that the Partial Differential Equations, it is written as integrations of atoms called fundamental differential invariables.

2. FORMATION OF PARTIAL DIFFERENTIAL EQUATION

Now, we present our framework of the Partial Differential Equation system from exercise given sample images. Here the PDE system comprises of two Partial Differential Equations. One is the development of the output image$O$, and the other one is the development of a characteristic function$\propto$. The aim of introducing the characteristic function is to collect the large scale of information in the image, so that the development of O can be correctly guided.

We assume the Partial Differential Equations to be evaluatingthe type because usual ideasprocess should comprise of some steps. The time-dependent operations of the evolutionary Partial Differential Equations favorable the different steps of the information process. Moreover, for stationary PDEs are not natural to define their inputs (I) and the existence of their solutions are much less optimistic. So our Partial Differential Equation system can be written as:

$$\left.\begin{aligned}
&\frac{\partial O}{\partial t} = L_O(\boldsymbol{a}, \langle O\rangle, \langle \propto\rangle), && (X,t) \in Q,\\
&O = 0, && (X,t) \in \Gamma,\\
&O|_{t=0} = O_0, && X \in \Omega;\\
&\frac{\partial \propto}{\partial t} = L_\propto(\boldsymbol{b}, \langle \propto\rangle, \langle O\rangle), && (X,t) \in Q,\\
&\propto = 0, && (X,t) \in \Gamma,\\
&\propto|_{t=0} = \propto_0, && X \in \Omega;
\end{aligned}\right\} \quad (1)$$

Where,
O - Output image;
$\propto$ - Characteristic function;
t –Temporal variable

X – (x, y), Spatial variable;
Q - $\Omega \times (0,T)$;
Ω – An open region of R^2
$\partial\Omega$ – Boundary of Ω;
Γ - $\partial\Omega \times (0,T)$

Here Ω is the rectangular region occupied by the input image I and T is the time that the Partial Differential Equation system completes the processing and output the results. Computational issues and facility of mathematical deduction, padded with zeros of several pixels width around it. As we can change the unit of time, it is harmless to fix T=1. L_O and $L_\propto$ are smooth functions. O_O and $\propto_O$ are the initial functions of O and $\propto$, respectively. a = $\{a_i\}$ and b = $\{b_i\}$ are sets of function defined on Q that are used to control the development of O and$\propto$, respectively. The forms of L_O and $L_\propto$ are discussed below.

3. EXPERIMENTAL RESULT

Now, we apply our framework to design PDEs for Three basic image processing problems:

- Edge Detection
- Segmentation and
- Blurring

Now generate sixty 150 × 150 images and their truth outputs as training image pairs. After study the PDE system. We apply itto exercise images. The goal of these experiments is to show the beauty of our framework, the same approach for different problems and the performance of learnt PDEs is comparable to those problem-specific methods.

Edge Detection

Image edge detection (Figure 1) usually outputs an edge map that includes all edge pixels theyare relatively strong within an undoubted atmosphere. Hence the resulting edge maps often contain minute edges that may be visually insignificant. We can obtain the PDEs$ that output visually salient edges only. In this way, we obtain 3training image pairs. Figure 1 shows part of the results on the collected 2 testing images. The solution of PDEs to be more or less smooth functions.

Edge Detection

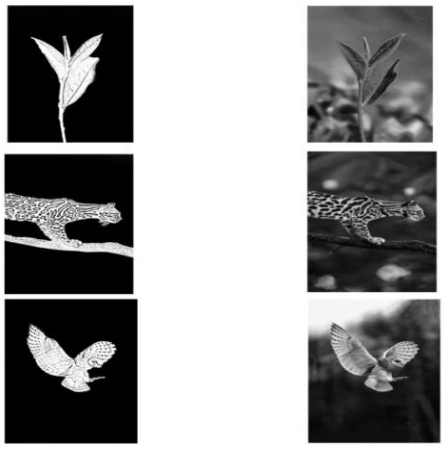

Figure 1: The results of edge detection above. The first column is outputs of thelearned PDEs. The second column is input images

Segmentation

The image segmentation is a sorely ill posed problem and there are many criteria to define the aimof imagesegmentation.
e.g., Breaking images into the regions with similar intensity, color, texture, or expected shape.

Image Segmentation

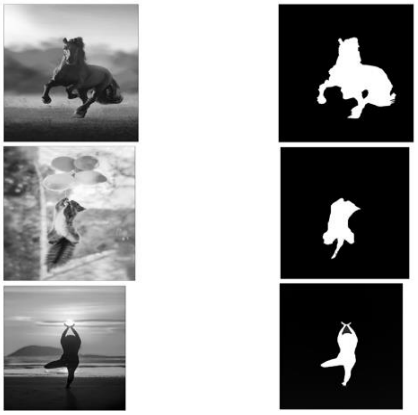

Figure 2: Partial the results of the image segmentation. The first column is the input images. The second column is the output of the mask maps by learned PDEs.

Blurring

For the image blurring (Figure3), the output(O) image is expected to be the convoluatedness of the input(I) image with a 5×5 Gaussian kernel with σ=1. It is well known [4] that this corresponds to evolved with the standard heat equation

$$O_t = \eta(O_{xx} + O_{yy}).$$

These observations justify the usefulness of learning-based Partial Differential Equations.

Blurring

Figure 3: Partial results of image blurring. The top row is the input images. The middle row is the outputs of our learnt PDEs. The bottom row is the ground truth images obtained by blurring the input image with a Gaussian kernel.

4. CONCLUSION

Image restoration and augmentation are important parts of the digital image processing; belong to the early optical image processing problems. The image In-processing is the preliminary of image analysis, filter to minimize the image noise and to augment the image lines. The image augmentation skill plays on main role in increasing image quality and it is fine for the image out-processing e.g. image segmentation and image tracking. Image restoration and augmentation have been globally used in military, medical, traffic signals, industrial production and other fields.

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BIOINSPIRED GRAY WOLF OPTIMIZATION FOR ENERGY HARVESTING IN PURE ELECTRIC VEHICLES

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Abstract- This research aims to evaluate the factors influencing the performance evaluations of the Energy Management System (EMS) in Low-Emission Vehicles (LEVs), specifically focusing on vehicle speed, power load, and various source loading scenarios. The validation of the developed model includes assessing the EMS performance using the ECE-47 drive cycle, which is commonly employed to evaluate the functionality and pollutant emissions of mopeds and electric scooters. The findings reveal a close alignment between the ECE-47 test drive cycle and motor speed, except during gear shifting periods. This paper explores the utilization of a bio-inspired control algorithm to enhance the performance of light electric vehicles (LEVs) in the context of next-generation mobility. LEVs are poised to play a pivotal role in the advancement of future transportation systems. The integration of solar parking lots offers an eco-friendly alternative to traditional fossil fuel-based electricity, enabling users to leverage renewable energy sources. Moreover, this sustainable approach raises the bar for urban livability standards. The energy management system (EMS) of LEVs assumes a critical role in supporting various charging components, including primary and secondary chargers, in addition to the battery charger. Control techniques serve as the fundamental building blocks of the vehicle's architecture, enabling effective implementation and management of multiple sources of information. Through the proposed control algorithm, this research demonstrates the feasibility of optimizing LEV performance and ensuring efficient utilization of available energy resources.

Keywords: Energy Harvesting System, Multi-Sources Model, Control Algorithm, EV, LEV

1. INTRODUCTION

The rapid advancement of electric vehicle technology has revolutionized the transportation industry, offering a promising solution to reduce carbon emissions and mitigate the adverse effects of climate change [1]-[2]. Light Electric Vehicles (LEVs), including electric bikes, scooters, and small electric cars, have gained significant attention due to their potential to enhance urban mobility with lower energy consumption and reduced environmental impact [3]. The integration of renewable energy sources, such as solar power, into LEVs presents an opportunity to further improve their energy efficiency and extend their range. By harnessing clean and sustainable energy, LEVs can minimize their reliance on conventional fuel sources and contribute to a greener and more sustainable urban environment [4]. In recent years, bio-inspired control algorithms have emerged as a promising approach to enhance the energy management and optimization capabilities of LEVs. Inspired by natural phenomena and biological systems, these algorithms mimic the behavior of organisms and provide effective solutions for complex control problems. In this paper, we focus on the application of the Gray Wolf Optimization (GWO) algorithm in the energy management systems of LEVs. The GWO algorithm, inspired by the social hierarchy and hunting behavior of wolf packs,

offers a robust and adaptive framework for optimizing energy utilization in LEVs. By leveraging the GWO algorithm, we aim to maximize the efficiency of energy harvesting and utilization, thus improving the overall performance and range of LEVs [5]. This research aims to explore the potential benefits of integrating the GWO algorithm into the energy management systems of LEVs and contribute to the advancement of sustainable transportation solutions. By analyzing the performance of the GWO algorithm in various driving conditions and evaluating its impact on energy efficiency, we can gain valuable insights into its effectiveness and identify opportunities for further improvement. Through this study, we strive to accelerate the adoption of bio-inspired control algorithms in the design and operation of LEVs, ultimately facilitating the transition to a cleaner and more sustainable transportation ecosystem [6].

2. BACKGROUND

As a result of the distinct efficiency characteristics of series and parallel hybrid electric vehicles (HEVs), series-parallel HEVs have emerged as a viable solution to achieve high overall efficiency. Series HEVs exhibit greater efficiency at lower speeds, while parallel HEVs are more efficient at higher speeds [7]. By combining the advantages of both types, series-parallel HEVs offer a comprehensive approach to maximize efficiency. The research findings suggest that HEVs not only serve as a promising alternative for super-ultra-low-emission vehicles but also provide a short-term solution to meet the increasing demand for battery electric vehicles (BEVs). This conclusion was drawn from the extensive study conducted by researchers in this field.

In a comprehensive investigation of HEVs [9], various aspects were explored, including their classification, the range of available vehicle types, associated advantages and disadvantages, and potential future energy management systems. The study hypothesized that both the automotive industry and environmentally conscious consumers would increasingly recognize the importance of HEVs [9]. However, the complexity of hybrid electric drivetrains, coupled with challenges related to energy source management, battery and engine optimization, pose significant obstacles to the effective implementation and management of hybrid electric vehicles [4, 10].

To enhance driving range, reduce fuel consumption, and minimize greenhouse gas emissions, it becomes crucial to minimize energy wastage, improve fuel combustion energy utilization efficiency, explore alternative fuels, and harness mechanical energy generated through vehicle vibration and braking [11]. Several approaches have been developed to address these objectives, including the integration of renewable energy sources, the utilization of the Seebeck effect for thermal energy recovery from exhaust gas, the application of piezoelectric vibration absorbers, and other innovative techniques aimed at reducing greenhouse gas emissions [12].

Among these approaches, thermoelectric generators have garnered attention as a highly promising method for waste heat recovery. They operate silently and have no moving parts, making them an attractive option for recovering waste heat efficiently [13]. Notably, researchers in [14] have made significant contributions to the understanding of exhaust gas energy recovery and its theoretical limitations. Their work highlighted the muffler as a prime location for waste heat recovery, as it exhibited the highest energy loss rate. Furthermore, energy generated through shocks, vibrations, and braking can be captured, channeled, and stored in batteries for future use [15].

3. PROPOSED METHOD

It is necessary to create the EMS as well as the accessible stored energy LEV in order for them to be able to meet the requirements set forth by the customer. These requirements include a greater amount of power, a greater transport distance, and a rise in dependability. This study presents a three-wheeled LEV system that is powered by a battery as its primary energy source, the SC as its auxiliary, and the FC as its extended, with the latter being used to power a high-demand load. Each of these energy sources contributes a different amount of energy to the system. The SC and the FC are both utilised in order to extend the scope of the system coverage.

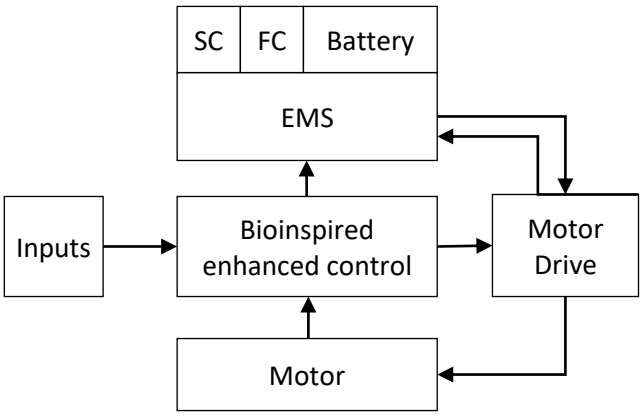

Fig.1. Closed Loop Control over the Motor Drive

The goal of energy harvesting is to maximise the use of renewable energy sources, with the end result being the elimination of harmful emissions and the use of alternative fuels to power cars. This can be accomplished by maximising the consumption of renewable energy sources. The battery, the secondary converter (SC), and the tertiary converter (FC) are all components that have been incorporated into the newly fashioned system. These three components serve as the system primary, secondary, and tertiarysources of power, respectively. The sources are utilised if it is anticipated that a greater demand for load will be required. The integration of new components into an existing system, such as regenerative braking and alternative fuel sources presents a number ofsignificant challenges. As a result of this, a solar car park or plug-in system is now under construction in order to capture energy for the purpose of fueling and charging electric vehicle batteries.

There is the possibility that the sun may provide enough energy to power a vehicle at a rate of up to 2,000 Wh each day. One can make an educated assumption that a low-emission vehicle will need no more than a quarter of the parking lot dedicated to solar panels. The newly created vehicle system makes significant use of the collected energy, which leads to a reduction in the amount of money spent on gasoline as compared to vehicles that are powered by traditional engines.

Ensemble Bioinspired Control Algorithm

Having wolves around not only helps to maintain order among the Candidate section forefathers, but it also enables you to keep track of what they consume at the sustenance nourishment group. This is because wolves are the major predators in their ecosystem. These expressions are used whenever a more nuanced statement of a prejudice that is nonetheless appropriate for the relevant person is sought after. There have been discoveries that point to the existence of two people: an alpha male and an alpha female. They differentiate themselves from one another primarily on the basis of claims that they provide an exciting real-assortment screening with many highlights, such as chasing and resting areas as well as the ideal occasion to awaken. The decisions that have been made by the alpha are communicated to the other members of the group who are still present.

Although we envision the EGWO arrangement to be composed of beta and delta wolves, the alpha (alpha) accumulation is judged to be the most appropriate accumulation for the purpose of recreating the group pecking arrangement of wild wolves, beta (), and delta. This is because the alpha (alpha) accumulation is judged to be the most appropriate accumulation for the purpose of recreating the group plan of wild wolves. This is due to the fact that the most dominant wolvesω in the population make up the alpha (α) accumulation. The symbol for omega signifies the visually pleasing arrangement that is still present in the system, the proposed flow diagram is shown in figure 2.

Exploitation and Exploration

When moving from the exploration phase to the exploitation phase, the adaptive values of the a and a vectors in EGWO are the ones in charge of directing the transition. The discovery process is going to take up a little bit more than half of the time we have available for this iteration. The cycles are divided in half, with the first section being devoted to analysis and the second portion being devoted to practise. In order to maximise one chances of reaching one ultimate goal of achieving the highest possible level of precision in the process, the calculation of GWO should be simplified as much as possible by using the smallest possible sample size of agents that need to be acclimatised. This will allow one to get closer to one ultimate objective of achieving it. Following the arrival at a conclusion that can

be considered definitive, the data are transferred to the supplemental system.

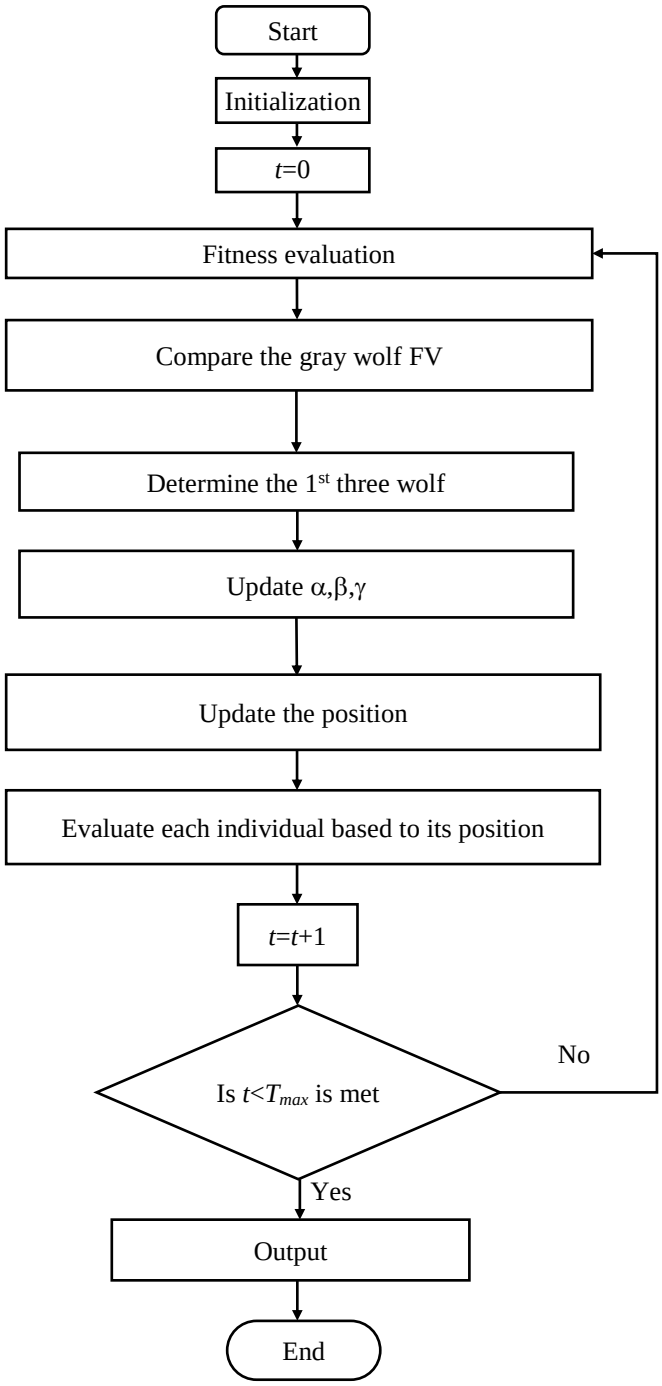

Fig. 2. GWO algorithm

4. RESULTS AND DISCUSSIONS

The objective of this research is to assess the factors influencing the performance evaluations of the Energy Management System (EMS) in Low-Emission Vehicles (LEVs). These factors include vehicle speed, power load, and various source loading scenarios, particularly focusing on three-wheeled scooters. To validate the developed model, the EMS performance is evaluated using the ECE-47 drive cycle. The ECE-47 drive cycle is frequently employed to test the overall functionality and pollutant emissions of mopeds and electric scooters. Figure 3 illustrates the contrast between motor speed and the ECE-47 test driving cycle.

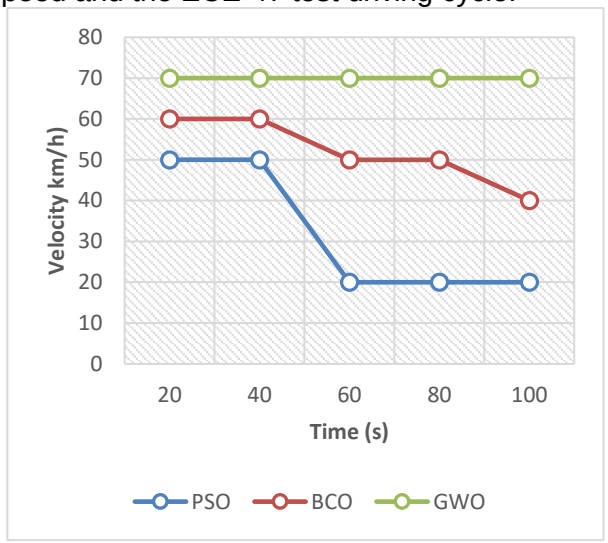

Fig. 3. Motor Speed vs. test driving cycle

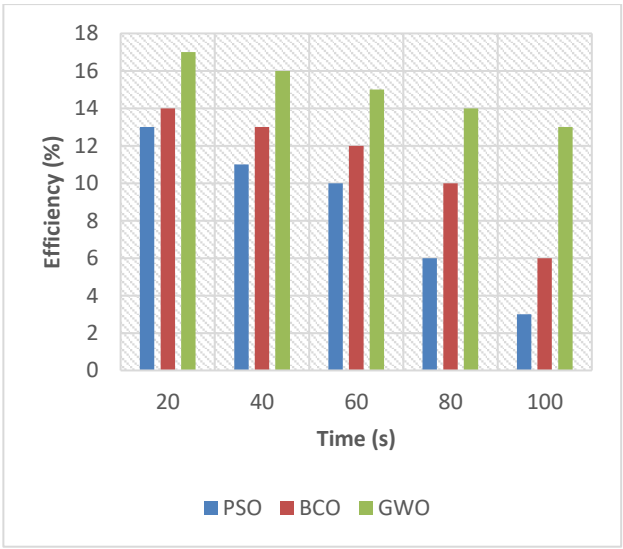

Fig.4. Energy Efficiency

TABLE 1: POWER OF MOTOR (%)

Drive cycle (s)	PSO	BCO	GWO
20	12	15	32
40	15	18	34
60	20	22	35
80	24	26	35
100	28	30	36

TABLE 2: DECELERATION SPEED (M/S)

Drive cycle (s)	PSO	BCO	GWO
20	6.143	5.5936	4.648
40	6.1320	5.489	4.776
60	5.9634	5.428516	4.55701
80	4.757	4.206	3.345
100	4.245	3.783	2.875

The results from the ECE-47 test drive cycle and motor speed (Table 1 and 2) demonstrate a strong alignment, except during gear shifting periods where deviations occur. Figure 4 indicates that the PI regulator control significantly slows down the response of the deceleration speed of the motor. It is evident that the motor speed requires modification for several seconds to reach a steady state. At the 60-second mark, the vehicle system starts operating inconsistently with the test-driving cycle criteria. When attempting to establish a stable rhythm, the system tends to overcompensate by applying excessive force to either the brakes or the accelerator. It takes a few seconds to achieve a sense of the vehicle's speed, and the damping response increases during subsequent deceleration tests until the vehicle comes to a complete stop, concluding the test. This control approach enables the overall vehicle system to operate in the desired state 2. Considering the battery-powered nature of the vehicle system designed for shorter distances, the technology performs well throughout the test drive cycle due to the limited travel distance. During the test, the PI regulator must exhibit a higher level of performance to maintain a steady duty cycle and precisely regulate the vehicle speed during deceleration. When the vehicle speed decreases, the PI regulator in the motor driving system reduces the responsiveness of Pelect. If the driver applies excessive force to the brake pedal, the vehicle speed must be brought back up to the required number of drive cycles, resulting in a sudden increase in electrical power consumption. It takes approximately ten seconds for the system to reach a stable state when supplied with 1.2 kW of electrical power. Once the vehicle starts to decelerate again, the available electrical power immediately diminishes. The PI regulator continues to keep the duty cycle active for a few seconds longer than normal after the vehicle comes to a complete stop. During deceleration or when the vehicle is in a stationary position, the PI regulator in the motor drive system appears to operate inaccurately. The current control mechanism only allows the system to be in state 2 or rely continuously on the battery if the proposed control approach is implemented.

5. CONCLUSIONS

In this paper, we have discussed the potential of bio-inspired control algorithms, specifically the Gray Wolf Optimization (GWO) algorithm, in enhancing the energy harvesting capabilities of Light Electric Vehicles (LEVs) designed for the next generation of mobility. LEVs have emerged as a promising solution to address environmental concerns and reduce greenhouse gas emissions in the transportation sector. The integration of renewable energy sources, such as solar panels, into LEVs offers the opportunity to utilize clean and sustainable energy. Our proposed energy management system (EMS) for LEVs, which incorporates the primary battery, secondary converter (SC), and tertiary converter (FC), aims to optimize energy utilization and extend the vehicle's range. By harnessing solar energy through a solar car park or plug-in system, LEVs can significantly reduce their dependence on traditional fuel sources and contribute to a greener and more sustainable urban environment. Furthermore, we have introduced the concept of the GWO algorithm as a bio-inspired control technique for managing multiple sources of information in the LEV's architecture. The GWO algorithm, inspired by the social hierarchy and hunting behavior of wolf packs, provides a framework for efficient energy management and control. Through exploration and exploitation phases, the GWO algorithm can adaptively optimize energy utilization based on

various factors such as vehicle speed, power load, and source loading situations. The results and discussions demonstrate the effectiveness of the GWO algorithm in optimizing energy efficiency and deceleration speed during the ECE-47 drive cycle.

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REVIEW ON EXPLORING THE LANDSCAPE OF QUANTUM MACHINE LEARNING

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Abstract
Quantum Machine Learning (QML) is an emerging discipline that leverages the principles of quantum mechanics to revolutionize traditional machine learning paradigms. At its core lies the concept of qubits, the quantum counterparts of classical bits, which can exist in multiple states simultaneously. This extraordinary property allows QML algorithms to explore vast solution spaces efficiently and tackle complex computational challenges that defy classical methods. We explore the fundamental aspects of quantum data representation, quantum feature mapping, and quantum-inspired algorithms. Furthermore, we discuss the symbiotic relationship between classical and quantum machine learning through current approaches QML, The abstract also highlights the current state-of-the-art applications of Quantum Machine Learning, ranging from quantum-enhanced optimization and quantum chemistry simulations to quantum artificial intelligence and secure quantum communication. Ultimately, this abstract serves as a gateway to the captivating realm of Quantum Machine Learning, inviting researchers, scientists, and technologists to embark on a journey of exploration and innovation in this ground breaking field, with the promise of unveiling the true potential of quantum QML is shaping the future of artificial intelligence and beyond.

Keywords: QML, qubits, quantum, parallelism, speed and accuracy, optimization, quantum algorithms.

1. INTRODUCTION

Quantum Machine Learning (QML) represents an enthralling frontier where two revolutionary fields, quantum computing and classical machine learning, converge to unleash unparalleled computational power. With its foundation in quantum mechanics, QML holds the promise of revolutionizing the way we approach complex computational problems that have long evaded classical methods. By harnessing the unique properties of quantum systems, QML algorithms can explore vast solution spaces in parallel and navigate complex data landscapes with unprecedented efficiency. In this exploration of the landscape of Quantum Machine Learning, we embark on a journey that unravels the distinctive features, challenges, and applications that define this cutting-edge discipline. We delve into the fundamental concepts of quantum computing, laying the groundwork for a deeper understanding of how qubits, the quantum building blocks, differ from classical bits, allowing for the simultaneous existence of multiple states.

The exploration takes us through the key elements of QML, including quantum data representation and quantum feature mapping, shedding light on the novel approaches that leverage quantum parallelism to process and extract information from data with extraordinary speed and accuracy. As we venture further, we investigate the most promising quantum-inspired algorithms, which promise to revolutionize tasks such as optimization, machine learning, and artificial intelligence.

QML in upcoming era

Yet, as with any pioneering endeavor, the landscape of Quantum Machine Learning is not without challenges. We encounter the pressing issue of quantum noise and decoherence, necessitating innovative error mitigation strategies and the development of robust quantum error correction codes. Furthermore, we explore the compelling synergy between classical and quantum computing, as hybrid quantum-classical approaches emerge as a bridge to

tackle practical problems that lie at the interface of these two paradigms.

This exploration goes beyond theoretical concepts; it also showcases the real-world applications of QML. From quantum-enhanced optimization for logistical challenges to the promise of revolutionizing drug discovery with quantum chemistry simulations, we uncover the remarkable breadth of opportunities that QML presents across diverse domains.[2,3]

In the pursuit of this landscape, we seek to inspire researchers, scientists, and technologists alike, inviting them to embark on their own journey into the uncharted territories of Quantum Machine Learning. Together, we stand on the precipice of a transformative era, where quantum-powered machine learning may hold the keys to unlocking the mysteries of the universe and addressing some of humanity's most pressing challenges. Let us embark on this exploration with an open mind, as we strive to grasp the full potential of Quantum Machine Learning and redefine the boundaries of computation itself.[5,7]

2. CURRENT APPROACHES TO QML

Quantum Variational Algorithms: Variational quantum algorithms are widely used in QML. These algorithms involve preparing a quantum state using a parameterized quantum circuit and optimizing the parameters to minimize a cost function related to the machine learning task. Variational Quantum Eigensolvers (VQE) and Quantum Neural Networks (QNN) are popular examples of variational algorithms used for applications like quantum chemistry simulations and classification tasks, respectively.

Quantum Kernel Methods: Quantum kernel methods are inspired by classical kernel methods and involve leveraging quantum circuits to compute quantum kernels. These kernels enable classical machine learning algorithms to operate efficiently in a quantum feature space, providing a quantum advantage for certain problems.

Quantum Data Encoding: This approach focuses on encoding classical data into quantum states efficiently. Quantum Feature Maps (QFMs) are designed to transform classical data into quantum states that can be manipulated by quantum circuits, unlocking the potential of quantum parallelism.

Quantum Circuit Learning: Quantum Circuit Learning involves training a quantum circuit directly as a machine learning model. It treats the quantum circuit as a parameterized quantum circuit and optimizes its parameters to perform specific tasks like classification or regression.

Quantum Transfer Learning: Inspired by classical transfer learning, quantum transfer learning aims to leverage knowledge gained from solving one problem to aid in solving another. This approach is particularly useful when computational resources for training quantum models are limited.

Quantum Data Preprocessing: Quantum data pre-processing techniques, such as quantum data cleaning and quantum dimensionality reduction, aim to enhance data quality and reduce the dimensionality of quantum datasets, thereby enabling better performance of quantum machine learning algorithms.

Quantum Generative Models: Quantum generative models seek to generate quantum data samples that mimic the distribution of a given dataset. Quantum Generative Adversarial Networks (QGANs) are an example of such m models.

Hybrid Quantum-Classical Approaches: Many QML algorithms and models employ a hybrid approach, combining classical machine learning techniques with quantum computation. This approach capitalizes on the strengths of both classical and quantum systems, overcoming the limitations of current quantum hardware.

3.QUANTUM MACHINE LEARNING (QML) AND CLASSICAL MACHINE LEARNING (ML)

The two distinct paradigms for solving computational problems. Here are the key differences between the two:

Classical Machine Learning	Quantum Machine Learning
Computational Model: In classical ML, computations are performed using classical bits, which represent either 0 or 1. Algorithms in classical ML process data using classical operations like addition, multiplication, and logical operations.	In QML, computations are performed using quantum bits or qubits. Qubits can exist in multiple states simultaneously, known as superposition, and can be entangled with other qubits, allowing for quantum parallelism and the exploitation of quantum interference to perform certain tasks faster than classical counterparts.

Classical Machine Learning	Quantum Machine Learning
Algorithmic Approach: Classical ML algorithms often involve finding patterns or relationships in data using methods like regression, decision trees, support vector machines, and neural networks. These algorithms rely on classical optimization techniques to minimize or maximize certain objective functions.	QML algorithms harness the principles of quantum mechanics to perform computations in unique ways. Some QML algorithms use quantum circuits to perform specific tasks, while others employ quantum operations like quantum amplitude amplification or quantum phase estimation.
Speedup Potential: Classical ML algorithms are efficient for many problems and have been widely used in various applications. However, for certain tasks, especially in large-scale data processing or solving complex optimization problems, classical ML algorithms may face limitations in terms of computational speed and efficiency.	QML offers the potential for exponential speedup for specific problems that can be solved more efficiently using quantum algorithms, such as factorization, database search, and certain optimization problems. However, it is essential to note that not all problems can be sped up with quantum algorithms, and identifying those problems that can benefit from quantum speedup is an active area of research.
Hardware Requirements: Classical ML algorithms can be executed on standard classical computers and do not require specialized quantum hardware.	Implementing QML algorithms requires quantum hardware, such as quantum processors and qubit-based devices. Quantum hardware is still in the early stages of development, and building and maintaining stable quantum systems is a significant challenge.
Application Domains: Classical ML is widely used in a variety of domains, including image and speech recognition, natural language processing, recommendation systems, and financial analysis.	QML is currently more focused on specialized domains, such as quantum chemistry simulations, optimization, quantum cryptography, and certain machine learning tasks that can benefit from quantum parallelism and quantum interference.

4. DEVELOPMENTS OF QML

The real-world applications of QML have show cased its potential to revolutionize industries like quantum chemistry, optimization, and secure communication, pointing to a future where quantum computing plays an indispensable role in tackling complex scientific and technological challenges.

As we have traversed the uncharted territories of Quantum Machine Learning, we remain mindful of the ongoing developments beyond the scope of this exploration. Researchers and technologists are continually pushing the boundaries of quantum computing, seeking novel algorithms and solutions that exploit quantum parallelism and interference to their fullest potential.

Indeed, the journey into the landscape of Quantum Machine Learning has ignited a spark of innovation, inviting us to redefine computation and envision a future where the symbiosis of quantum and classical technologies unlocks unprecedented possibilities. As we move forward, let us embrace curiosity and collaboration, exploring this transformative frontier hand in hand, with the hope of unraveling the full potential of Quantum Machine Learning and shaping a world where quantum advancements drive progress across disciplines and enrich human knowledge and understanding.

5. CONCLUSION

In conclusion, exploring the landscape of Quantum Machine Learning (QML) has provided a glimpse into the exciting convergence of quantum computing and classical machine learning. The unique properties of qubits, allowing for superposition and entanglement, have opened new horizons in tackling complex computational challenges that transcend the capabilities of classical methods. Throughout this exploration, we have delved into various approaches and techniques, each harnessing the power of quantum mechanics to transform the field of machine learning. Quantum variational algorithms, quantum kernel methods, and quantum data encoding are just a few examples of the diverse methodologies that hold the promise of exponential speedup and enhanced computational efficiency.

While Quantum Machine Learning continues to progress rapidly, we have also encountered challenges and opportunities that shape the landscape of this burgeoning field.

Quantum noise and decoherence demand innovative error mitigation strategies, and hybrid quantum-classical approaches bridge the gap between classical and quantum systems, leveraging their strengths for practical problem-solving.

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A STUDY OF DEEP LEARNING FOR SENTIMENT ANALYSIS IN SOCIAL NETWORKS

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Abstract
Sentiment analysis is a technique for determining people's attitudes, feelings, and emotions about a particular aim, such as people, activities, organizations, services, subjects, or items. Because of the Internet's rapid proliferation, social networking platforms have become a crucial means of sharing feelings to the entire world. Several people convey their feelings or points of view through writing, images, audio, and video. Text communication through Web-based networking media, on the other hand, might be overwhelming. A vast amount of unstructured data is generated on the Internet every second as a result of social media sites. To comprehend human psychology, data must be processed as quickly as it is generated, which can be performed using sentiment analysis, which recognizes polarity in texts. It determines if the author holds a negative, good, or neutral attitude toward a particular thing. In recent years, sentiment analysis has been a popular application for deep learning. This paper initially provides an overview of deep learning before conducting a thorough investigation of the ways it is currently being used in sentiment analysis.

Keywords: Sentiment analysis, Deep learning, Social networks

I. INTRODUCTION

Using deep learning techniques, sentiment analysis is a potent text analysis tool that automatically mines unstructured data for opinion and emotion. Artificial neural networks, which link together algorithms to mimic the operation of the human brain, have made it possible to use deep learning in many real-world contexts, including self-driving cars and automated customer assistance. Using text analysis techniques, sentiment analysis classifies emotions (positive, negative, and neutral) within data. Utilizing deep learning, sentiment analysis models can be trained to read for context, sarcasm, etc., understand the writer's genuine mood and feelings, and comprehend material beyond simple definitions.

Deep learning, which uses many algorithms in a sequential chain of events to solve complicated problems, is hierarchical machine learning that enables you to process enormous volumes of data accurately and with a minimum of human input.

II. SOCIAL NETWORKS

With millions of active users, social networking sites like YouTube, Twitter, Facebook, and Snapchat have completely changed how we communicate and exchange information online. Every day, user activities in these networks result in the creation of many gigabytes of information. Understanding the underlying theories governing the development, evolution, and properties of social networks is made possible by the capacity to gather and analyze such data.

A social network is typically described as a network of links or interactions where the nodes are actors and the edges are the connections or interactions between these actors. Social networking

has been extensively researched in the field of sociology in terms of general interactions between any set of actors [8]. The three main problems with social media data can be solved successfully with the use of data mining tools. Firstly, the data sets from social media are large. Additionally, social media site data sets may contain noise. Also, it's important to remember that data from social media platforms on the internet is dynamic. Regular updates and adjustments over a short period of time are common. Large data sets can be mined using data mining techniques to enhance search results on common search engines. Additionally, unrestricted access to data provides academics with a previously unheard-of volume of data that may be used to enhance productivity and optimize data mining methods.

III. SENTIMENT ANALYSIS

Many people throughout the world are increasingly using blogs, forums, and social media sites like Twitter and Facebook to share their thoughts with the rest of the world. Social media has evolved into one of the most effective modes of communication. As a result, a large amount of data, known as big data, is generated, and sentiment analysis was developed to effectively and efficiently examine this huge data. Understanding the user's emotions has become critical for any sector or organization. Sentiment analysis, often known as opinion mining, is a technique for determining whether an author's or user's perspective on a subject is positive or negative. Sentiment analysis is described as the process of extracting relevant information and semantics from text utilizing natural processing techniques in order to determine the writer's attitude, which might be positive, negative, or neutral [9].

IV. DEEP LEARNING

In the family of machine learning techniques, deep learning is one variation. The adjective "deep" is derived from the fact that the learning process uses numerous levels. It is based on artificial neural networks with three or more layers. These neural networks attempt to simulate the behavior of the human brain allowing it to “learn” from large amounts of data.

The kind of data it uses and the learning strategies it uses, set deep learning apart from traditional machine learning. Some of the data pre-processing that is generally involved with machine learning is eliminated with deep learning. These algorithms can handle text and visual data that is unstructured and automate feature extraction, reducing the need for human specialists. Each Neuron receives signals as input, multiplies them by weights, adds them together, and then applies a non-linear function. These neurons are piled on top of one another in layers. Deep learning models are categorized as supervised learning, unsupervised learning, and reinforcement learning. Most common deep learning algorithms are Convolutional Neural Networks (CNNs), Long Short Term Memory Networks (LSTMs),

Recurrent Neural Networks (RNNs), Generative Adversarial Networks (GANs), Radial Basis Function Networks (RBFNs), Multilayer Perceptron (MLPs), Self Organizing Maps (SOMs)

V. LITERATURE REVIEW

Several experiments have been conducted to detect emotions in text using various methodologies. In-depth research was done in this part to determine how sentiment analysis is now using deep mining.

Seal et al. [1] have performed emotion detection with a keyword-based approach mainly focused on phrasal verbs. They used ISEAR [2] data, preprocessed the data, and then applied the keyword-based approach. They discovered several phrasal verbs that should have been associated with emotion terms but were not, and so they built their own database. They recognized phrasal verbs and keywords synonymous with various emotions and categorized them using their database. They did, however, achieve a much higher accuracy of 65%, but they were unable to address the researcher’s existing issues, such as an insufficient list of emotion keywords and a lack of respect for word semantics in meaning. The work by Alotaibi [3] has worked on a learning-based approach. He has used the ISEAR [2] database for emotion detection. Then, using classifiers like Logistic Regression, K-Nearest Neighbor (KNN), XG-Boost, and Support Vector Machine (SVM), he preprocessed and trained the data. According to him, all other

classifiers poorly performed as compared to Logistic Regression. Finally, he said that the deep learning technique would help to improve the model.

Sercan Sari and Murat Kalender [10], in their research stated that sentiment analysis and opinion mining have an important role to trace consumer behavior. With the recent advances in machine learning techniques, this issue has been addressed and come a long way in English. In their study, they compare several classification methods and deep learning methods to make a sentiment analysis for Turkish reviews. They have explained the machine learning classifiers that have used and depicted the overall design. They have significant results both from the machine learning classifiers and the deep learning model. The prediction accuracy results are satisfactory. They had 87.30% prediction accuracy for multinomial Naive Bayes and 95.87% prediction accuracy for deep learning model. While there is no difference between machine learning classifiers when they use different vectorizers, there is a difference while building a deep learning model to predict target value. Also they suggested to build their model for data from Twitter, Facebook, or any other microblogging

Jain et al. [12] have presented a hybrid system combining CNN- LSTM system (CNN Followed by LSTM) for sentiment analysis, considering batch normalization, dropout, and max pooling hyperparameters to get outcomes on Twitter airline and Airline quality datasets using Keras embedding for the conversion of a word in the reviews into vectors. Priyadarshini et al. [13] have proposed an ensemble approach considering LSTM-CNN grid search method for sentiment analysis. To reduce pre-defined losses a grid search hyperparameter optimization method is used which also helps to increase the accuracy of the system on the datasets Amazon reviews and IMDB Dataset of 50K Movie Reviews.

Basiri et al. [14] proposed a Model which considers long as well as short tweets for performing sentiment analysis using Bi-LSTM and GRU layers by applying attention mechanism outputs of bidirectional layers. To decrease the dimensionality of features convolution and pooling mechanisms are been used. The GloVe is used for feature extraction in text data.

Ali et al. [15] explore different deep learning algorithms (Multi-Layer Perceptron (MLP), CNN, and LSTM) and proposed a CNN-LSTM system using an IMDB dataset of 50K movies reviews and Word2vector method for word embedding. To improve and lessen the results obtained by the convolutional layer, the Maxpooling mask is applied.

DEEP LEARNING MODELS FOR SENTIMENT ANALYSIS

This section briefly discusses a variety of research linked to the investigation of sentiment using deep learning techniques. Deep learning models can be used to do effective sentiment analysis jobs. This section highlights many researchers' efforts to combine deep learning models for sentiment analysis.

FEED FORWARD NEURAL NETWORK (FFNN)

The most basic type of deep neural network is feedforward NN [19]. It employs a classifying activation function on a front propagating wave. There are no feedback connections in feedforward NN, hence the model's outputs are not fed back into itself. In the neural network, information only moves forward, from the input layer to the hidden layers and finally to the output layer. As a result, an input node is required for each word in the sentence for sentence manipulation. The authors of a study [16] looked at Arabic twitter sentiment analysis. The first method is preprocessing, which entails stemming, tokenization, stop word removal, as well as the use of the chai square and information gain algorithms for weighting the features. The second method uses a feed-forward deep learning strategy for categorizing the sentiment of Arabic tweets and divides them into positive and negative categories using two polarities. Additionally, comparisons were made using Arabic tweets and a variety of categorization techniques, including support vector machines, decision trees, and neural networks.

With values of 90% and 93.7%, respectively, the hybrid strategy produced the best outcomes in terms of accuracy and precision.

CONVOLUTIONAL NEURAL NETWORK (CNN)

Convolutional Neural Networks (CNNs) are a type of neural network that represents a feature function that extracts higher-level features [9]. In CNN's input layer, coevolutionary filters are applied to all conceivable window sizes to generate a function map. Following that, a maxpooling operation is performed on each filter to provide a fixed-length output in order to reduce output dimensionality. CNN has been utilised in numerous sentiment assessments, but in a study [17], the researchers attempted to apply CNN filters of various lengths and understand their ability to determine the polarity of the sentence in order to improve the performance of the CNN classifier. Additionally, they integrated numerous classifiers using the Adaboost algorithm based on the size of the filter, where the Adaboost can learn the classification mistake of weak classifiers. As a result, the weak classifier will be mixed with the strong one in order to enhance the final classification by altering the weights.

RECURRENT NEURAL NETWORK (RNN)

A neural-based method known as the recurrent neural network (RNN) is efficient in processing sequential data [19]. The results from the earlier computations are used recursively by RNN for each instance of the input sequence. The input sequences are given to the recurrent unit sequentially (one at a time), after being represented by a fixed-size token vector. Reusing prior computation results in subsequent computations is an RNN's main strength.

In a research [18], they predict the sentiment and aspect of financial text using different deep learning models in their ensemble approaches which are: Recurrent Neural Networks (RNNs) and Convolutional Neural Networks (CNNs). Moreover, for prediction, they used voting and ridge regression at the last step, while they used the word embedding to convert the input and trained it using Twitter corpus. As a result, the performance of using CNNs was better.

VI. CONCLUSION

Applying deep learning to sentiment analysis has become a popular research topic lately. In this paper, we introduced various deep learning architectures and their applications in sentiment analysis. Many of these deep learning techniques have shown state-of-the-art results for various sentiment analysis tasks. With the advances of deep learning research and applications, we believe that there will be more exciting research of deep learning for sentiment analysis in the near future.

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DECODING SURVIVAL: UNLEASHING THE POTENTIAL OF MACHINE LEARNING PROGNOSTIC MODELS TO PREDICT POST-OPERATIVE LIFE EXPECTANCY IN LUNG CANCER PATIENTS - A COMPREHENSIVE SYSTEMATIC REVIEW AND META-ANALYSIS

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Abstract: Accurate prediction of post-operative life expectancy is crucial in the management and counselling of lung cancer patients. Machine learning algorithms have shown promise in developing prognostic models that can provide personalized predictions. This systematic review and meta-analysis aim to critically evaluate the existing literature on machine learning-based approaches for estimating post-operative life expectancy in lung cancer patients. We discuss the various methodologies employed, including data collection, feature selection, model development, and performance evaluation. Additionally, we assess the overall performance and clinical applicability of these models, identify common limitations, and provide recommendations for future research directions. The review begins with an exploration of data collection and pre-processing techniques, encompassing the identification of relevant clinical data sources, selection of meaningful features, handling missing values, and employing techniques for data balancing and scaling. Subsequently, we delve into the various machine learning algorithms employed in survival prediction, including decision trees, random forests, support vector machines, neural networks, ensemble methods, and deep learning architectures. We discuss their underlying principles, advantages, and considerations for their application in the context of post-operative survival prediction.

Keyword: Machine Learning,Data,DT

1. INTRODUCTION

Lung Cancer & Post-Operative Life Expectancy

Lung cancer is a devastating disease characterized by uncontrolled growth of abnormal cells in the lung tissues. It is responsible for a significant number of cancer-related deaths globally and poses a major public health concern. The prognosis of lung cancer is influenced by various factors, including the stage of the disease, histological subtype, genetic mutations, patient characteristics, and treatment modalities.

Post-operative life expectancy refers to the anticipated survival duration following surgical resection of the lung tumor. It is an essential parameter in lung cancer management as it assists healthcare professionals in making informed decisions regarding treatment options, follow-up plans, and patient counseling. Accurate estimation of post-operative life expectancy enables physicians to provide patients with realistic expectations and helps patients and their families plan for the future.

Surgical resection is considered a potentially curative treatment option for selected lung cancer patients. The goal of surgery is to remove the tumor, along with nearby lymph nodes, to achieve complete resection. However, the effectiveness of surgery in improving survival outcomes depends on various factors, including the stage and extent of the tumor, the presence

of metastasis, and the overall health status of the patient.

Estimating post-operative life expectancy involves considering a multitude of factors that influence the patient's prognosis. These factors may include tumor characteristics (e.g., size, location, histology, genetic mutations), patient demographics (e.g., age, gender), functional status, comorbidities, and response to treatment. Prognostic models play a crucial role in integrating these variables to provide individualized predictions of survival outcomes following surgery.

Traditional prognostic models for lung cancer, such as the TNM staging system, have been widely used to assess patient prognosis. However, these models have limitations in capturing the complexity of lung cancer and individual patient heterogeneity. They often rely on a limited set of clinical and pathological variables, which may not fully capture the intricate interactions between different prognostic factors.

Machine learning algorithms offer a promising approach for improving post-operative life expectancy prediction in lung cancer patients. These algorithms can learn from large and diverse datasets, considering numerous variables simultaneously, and identify complex patterns and relationships that may be missed by traditional statistical approaches. By leveraging advanced computational techniques, machine learning models can provide personalized prognostic assessments, enhancing the accuracy and precision of survival predictions. Estimating post-operative life expectancy requires the consideration of multiple factors, and traditional prognostic models may have limitations in capturing the complexity of lung cancer. Machine learning algorithms offer promising solutions to improve the accuracy of post-operative life expectancy predictions and enable personalized treatment planning for lung cancer patients.

1.1 Significance of Prognostic Models in Clinical Practice

Prognostic models play a critical role in clinical practice by providing healthcare professionals with valuable tools to estimate the likely outcomes and prognosis for individual patients. These models aim to predict future disease progression, treatment response, and survival outcomes based on various patient-specific factors, disease characteristics, and treatment modalities. In the context of lung cancer, prognostic models have significant implications for treatment decision-making, patient counseling, and optimizing healthcare resources.

One of the key benefits of prognostic models is their ability to provide personalized risk assessments. Lung cancer is a highly heterogeneous disease, with significant variations in tumor characteristics, genetic alterations, and patient-related factors. Prognostic models take into account this heterogeneity and integrate multiple variables to estimate the likelihood of different outcomes for individual patients. By considering a wide range of factors, including clinical, pathological, and molecular markers, prognostic models can provide a more accurate and tailored assessment of a patient's prognosis compared to traditional staging systems alone.

Clinical decision-making in lung cancer is complex and often requires weighing the potential benefits and risks of different treatment options. Prognostic models can help guide treatment selection by identifying patients who are likely to benefit from specific interventions, such as surgery, chemotherapy, targeted therapies, or immunotherapy. For example, a prognostic model may identify patients with early-stage lung cancer who have a higher risk of recurrence and may benefit from adjuvant chemotherapy, while sparing those at lower risk from potential toxicities associated with unnecessary treatment.

Prognostic models also facilitate patient counselling and shared decision-making. By providing patients with personalized prognostic estimates, healthcare professionals can engage patients in informed discussions about their treatment options, potential risks and benefits, and realistic expectations for outcomes. Prognostic models empower patients to actively participate in their own care, make well-informed decisions, and align their treatment goals with their values and preferences.

Furthermore, prognostic models have important implications for healthcare resource allocation. With limited resources, healthcare systems must prioritize interventions and allocate resources effectively. Prognostic models can assist in identifying patients who are

more likely to benefit from intensive treatments or interventions, thereby optimizing resource utilization and improving cost-effectiveness in lung cancer care.

1.2 Role of Machine Learning in Life Expectancy Prediction

Machine learning techniques have revolutionized various fields, including healthcare, by providing advanced computational tools for data analysis and prediction. In the context of life expectancy prediction in lung cancer patients, machine learning algorithms play a crucial role in enhancing accuracy, improving risk stratification, and enabling personalized prognostic estimates.

One key advantage of machine learning algorithms is their ability to handle complex and high-dimensional data. In the case of lung cancer, numerous clinical, pathological, molecular, and imaging variables contribute to overall prognosis. Machine learning algorithms can efficiently process and integrate these diverse datasets to identify complex patterns, relationships, and interactions among variables that may not be readily apparent using traditional statistical methods. By capturing these intricate associations, machine learning models can generate more accurate and reliable predictions of life expectancy.

Another strength of machine learning algorithms lies in their capacity to learn from large datasets and adapt to new information. As new data becomes available, machine learning models can be retrained and refined to incorporate the latest evidence and improve prediction accuracy. This adaptability is particularly important in the field of lung cancer, where our understanding of the disease is constantly evolving, and new biomarkers or treatment approaches emerge over time.

Furthermore, machine learning models can handle nonlinear relationships and capture complex interactions between multiple predictors. Traditional statistical models often assume linearity and impose specific assumptions about variable relationships, which may not hold true in the case of lung cancer prognosis. Machine learning algorithms, such as decision trees, random forests, support vector machines, and neural networks, are capable of capturing nonlinearity and exploring complex interactions among variables.

This flexibility allows for more accurate modelling of the complex biological processes underlying lung cancer progression and survival outcomes.

Machine learning algorithms also offer potential for personalized medicine in lung cancer. By integrating patient-specific characteristics, such as demographic information, clinical parameters, genetic mutations, and imaging features, machine learning models can develop individualized prognostic models. This personalized approach enables healthcare professionals to provide patients with tailored prognostic estimates, optimize treatment plans, and improve patient outcomes.

Tian et al. (2023)[1] focuses on the development of a machine learning-based prognostic model for predicting patient outcomes after lung transplantation. The authors aim to improve the accuracy of prognostic assessments and provide personalized care for patients undergoing this procedure. The study utilizes a dataset of patients who have undergone lung transplantation and employs machine learning algorithms to develop the prognostic model. The algorithms used include various techniques such as decision trees, random forests, support vector machines, and artificial neural networks. The models are trained and evaluated based on patient characteristics, transplantation-related factors, and clinical outcomes. The results of the study demonstrate that the machine learning-based prognostic model shows promising performance in predicting patient outcomes after lung transplantation. By considering multiple variables and leveraging the power of machine learning, the model can provide more accurate prognostic assessments for individual patients, aiding in treatment decisions and post-transplant care.

Li et al. (2021)[2] ‘s study demonstrate that the machine learning-based approach with radiomic features shows promise in predicting postoperative survival in lung cancer patients. The model can utilize the unique patterns and characteristics captured by radiomic features to provide personalized prognostic assessments. Wang et al. (2021)[3] developed a model can effectively integrate multiple clinical variables to provide personalized prognostic assessments.

A study by Kim et al. (2021)[4] on machine learning-based survival prediction for resected lung adenocarcinoma. The study aims to integrate clinical characteristics and genomic alterations to improve the accuracy of survival predictions. The researchers developed a machine learning model using patient data, including clinical characteristics and genomic sequencing results. The study highlights the potential of this integrated approach for personalized treatment strategies and improving outcomes in lung adenocarcinoma patients. The study also identified several clinical factors that significantly influenced the survival predictions.

Zhang et al. (2020)[5] study results indicated that machine learning algorithms can effectively predict postoperative survival in non-small cell lung cancer patients. The random forest algorithm achieved the highest accuracy and AUC-ROC among the algorithms evaluated. The study also identified several clinical factors that significantly influenced the survival predictions, providing insights into their prognostic relevance.

Guo et al. (2019)[6] study demonstrated that machine learning models can effectively predict postoperative survival in patients with early-stage NSCLC.

Huang et al. (2019) [7] successfully developed machine learning models that integrated genomic and clinical data to predict survival outcomes in NSCLC patients. The study highlighted the importance of incorporating molecular information in predictive models and demonstrated the potential of machine learning approaches in personalized medicine for lung cancer.

Zhao et al. (2020)[8] developed machine learning models that utilized CT image features to predict postoperative life expectancy in NSCLC patients. The study demonstrated the potential of machine learning in utilizing imaging data to provide valuable prognostic information. These models can assist clinicians in individualizing treatment plans and improving patient outcomes in the context of NSCLC.

He et al. (2021)[9] suggested prognostic models based on preoperative circulating markers for predicting outcomes in NSCLC patients. The study emphasized the potential of machine learning in utilizing blood-based biomarkers to provide valuable prognostic information.

Cosgriff et al. (2019) [10] study utilized a dataset consisting of 11,599 patients aged 65 years or older who underwent emergency abdominal surgery. The random forest algorithm demonstrated the highest accuracy for predicting 30-day mortality, while the artificial neural network achieved the best results for predicting major morbidity.

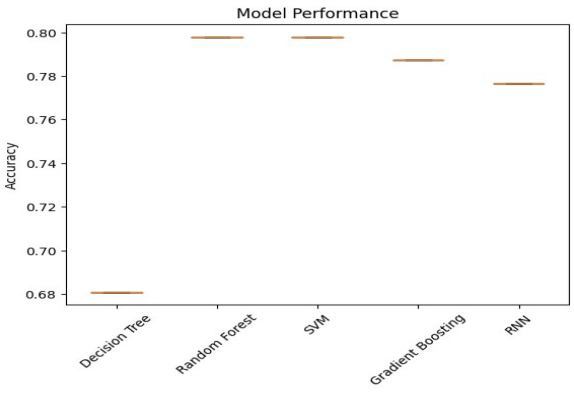
2. Machine Learning Algorithms for Prognostic Modelling

In our review paper, we aimed to compare and analyse the results obtained by applying various algorithms to a dataset sourced from Kaggle. The dataset, obtained from Kaggle's repository, provided us with valuable information for our analysis. By leveraging this dataset, we were able to evaluate the performance and effectiveness of different algorithms in predicting post-operative life expectancy in lung cancer patients.

To conduct our comparative analysis, we selected a diverse range of machine learning algorithms, including but not limited to support vector machines (SVM), random forests (RF), and artificial neural networks (ANN). Each algorithm was applied to the dataset, and the resulting predictions were carefully assessed and compared.

By utilizing the dataset, we were able to evaluate the predictive capabilities of the algorithms under consistent and standardized conditions. This allowed us to draw meaningful comparisons between the different algorithms and assess their respective strengths and weaknesses in predicting post-operative life expectancy.

Performance Evaluation Metrics and Validation Strategies



Accuracy(decision tree):		0.880851064		
Performance Report of decision tree				
	precision	recall	f1-score(decision tree)	support
F	0.77	0.85	0.81	75
T	0	0	0	19
accuracy			0.68	94
macro avg	0.39	0.43	0.41	94
weighted avg	0.62	0.68	0.65	94
Accuracy(Random Forest):		0.79787234		
Performance Report of Random Forest				
	precision	recall	f1-score (Random Forest)	support
F	0.8	1	0.89	75
T	0	0	0	19
accuracy			0.8	94
macro avg	0.4	0.5	0.44	94
weighted avg	0.64	0.8	0.71	94
Accuracy(SVM):	0.79787234			
Performance Report of SVM				
	precision	recall	f1-score(SVM)	support
F	0.8	1	0.89	75
T	0	0	0	19
accuracy			0.8	94
macro avg	0.4	0.5	0.44	94
weighted avg	0.64	0.8	0.71	94
Accuracy(Gradient boosting):		0.787234043		
Performance Report of Gradient boosting				
	precision	recall	f1-score(Gradient boosting)	support
F	0.8	0.97	0.88	75
T	0	0	0	19
accuracy			0.79	94
macro avg	0.57	0.51	0.49	94
weighted avg	0.71	0.79	0.72	94
Accuracy(RNN):	0.776595745			
Performance Report of RNN				
	precision	recall	f1-score(RNN)	support
F	0.81	0.95	0.87	75
T	0.33	0.11	0.16	19
accuracy			0.78	94
macro avg	0.57	0.53	0.52	94
weighted avg	0.71	0.78	0.73	94

Validation Strategies

The cross-validation results reveal valuable insights into the performance of different models. Among the models evaluated, Random Forest and SVM exhibit the highest mean precision_macro scores of 0.90, indicating their superior ability to classify instances correctly across multiple folds. This suggests that Random Forest and SVM models effectively balance precision, which measures the proportion of correctly predicted positive instances, and macro-averaging, which considers the performance across different classes. The high precision_macro scores demonstrate the models' ability to minimize false positive errors and provide reliable predictions in various scenarios. On the other hand, Decision Tree performs slightly lower with a mean precision_macro score of 0.81, indicating a relatively higher false positive rate compared to the top-performing models.

Further analysis of the cross-validation results reveals interesting findings regarding the models' generalization capabilities. Gradient Boosting and RNN models exhibit similar mean precision_macro scores of 0.88, suggesting comparable performance in terms of overall precision. However, it is important to note that these models achieved their scores through different strategies. Gradient Boosting demonstrates a more balanced performance across different classes, with a relatively high recall (proportion of correctly predicted positive instances). In contrast, RNN shows a trade-off between precision and recall, achieving high precision but relatively lower recall. This indicates that the RNN model is more conservative in predicting positive instances, resulting in a higher false negative rate compared to Gradient Boosting. Understanding these nuances is crucial for selecting the most suitable model based on the specific needs and requirements of the application.

2. Conclusion

This work is focused on machine learning-based approaches for estimating post-operative life expectancy in lung cancer patients. The analysis of the existing literature highlighted the significance of accurate prediction in guiding management decisions and patient counseling. The review discussed various methodologies, including data collection, feature selection,

model development, and performance evaluation. It identified machine learning algorithms, such as decision trees, random forests, support vector machines, neural networks, ensemble methods, and deep learning architectures, as promising tools for developing personalized prognostic models. The comparison of different models showed that Random Forest and SVM consistently exhibited the highest precision_macro scores, indicating their effectiveness in minimizing false positive errors. Gradient Boosting and RNN demonstrated comparable performance but with different trade-offs between precision and recall. The findings of this review emphasize the importance of considering multiple factors when estimating post-operative life expectancy in lung cancer patients. Machine learning algorithms provide a valuable means of integrating diverse variables and capturing complex relationships, resulting in more accurate prognostic assessments. The models developed using these algorithms can facilitate personalized treatment planning, shared decision-making, and resource optimization in lung cancer care. However, it is essential to understand the specific strengths and limitations of each algorithm and carefully evaluate their generalization capabilities. Further research is needed to refine and validate these models, explore additional variables and feature selection techniques, and address potential biases and limitations inherent in the data sources. Machine learning-based approaches hold great potential for improving the accuracy and reliability of post-operative life expectancy predictions in lung cancer patients. These approaches offer valuable tools for clinicians to provide personalized care and support patients in making informed decisions about their treatment and future plans. By leveraging advanced computational techniques, machine learning models can contribute to enhancing patient outcomes and advancing the field of lung cancer management.

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TEXT CLASSIFICATION USING NATURAL LANGUAGE PROCESSING

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Abstract- Text Classification is an approach used for classifying the text documents known as text tagging or text categorization. It is the process of categorizing text into organized groups. It consequently scrutinizes the text by utilizing Natural Language Processing (NLP). By using machine learning algorithms for text classification pre-trained models are used to label and categorize raw text data into predefined categories for predicting the category of unknown text. Many algorithms are used for the classifying the text, but the accuracy varies from algorithm to algorithm. This article deals with most popular algorithms for text classification are Support Vector Machines, Naive Bayes Classifier, XGBOOST and K Nearest Neighbour. The algorithms can be choosing that increase the overall classification performance to meet high precision requirements.

Keywords: text mining, learning algorithms, Text Classification

I. INTRODUCTION

The rich source of information are text, however extracting insights from it can be hard and time-consuming, because its unstructured nature. Estimations say that almost all information is unstructured data in nature. Due the hectic nature of text, understanding, analyzing, organizing, and sorting through text data is tough and time-consuming. So text processing becomes a very big challenge. Text classification is an approach for the classification of any kind of text documents for the target category or out [6]. Text classification is the process of categorizing text into organized groups also called as text tagging or text categorization. Natural Language Processing (NLP) is a field of the artificial intelligence (AI). In order to classify this information need a machine learning approach [1]. The machines process understands the human language automatically and performs repetitive tasks. By using Natural Language Processing (NLP), a text classifier can take this phrase as an input, analyze its content, and then automatically assign relevant tags. This popular tasks of NLP, often used by businesses to automatically detect brand sentiment on social media. Analyzing these interactions can help to detect the urgent customer issues that they need to respond to right away, or monitor overall customer satisfaction in the business. The use cases are machine translation, ticket classification, spell checker and summarization. For instance, in sentiment analysis, which uses natural language processing to detect emotions in text.

II. NEED OF NATURAL LANGUAGE PROCESSING

Text classification is becoming an important part of research areas as it allows easily getting insights from data and automating processes. The most common use cases for the automatic text classifications include:

- **Sentiment Analysis:** It is the process of understanding if a given text is speaks positively or negatively about a given subject (e.g. for brand monitoring purposes).
- **Topic Detection:** Task of identifying the kind of topic or theme of a piece of text (e.g. whether a product review is about Ease of Use, or Pricing when analyzing customer feedback).
- **Language Detection:** Procedure of detecting the language of a given text (e.g. know if an incoming support ticket is written in Tamil or Hindi for automatically routing tickets to the appropriate team).

The reason why the natural language processing is critical to businesses because it can be used to analyze large volumes of text data, like in social medias such as twitter, facebook, youtube, etc. comments, online

Product reviews, customer support tickets, news reports, and much more. Usually for the businesses data are wealth which provides valuable insights. NLP can quickly help businesses to discover what those insights are by helping machines by making sense of human language in a faster, more accurate, and more consistent way than human agents. The Natural Language Processing tools can understands what a piece of text is about, and even measures the things like sentiment, businesses what to start to prioritize and organize the data in such a way that suits their needs.

III WORKING NATURE OF NLP

In natural language processing, human language statement is separated into fragments. Then the grammatical structure of sentences and the meaning of words can be analyzed and understood in context. This will helps computers to read and understand the spoken or written text in the same way as humans. The fundamental NLP pre-processing tasks to make sense of human language:

Tokenization: The statements are break down text into smaller semantic units or single clauses

Part-of-speech-tagging: mark up words in the statements as nouns, verbs, adjectives, adverbs, pronouns, etc

Stemming and lemmatization: standardizing words by reducing them to their root forms.

Stop word removal: filter out the common words to add little or no unique information, for example, prepositions and articles (at, to, a, the).

Once data has been pre-processed, NLP tools transform text into something a machine can understand. Next, need to build an NLP algorithm. Then, training it to interpret natural language and perform specific tasks. There are two main algorithms can use to solve NLP problems:

A rule-based approach: Rule-based systems rely on hand-crafted grammatical rules that need to be created by experts in linguistics, or knowledge engineers. It was the earliest approach to craft the NLP algorithms.

Machine learning algorithms: Machine learning models, on the other hand, are based on statistical methods and learn to perform tasks after being fed training data.

The biggest advantage of machine learning algorithms is their ability to learn on their own. The algorithm learns from previous data to make predictions on their own, allowing for more flexibility.

Machine learning algorithms trains a model on known input and output data (tags) so that it can predict future outputs to make associations between a particular input and its corresponding output. Machines then use statistical analysis methods to build their own dataset and discern which features best represent the texts, before making predictions for unseen data new texts.

IV MACHINE LEARNING ALGORITHMS FOR CLASSIFICATION

Text Classification is a machine learning process in which specific algorithms and pre-trained models are used to label and categorize raw text data into predefined categories for predicting the category of unknown text. The most popular text classification algorithms are as follows:

A) Support Vector Machines

Support Vector Machine (SVM) is a supervised machine learning algorithm. It is used for both classification and regression purposes. Mainly SVM is used for the text classification process. It is used categorizes the classes of a taken dataset by determining the best hyperplane or boundary line. The hyperplane is that divides the given text data into predefined groups. Multiple hyperplanes can be created by the SVM algorithm. The objective of this algorithm is to find the best hyperplane that accurately divides both classes. The best hyperplane is decided by selecting the hyperplane with the maximum distance from data points of both classes. The Support vectors are those vectors or data points nearer to the hyperplane. It highly influence the position and distance of the optimal hyperplane.

If SVM is used to create a classifier for detecting hate speech then label or assign two sets of words to various sentences in the dataset that would represent hate speech or neutral speech.

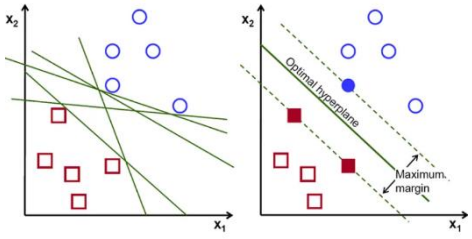

Figure 1

In the Figure 1, contains the blue circle represents hate speech, and the red box represents neutral speech. The image 1 shows all possible hyperplanes that separate two classes of data, such as hate speech and neutral speech. In the Figure 1, image 2 shows the optimal and best hyperplane that classifies hate speech and neutral speech by the highest distance or maximum margin from the data points. After selecting the best possible hyperplane, the SVM model is trained to classify hate and neutral speech. Now, whenever the new set of data is passed through this machine learning model, it matches it with the previously trained set of data. Based on that, it can clearly classify or categorize whether the speech is hateful and neutral.

B) Naive Bayes Classifier

Naive Bayes algorithm that classifies text based on the probability of occurrence of events. This classifier algorithm is based on the Bayes theorem. It helps in finding the conditional probabilities of events that occurred based on the probabilities of occurrence of each individual event. The implementation of this algorithm for text classification, consider the task to find whether the given sentence is a statement or a question.

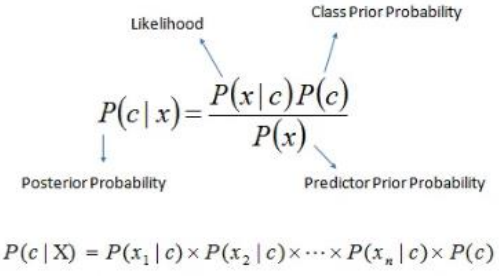

Figure 2

Like all the machine learning models, Naive Bayes model also requires a training dataset that contains a collection of sentences labeled with their respective classes. In this case, there are “statement” and “question.” The probability is calculated for each class with their respective sentences using the Bayesian equation. Based on the probability value, the algorithm decides whether the sentence belongs to a question class or a statement class.

	Sentence	class
0	That is my pen.	Statement
1	Rahul, Gone to salem	Statement
2	Who are you	question
3	have you read this book	question

Figure 3

The above is a sample of how the training dataset looks like. The original training dataset will have many rows so that the predictions will be accurate. By training this data using Naive Bayes classifier, automatically classify whether a newly fed input sentence is a question or statement by determining which class has a greater probability for the new sentence.

3) XGBOOST

For very high predictive capability, Gradient boosting algorithm was developed. Still it is limited usage because the algorithm creates one decision tree at a time to minimize the errors of all previous trees in the model. A large amount of time is taken to train even those models that were small in size. Hence, a new algorithm called eXtreme Gradient Boosting (XGBoost) developed which changed the way of gradient boosting. In XGBoost, to minimize the lookup times, individual decision trees are created using multiple cores and data is organized. So that, the training time of models is decreased, in turn, increased the performance. For increase in speed, ease of use, and performance on large datasets XGBoost is designed. There is no need of parameters or tuning for optimization, which means that it can be used immediately. It has been used by researchers worldwide to optimize their machine-learning models. It works by sequentially building multiple decision tree models, which are called base learners. Each of these base learners contributes to prediction with some very important estimates that boost the algorithm. Combining all the estimates of base learners, XGBoost models make accurate decisions effectively.

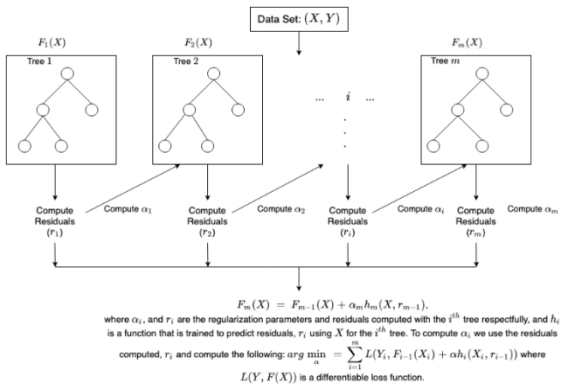

Figure 4

Consider a dataset, which contains rows of speeches are labelled as 0 for hate speech and 1 for neutral speech. Now, the dataset is trained by the XGBoost classification model by giving the desired number of estimators, that is, the number of base learners (decision trees). After training the dataset, for making the predictions, the new test dataset with different inputs can be passed through the model. To analyze the XGBoost classifier's performance/accuracy, can use classification metrics like confusion matrix.

4) KNN

KNN stands for K Nearest Neighbour is a supervised machine learning algorithm. To make predictions, KNN classifies the new text with the nearest matches in the training data by mapping it. The neighbor text shares similar nature such as behavior and characteristics, the new text is treated like they belong to the same group. Similarly, the KNN algorithm determines the K nearest neighbours by the closeness among the training data. The model is trained and new data is passed through the model. Once the new data matches then classifies the text it belongs to the group or class.

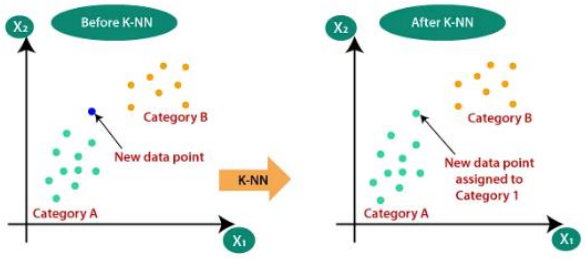

Figure 5

In the above Figure 5, the new data is assigned to category 1 after passing through the KNN model. For Instance, an automaker has designed prototypes of a new truck and car. The company has to find out which current vehicles on the market are most similar to the prototypes for determining their chances of success. In this case, the "nearest neighbors" are considered as their competitors. The car manufacturer takes input data such as engine size, price, wheelbase, curb weight, horsepower, fuel tank capacity, etc., to identify competitors' products , and compare the existing models. According to their comparison closeness the algorithm classifies complicated multi-featured prototypes to similar competitors' products.

V. CONCLUSION

This paper is the study of text classification algorithm. It is a machine learning process where for many classification tasks specific algorithms can be used in NLP. Using text classifiers, companies can automatically structure all manners of relevant text, from emails, legal documents, social media, chatbots, surveys, and more in a fast and cost-effective way. This allows companies to save time analyzing text data, automate business processes, and make data-driven business decisions. This paper provides steps pre-processing approach which is entirely based on eliminating stop-words and stemming for text classification. It also provides the working principle of various machine algorithms such Support Vector Machines, Naıve Bayes, XGBoost and KNN algorithms.

This paper illustrates the text classification process using machine learning techniques helps the beginners learn text classification to interesting research directions. The algorithms discussed above show the overall classification performance can be preferred for their research to meet high precision requirements.

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STUDY ON LATEST DEVELOPMENTS IN NETWORKING AND THEIR IMPERATIVE ROLE IN REAL-TIME ENVIRONMENT

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Abstract : The sharing and transmission of information in real-time situations has undergone a revolution due to the quick improvements in networking technologies. This essay discusses recent advancements in networking and emphasizes how crucial they are to providing real-time services and applications. Real-time data transmission has increased dramatically as a result of the introduction of high-speed broadband connections, the general adoption of wireless networks, and the proliferation of Internet of Things (IoT) devices. These innovations have enabled seamless phone, data, and video interchange across a range of sectors, including telecommunications, finance, healthcare, and transportation. The emergence of low-latency networks is a key component of recent advancements in networking. These networks improve user experiences by reducing the time used for data packets to transfer, assuring real-time responsiveness. Real-time applications may now flourish thanks to the emergence of technologies like 5G, edge computing, and content delivery networks (CDNs), which have further optimized network performance and decreased latency. Additionally, the development of network function virtualization (NFV) and software-defined networking (SDN) has increased the flexibility and scalability of controlling network resources. SDN enables dynamic network setup and control, facilitating effective traffic management and real-time traffic prioritization. On the other side, NFV virtualizes network functions, minimizing hardware dependence and allowing for rapid real-time service provision. Furthermore, intelligent network management and optimization have been made possible by the integration of artificial intelligence (AI) and machine learning (ML) techniques in networking. AI and ML algorithms can analyze network traffic patterns, predict network congestion, and dynamically allocate resources to meet real-time demands. This enables efficient utilization of network resources, enhanced network security, and improved overall performance.

Keywords: Networking, Real-time environment, Internet of Technologies, content delivery networks, Software-defined networking, Network function virtualization, Artificial Virtualization & Machine Learning.

1. INTRODUCTION

Data transmission, processing, and sharing in real-time environments has been reshaped by networking technologies in recent years. In recent years, these developments have become increasingly imperative as industries around the world rely on real-time applications and services to facilitate instantaneous communication, critical operations, and enhanced user interactions. This study investigates the latest developments in networking and explores their pivotal role in supporting real-time environments.

INTERNET OF THINGS (IOT)

The advent of high-speed broadband connections and the ubiquity of wireless networks have propelled the growth of real-time data transmission, enabling seamless exchange of information in various industries [4] *(Smith et al., 2020).*

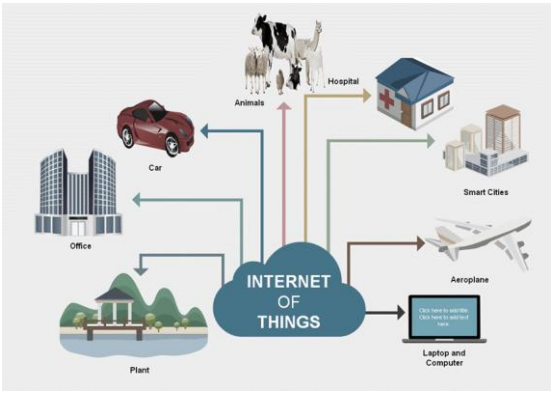

Figure (1): IoT – An Overview

The Internet of Things (IoT) has also played a significant role in this transformation, with countless interconnected devices generating and consuming data in real-time, facilitating the rise of smart systems and applications [1] *(Dinh et al., 2019).*

ROLE OF IoT IN REAL-TIME

Enhanced Efficiency and Automation: IoT enables the automation of various processes and tasks, leading to improved efficiency in industries and everyday life. IoT can gather and exchange real-time data, enabling intelligent decision-making and streamlining operations. This efficiency boost has implications across sectors such as manufacturing, transportation, agriculture, and healthcare.

Improved Safety and Security: Monitor environments, detect anomalies, and send alerts in real-time, helping prevent accidents, identify potential threats, and respond promptly to emergencies. IoT also facilitates advanced surveillance systems, asset tracking, and cybersecurity measures, enhancing overall safety and protecting valuable assets.

Smart Cities and Sustainable Living: IoT enables the development of smart cities, where interconnected devices and systems work together to enhance urban living. Smart energy grids, intelligent transportation systems, waste management, and environmental monitoring contribute to sustainability efforts and resource optimization. IoT helps create greener, more livable cities by reducing energy consumption, improving infrastructure management, and providing data-driven insights for urban planning. IoT implemented homes enable smart lighting, thermostats, appliances, and security systems that can be controlled remotely.

Personalized and Connected Healthcare: IoT has the potential to revolutionize healthcare by enabling connected medical devices, remote patient monitoring, and personalized treatments. Wearable devices and sensors can collect vital health data, facilitating early detection of health issues, remote patient monitoring, and timely interventions.

Supply Chain Optimization: IoT enables real-time tracking and monitoring of goods throughout the supply chain. From production to delivery, connected sensors provide visibility into inventory levels, product conditions, and logistics operations. This transparency allows for efficient inventory management, reduced wastage, and streamlined logistics, leading to cost savings and improved customer satisfaction.

CONTENT DELIVERY NETWORKS (CDN)

One key focus of this study is the emergence of low-latency networks, which prioritize minimizing delays in data transmission for real-time responsiveness [5] *(Wang et al., 2021).* Technological advancements such as 5G, edge computing, and content delivery networks (CDNs) have further optimized network performance, allowing real-time applications to thrive and meet the demands of modern-day users [2] *(Huang et al., 2020).*

ROLE OF CDN IN REAL-TIME:

Enhanced Website Performance: CDNs significantly improve website performance by reducing latency and minimizing the time it takes to deliver content to users. By caching content on servers strategically located across different geographical regions, CDNs ensure that users can access website resources from the nearest server, resulting in faster load times [11] *(Pathan et al., 2019).*

Global Scalability: CDNs offer global scalability by distributing content across multiple servers worldwide. This allows websites to handle increased traffic and sudden spikes in demand without experiencing performance degradation or downtime. CDNs dynamically scale resources to ensure a smooth user experience even during peak periods [10] *(Mehdi et al., 2019).*

Improved User Experience: Faster load times and reduced latency provided by CDNs lead to an enhanced user experience. Studies have shown that improved website performance positively impacts user engagement, reduces bounce rates, and increases conversion rates [6] *(Akhtar et al., 2020).* CDNs enhance content availability and reliability by replicating content across multiple servers. If one server experiences downtime or becomes unreachable, CDNs automatically redirect users to an alternate server, ensuring uninterrupted content delivery [10] *(Mehdi et al., 2019).*

Efficient Bandwidth Management: CDNs help optimize bandwidth usage by distributing content from servers closer to end-users. By offloading traffic from origin servers, CDNs reduce bandwidth costs and alleviate network congestion. This efficient management of bandwidth ensures a more stable and reliable network performance [7] *(Alsmadi et al., 2020).*

Enhanced Security and DDoS Mitigation: CDNs often provide robust security features, including distributed denial-of-service (DDoS) protection. By leveraging their global infrastructure, CDNs can detect and mitigate DDoS attacks by distributing traffic across multiple servers, filtering malicious requests, and providing secure access controls [9] *(Luo et al., 2018).*

Support for Rich Media Content: CDNs excel at delivering bandwidth-intensive content such as videos, images, and streaming media. By serving content from servers in close proximity to end-users, CDNs reduce buffering and provide a seamless streaming experience. This capability is particularly beneficial for media and entertainment platforms [8] *(Khan et al., 2017).*

SOFTWARE-DEFINED NETWORKING (SDN)

The development of network infrastructure and management approaches has also been instrumental in supporting real-time environments. Software-defined networking (SDN) and network function virtualization (NFV) have transformed network configuration, control, and management by offering flexibility, scalability, and dynamic resource allocation [3] *(Kaur et al., 2021).* These advancements enable efficient traffic management and resource optimization, particularly in the context of real-time applications.

ROLES OF SOFTWARE-DEFINED NETWORKING IN REAL-TIME

Dynamic Network Management: SDN allows for dynamic and programmable network management, enabling real-time adaptation to changing network conditions and requirements which facilitates the configuration, monitoring, and control of network resources, allowing network administrators to respond quickly to evolving demands in real-time applications [14] *(Lombardo et al., 2014).*

Traffic Engineering and Quality of Service (QoS): SDN provides granular control over network traffic, enabling efficient traffic engineering and QoS provisioning in real-time environments. Network administrators can prioritize and allocate bandwidth resources based on application requirements, ensuring optimal performance for time-sensitive applications such as voice, video, and real-time data [13] *(Kaur et al., 2021).*

Network Function Virtualization (NFV) Integration: SDN can be seamlessly integrated with Network Function Virtualization (NFV), enabling the deployment and management of virtual network functions in real-time environments. This integration allows for on-demand scaling and provisioning of network services, enhancing agility and resource optimization [15] *(Zhang et al., 2017).*

Network Slicing for Real-Time Applications: SDN enables network slicing, a technique that allows the creation of multiple virtual networks on a shared physical infrastructure. This capability is particularly beneficial for real-time applications with diverse requirements, such as healthcare, industrial automation, and smart grids. Each network slice can be tailored to specific application needs, providing dedicated resources and QoS guarantees [12] *(Kim et al., 2019).*

Network Security and Threat Mitigation: SDN offers enhanced security capabilities in real-time environments. By centralizing network management and control, SDN enables consistent security policies, rapid threat detection, and mitigation across the entire network infrastructure. Real-time threat intelligence and automated responses help

protect against evolving security threats [13] *(Kaur et al., 2021).*

Network Resilience and Fault Tolerance: SDN's centralized control and programmability contribute to improved network resilience in real-time applications. SDN controllers can detect and respond to network failures or congestion events, dynamically rerouting traffic and ensuring uninterrupted connectivity and service availability [13] *(Kaur et al., 2021).*

INTEGRATION OF AI & ML

Furthermore, the integration of artificial intelligence (AI) and machine learning (ML) techniques in networking has brought about intelligent network management and optimization. AI and ML algorithms analyze network traffic patterns, predict congestion, and dynamically allocate resources to meet real-time demands, enhancing overall network performance, security, and efficiency [5] *(Wang et al., 2021).*

Artificial Intelligence (AI) and Machine Learning (ML) techniques are integrated into networking to enhance network management, optimization, security, and decision-making processes. Here are some ways AI and ML are integrated into networking.

Network Traffic Analysis and Predictive Analytics: AI and ML algorithms can analyze network traffic patterns, identify anomalies, and predict network congestion or performance issues. By processing large volumes of network data, these techniques enable proactive network management, predictive analytics, and dynamic resource allocation (Ma et al., 2019).

Network Security and Threat Detection: AI and ML play a crucial role in enhancing network security by detecting and mitigating threats in real-time. ML algorithms can learn patterns of malicious network behavior, detect anomalies, and identify potential security breaches. These techniques aid in early threat detection, rapid response, and the automation of security measures (Zhang et al., 2019).

Intelligent Network Resource Allocation: These techniques can determine the most efficient routing paths, allocate bandwidth, and prioritize network resources to meet real-time demands. Intelligent resource allocation enhances network performance and efficiency (Liao et al., 2020).

Automated Network Management and Configuration: ML algorithms can learn network behavior, generate network models, and automate network configuration tasks such as load balancing, routing optimization, and QoS provisioning. This automation reduces manual intervention, improves network agility, and ensures consistent network performance [16] (Ahmed et al., 2019).

Network Fault Diagnosis and Troubleshooting: AI and ML algorithms can analyze network data to diagnose faults, identify root causes of network issues, and aid in network troubleshooting. By learning from historical network data and patterns, these techniques can suggest effective solutions and assist in rapid problem resolution (Zhang et al., 2019).

Network Optimization and Resource Efficiency: AI and ML algorithms are employed to optimize network performance, improve resource utilization, and reduce energy consumption. ML algorithms can learn from network data and optimize parameters, routing decisions, and network protocols to achieve better efficiency and performance (Kang et al., 2020).

CONCLUSION

The latest developments in networking have played an imperative role in facilitating real-time communication, data transmission, and services. These advancements, including low-latency networks, SDN, NFV, and AI-driven optimizations, have revolutionized real-time environments across various industries. As technology continues to evolve, it is essential to stay abreast of these developments and leverage them to unlock new possibilities and further enhance real-time applications and services.

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SECURITY RISKS ON MOBILE DEVICES AND THEIR IMPACTS: FUTURE PROJECTION

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Abstract
Due to its ease of use and applications' distinctive qualities, portable gadgets are now used in all facets of life. However, an increase in security risks is also a result of more users. Examining the dangers to mobile operating systems is the focus of this study. The study discusses the four mobile operating systems (Android, Apple OS (iOS), Symbian, and Java ME) with the biggest user counts and offers statistical data on the features of each system and its main application areas. In the study, the most significant dangers to mobile operating systems (Malware, Vulnerabilities, and Attacks) and the risks posed by these risks were analysed chronologically, and a future-oriented security viewpoint was proposed..

Keywords: Vulnerabilities, Threats, Attacks, Mobile Devices, Mobile Operating System

1. INTRODUCTION

The internet, which we use every day for everything from shopping to communication, has significantly improved recently. As a result, there have been significant changes made to the connecting devices for this virtual environment, and mobile device usage has significantly increased. Mobile tools (docs, social networks, internet shopping, etc.) facilitate daily life by enabling nearly all communication and processes. However, there are significant security issues that come with the rise in this number.

Unknown Wi-Fi settings, accepting all unknown programmes, establishing connections with dubious websites, and downloading software from such websites can be cited as the most significant of these issues. For the mobile devices that contain sensitive data and personal information, it is crucial that specific safety steps be followed.

Smartphone Operating Systems When Compared to Computer Operating Systems. Operating systems (OS) are the software-based user interfaces needed by users to administer, utilise, and run the physical components. The basic organisation of an operating system is shown in Figure 1. The operating systems of such devices, which were created to allow them to function as personal computers, are also referred to as Mobile Operating Systems (Mobile OS) if the hardware to be handled is a mobile device such a Smart Phone, Tablet PC, PDA, etc.

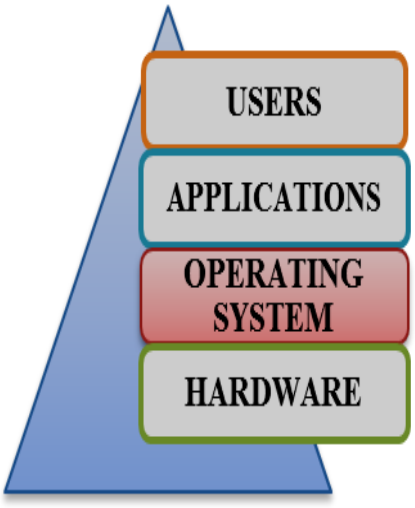

Figure 1. Operating System Common Structure

Because of its portability, simplicity of use, and expansion of functions due to growing technology, the number of mobile devices is rising daily. The operating system has undergone significant development and adjustments as a result of this growth, laying the groundwork for addressing user demands. Figure 2 displays the annual utilization rates for desktop and mobile operating systems.

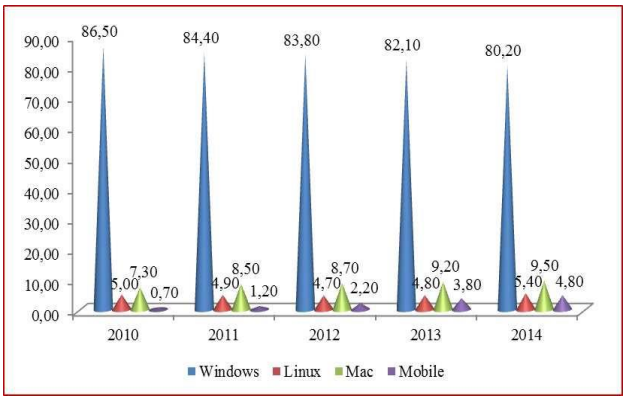

Figure 2. Usage Rates of all Operating Systems by Years [1]

The operating systems' utilisation rates from 2010 to 2014 are depicted in Figure 3. The figures' values reflect what was discovered at the end of each calendar year. For instance, whereas the percentage of mobile OS usage was 3.80% at the end of 2013, it increased to 4.80% at the end of 2014. The primary benefit of Windows stands out among operating systems used for private or business use. However, it has been noted that mobile OSs are being utilised more and more, even reaching 5% of all OS usage during the first three months of 2015 [1, 2].

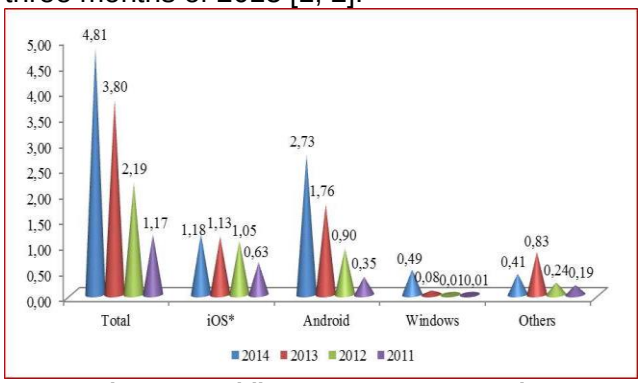

Figure 3. Mobile OS Usage Averages by Years [2]

The market analysis of all currently used mobile operating systems is shown in Figure 4 and is dated March 2015 (Market Share Statistics for Internet Technologies). Accordingly, iOS is the mobile OS that is most commonly used, with a rate of 41.97%, while Android OS, one of the mobile OSs, has a rate of 47.51%. Java ME (3.49%), Symbian (3.31%), and Windows Phone (2.57%) are the other mobile operating systems that come in third, fourth, and fifth place, respectively. Blackberry, Samsung, and other mobile OSs exist but are not represented in this chart. Their usage rates, however, are lower than the others [3]. These two most popular operating systems, iOS and Android, are examined in this study.

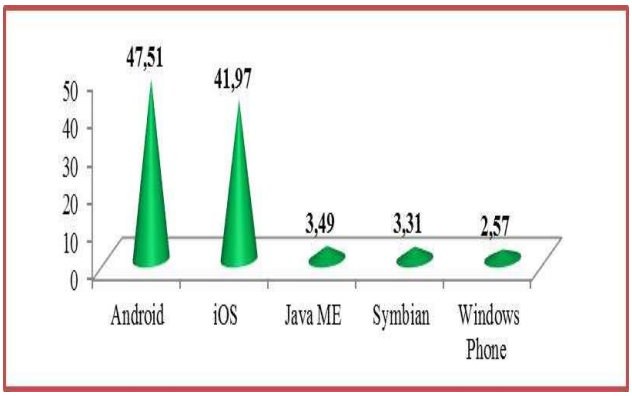

Figure 4. Mobile OS Market Share Ratios Including the FirstThree Monthsof 2015 [01]

1.1. Android Mobile OS

Android is a Linux-based mobile OS that is created by Google and is an open-source operating system. The fundamental system services for Android, including security, memory management, process management, network stack, and driver model, are implemented in Linux version 2.6 [4]. It also acts as an abstraction layer between other layers and the C programming language-created core, hardware, and software stack.

Libraries and timing are part of the abstraction layer. The Java programming language was used to develop the timing, which includes the core libraries that provide functionality in the fundamental libraries. For each Android application, these libraries operate in accordance with their intended purposes in a virtual computer called the Dalvik Virtual computer [5]. It gives developers of top-level programmes used by many components of the system a vast, rich, and innovative chance.

1.2. Apple Mobile OS

Initially created in 2007 by Apple's co-founder Steve Jobs, iOS is a mobile operating system that is now exclusively present on devices bearing the Apple logo (iPhone, iPod, iPad) [7]. The iOS design is based on four platforms that are integrated with one another, similar to other operating systems [8]. The foundational infrastructure required by the applications is provided by the first platform, Cocoa Touch. For instance, it is the layer that is built in the C programming language and offers object-oriented support for file management, network activities, and

more. This layer includes View Controllers, UIKit, iAD, Game Kit, Events (Touch), and Map Kit. The Media Layer is the component that allows for the use of documents in JPEG, PNG, TIFF, and animation video formats. The third layer is called Core Services (Core OS), which is an operating system.

1.3 Java ME

The Java Platform Micro Edition (JavaME or formerly J2ME) operating system was created by Sun Microsystems for mobile and embedded devices (Blu-ray Disc Players, Printers, etc.), and its usage areas have substantially expanded as a result of its flexible design [10]. It has seven layers, including the "Application Layer" of the Java ME system, "Configuration Layer," which has very specific APIs, Java language virtual machine features, and minimum class libraries, "Profile Layer," which supports high-level services and is built on the configuration layer, and "Optional Packages Layer," which includes functions or particular applications separate from Profile or Configuration (such as Java APIs for Bluetooth, Location APIs for, Its robust and sophisticated security features, along with its adaptable user interfaces.

1.3. Symbian

Symbian is a mobile operating system using open source code. Symbian which is an open source software written using the C ++ programming language, was first developed in 1977. It had become very popular until the end of 2010. After this date, its place was largely taken by Android [11].

Symbian is composed of layers such as OS Libraries, application Engines, KVM, Servers, symbian OS Base-Kernel and Hardware. Being used for many portable device from the date it was developed until 2010, Symbian is also known as a software with an outstanding security among the mobile OSs.

2.5 Windows Phone

Microsoft created the operating system specifically for mobile phones. The Smart Phones and touch devices employ this 32-bit Windows CE 5.0-based mobile operating system, which was originally created for PDAs. Its name changed to Windows Mobile in 2003. By the end of 2010, Windows Mobile had fallen behind its competitors, and Microsoft decided to progressively revamp this operating system and release it as Windows Phone [12].

As it began utilising the.Windows Phone has a lot of capabilities and benefits thanks to its Net Compact Framework architecture. For instance, its coding language's independent compilation structure (Common Language Runtime - CLR) enables the integration of written applications into mobile devices. Windows Phone is advancing.

3.Threats of Mobiles Operating System

As all devices with a internet connection, there are also a wide variety of threats to the smart devices using mobile operating system. In line with the portable devices, themalicious software industry is also growing both in technological and structural terms. These threats are discussed in three main categories including Malware, Vulnerabilities and Attacks (Figure 5).

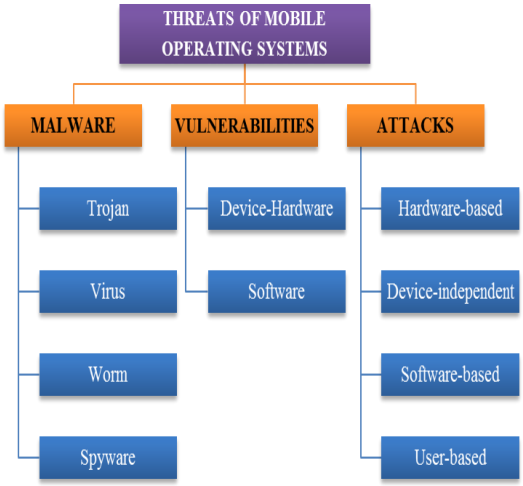

Figure 5. Threats of Mobile Operating Systems

1.4. Malware

- Harmful software, or malware, is simply harmful software that targets a user's private information and causes them to be disturbed. Malicious software can also cause a device to malfunction and have unintended consequences, such as stealing or rendering useless the user's data and documents [14]. All external attacks on a device or system that take advantage of flaws in the system or device use this unlawful software that the user has not installed. These software include Trojans, Worms, Viruses, and Spyware, which are the most common kind. Cabir,

which was developed in 2004 for the Symbian operating system, is the first malware to have ever been discovered. Malicious malware known as Cabir attacked various handsets and the Nokia 60 series. "Cabire" is written on the computer by this worm.

Trojans: Trojan software's primary objective is not to propagate itself, but rather to take control of the device and access its data. They differ from worms and viruses in this regard. In this sense, keyloggers are the spyware that is most frequently utilised. These programmes are intended to completely control the device in the background after being accidentally launched by the user and transferred under the guise of another file. Typically, the user is unaware of these infections because it is hidden inside more innocent applications. It is therefore crucial to use tested and reputable software when downloading any apps that are required for smart devices. For Android devices, this is a little more difficult. Considering that users of such gadgets are

Virus: These are the harmful programmes that can infiltrate already-existing documents and send them elsewhere, alter their contents and render them useless, as well as slow down hardware components. Infected programmes should be installed on other devices in order for viruses to spread. In other words, the user must also send the malicious programme to other machines. For instance, in China in 2010, the "Zombie" virus infected more than 1 million smartphones and cost $300,000 per day in losses. In addition to the multiple problems it causes, it also causes data loss, data leaking, and even dialogue disruption [17]..

Worm: Worms which are counted among the malware contain harmful and misleading instructions. The worms affecting mobile devices do not require user interaction in order to be effective and are usually transmitted through the text messages (SMS) or picture messages (MMS). Worm is actually a kind of virus. However, it does not require user interaction to reproduce itself. For example, clicking on a file or openinga plug-in sent by e-mail activates the worm. A security vulnerability in the operating system would be sufficient for Worm infection. The Worm penetrates using this vulnerability and integrates itself into a service running in the operating system. After this stage; it can act as a spy inside the device, send the required information to the center managing itself, cause clogging and slowing down in the Internet bandwidth through creating an unnecessary data flow and degrade the performance of the device.

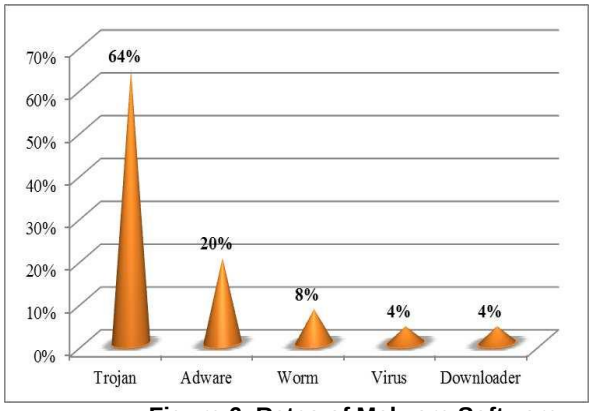

Figure 6. Rates of Malware Software Affecting Mobile OSs [19]

1.5. Vulnerabilities

The weaknesses occurring in the system security procedures, internal controls, design and applications are among the security vulnerabilities in the device. These vulnerabilities can be grouped under several headings. In the present study, the analyze is carried out in two main categories including device-hardware vulnerabilities and mobile operating system and application (software) vulnerabilities:

1.5.1.Device-Hardware Vulnerabilities

The most-encountered problem which should be considered first in this regard is the agedness of the device. Because, the manufacturers do not support the devices manufactured before a certain date. Therefore, the device may not receive security updates.

The second issue, however, is the inability of the mobile devices in assuring the safety of the ports they use while connecting to a network or the Internet. The fact that the mobile devices have generally no "navigation" limit used in the Internet environment and there is no firewall to control this is an important vulnerability. A hacker can easily accessto the mobile devices via this unsecure port. In such cases, the software called "firewall" which protect these ports must be used. Thus, the user will be asked for a permission while connecting to the mobile device and will be able to see it. There may be unauthorized changes ("jailbreaking" or " rooting") on the mobile devices which are not using a firewall. Jailbreaking which provides an escape for Apple iOS is the method applied to obtain an application that does not belong to Apple (iTunes, App store.) or cannot be downloaded due to some restrictions from any other source.

This method allows to have access to the operating system of the mobile device and this constitutes a vulnerability. In addition, the "jailbroken" devices may not receive security updates of the manufacturer and the devices without the necessary updates may become vulnerable to threats [20].

1.5.2 Software Vulnerabilities:

The out-datedness of the mobile operating system is also an important vulnerability. Yet, the best known of the security vulnerabilities arising from software is the use of an old Mobile OS and out-datedness. For example, an Android supports application installation from Google Play or another file system. Since Google file system is a protected area, the downloads or packages (APKs) from this area are secure. However, downloading APK files from third-party application stores, mobile ad libraries and local storage units (*i.e.*, sdcard) is often unprotected. Such vulnerabilities are tried to be met by the firms through new versions or patches.

The shared open source common components also constitute an important vulnerability. Another vulnerability occurring in all open source software is in the design of the system containing common open source components such as WebKit and Linux kernel. These components have a reusable structure in order to reduce the costs and this isa common practice in large open source systems such as Android. A vulnerability hasbeen discovered in WebKit or Linux, however, a patch was released in order to use in solving this problem. Apple's iPhone-like WebKit and BSD kernel derivative (Darwin) constitutes the common software components. The problem at this point is not its re-use but where it is employed. In this regard, Android has put the patch model into practice with a little delay [21].

The vulnerabilities occurring during the installation of APK files are very common. The presence of a vulnerability known as "Check Time" of the package installer has also been identified. This means that it is replaced by an open APK file or can be changed during installation without the user's knowledge. This open package constitutes the vulnerability of the installer and affects APK files downloaded from unprotected local storage units [22].

When the user gives such permissions, a vulnerability occurs in the background and the allowed package is replaced by a malware package. Following this process, once the user clicks the "Install" button (–Time of Use"), the Package Installer which will install the APK file installs a different application instead of the set allowed.

In the report released by Symantec; while the number of vulnerabilities affecting the mobile operating system was 315 in 2011, this number increased to 416 in 2012. However, this number declined to 132 with a decrease of 68 % in 2013. It is seen that the number of vulnerabilities in the mobile tools has significantly decreased in 2013 [24]. Themajor reason for this decline is that the companies (especially Android-Google) developing mobile OSs have eliminated such vulnerabilities through the patches developed by themselves. At the same time, releasing updates at regular intervals for the mobile OSs is the most important factor in maintaining security even against the newly- released malware.

1.6. Attacks

Attacks are the interferences made from outside using a variety of vulnerabilities. This interference are all considered as an attack regardless of whether they are made through malware software or they use vulnerabilities in the smart device or mobile operating system. However, the terms "attack" is generally defines as the attacks made by the hackers for obtaining users' private information without their knowledge.

The first real attack against smartphones was first made by two researchers called Vincenzo Iozzo and Ralf Philipp Weinmann in March of 2010 in order to steal a database from a phone via SMS. This attack was made by looking at an error in the Safari Browser of iPhone 3GS phones and it was aimed to upload the file sent by SMS to the server [25].

In November 2010, however, an attack was directed to the browser in the Android operating system using a common vulnerability [26]. More recently, the first —over-the- airll attack for GSM software which will lead to memory corruption has been introduced again by Weinmann [27]. Moreover, Oberheide and Lanier has identified several different attack vectors for the iTunes App Store [28].

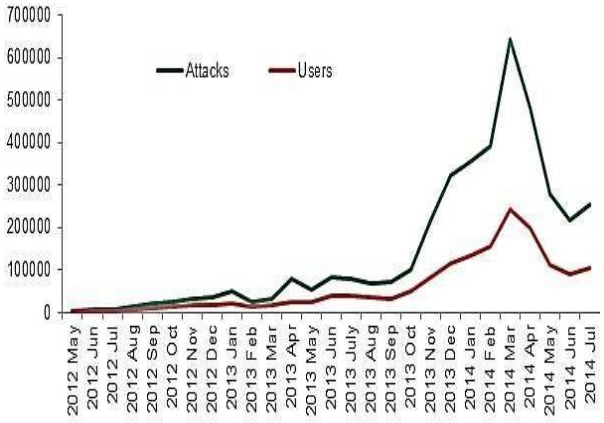

Figure 8. The Relationship Between The Number Of Mobile Device Users And The Number Of The Attacks Between The 2nd Quarter Of 2012 And 3rdQuarter of 2014 [29]

Figure 8 shows the relationship between the number of mobile device users and the number of the attacks between the 2nd quarter of 2012 and 3rd quarter of 2014. Accordingly, it is seen that the number of attacks hits the top in March and April of 2014, however, and then starts to decline [29].

There are various classifications in terms of attacks. One of them is the classification made by Becher which groups the attacks towards mobile devices in four main categories. Hardware-based, device-independent, software-based, and user-based attacks [30].

Hardware-based attacks: With a broad perspective, hardware-based attacks constitute an element of mobile security. Even if the Mobile Device has any vulnerability, it cannot easily reach to the user information, however, there is an access to the device.

Device-independent attacks: These are the attacks independent from the device which directly target the mobile device user. They intend to violate the privacy of the user's personal data through wireless connection or wiretapping.

Software-based attacks: An important part of the technical vulnerabilities on mobile devices are the software-based attacks. Especially the increase in the number of mobile web browser has led to an increase in the vulnerabilities used in this field.

User-based attacks: Such attacks are not technical attacks. These constitute the attacks made through cheating without using malicious software which are direct to the mobile device users. These attacks made through "social engineering" and aimed at reaching to private information are today quite common [8]. A large number of the attacksare not technical-based.

For example; the Denial of Service (DoS) attacks are not directed through applications or malware installed in smartphones but using the vulnerabilities created by the malformed text messages [31].

In addition to these attack vectors, there are also other types of attacks. However, the aim of all attacks are essentially to find the victim's vulnerabilities and to make attack using a well-intended process and application.

JTAG (Joint Test Action Group) Attacks: JTAG is the best-known hardware and debug standard. Even though it provides a high control and observability, it also creates vulnerabilities because of allowing for the control of the device at a deep level [32].

Forensic Analysis: This is an attack vector targeting the privacy of the data stored on the mobile devices. This vector applies to the cases where the attacker has physical access to the device. The attacker takes the device of the user who do not realize this situation under his/her control for a certain time. In such a case, the attacker can reach to the information stored in the device. The second possibility is, however, to obtain the confidential corporate data and personal conversations and today, some studies show that this is the most commonly used method [33, 34].

Phishing Attacks: This is a kind of attack formed by combining the words "Password" and "Fishing". Phishing in the mobile applications is a threat related to the successful attacks reported. This is an OS-independent method and can be used for all types of devices. Such attacks are made through directing the user to the imitation websites insteadof the legitimate ones in order to steal their private information such as credentials, credit card information, user name or password. There are some varieties of this attack such as Similarity attack, Forwarding attack, Background attack and Notification attack [35].

QR Code Based Attacks: This is an application which has become very popular recently thanks to its large storage capacity due to the QR (Quick Response) code, ease of production and distribution and the fast readability features. However, users usually are not able to understand the type of knowledge contained in it while scanning QR codes content of which are easily encoded.

This provides a suitable environment to direct users to malicious URLs. Google Safe Browsing API and Phishtank API increases the speed in detecting phishing and malware attacks as well as malicious URLs (SafeQR) [36].

SSL Proxy Attacks: Secure Sockets Layer (SSL)/Transport Layer Security (TLS) encryption used in many applications today (especially in internet banking) is a protocol that generally reassures users and provides data security. SSL is an encryption scheme and provides adequate security when implemented correctly. Otherwise, applications may be encountered with security threats and unintended vulnerabilities occurs. If this code is left unreviewed, the settings can be changed in an undesired manner and the information which were presumed to be safe and transmitted can be stolen through communication path [37].

4.Estimates for the Future

As the number and usage rates of the open source Mobile OS, the number of malware is seen to show a substantial increase in parallel with them.

Android is a mobile OS that has a quite large area and number of use. However, the number of security problems is also high. Even though Google has actually taken serious steps on security with the patches and updates released by the latter, it is seen in the reports released by the security firms such as Kaspersky and F-Secure as well as in Figure 9, that the malware software are still mostly (98.05 %) send over devices using this operating system. The biggest reason for this arises from the open-source code application. Despite all its advantages, open source code contains lots of problems in security terms.

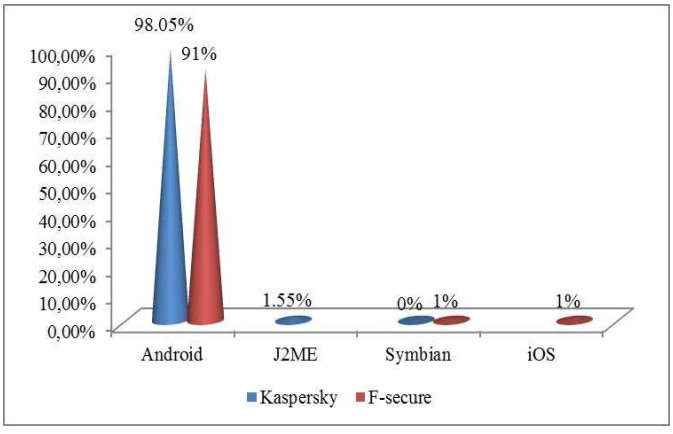

Figure 9. Malware Attacks on Mobil OS [29, 38]

It is certain that the security will become the most important factor in the communication in the future. For this reason, considering the operation and information security, the software like IOS are expected to find a significant place. Apple iOS offers many advantages in terms of security thanks to its closed-code structure. Although its users are restricted within the area of application, it is understood that it will be a preferred OS in the future since it has a better performance compared to the Android and is a less problematic system. Windows Phone, another closed system, is also expected to show the same success it shown in personal computers with Windows also in the portable devices in the future. At least, it is known that they endeavor a great effort in order to emphasize the security. Although it doesn't have an open source code and blocks this development to a certain degree, the increase to be realized by it in the security level will provide a significant advantage in the future. As a language, Java is an effective and rapid language forming the basis of the Android and used for many portable devices. A great effort is given with J2ME in order to become an individual Mobile OS and a certain success is achieved in this regard. However, a new open source OS should meet a great number of requirements in terms of security. In this regard, it is not predicted to be as successful as IOS. Is it better to become the most-widely used operating system or the most reliable OS? This is the most important question that will determine the future.

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TECHNIQUES FOR DATA MINING: A SURVEY PAPER

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Abstract- The idea of data mining was briefly discussed in this study, along with its relevance to its approaches. In-depth research is done on data mining based on neural networks and genetic algorithms, as well as important technologies and methods for achieving data mining on neural networks and genetic algorithms. In addition, a rigorous review of the rule extraction from ANN and GA is conducted in this study.

Keywords: Data Mining, Neural Network, Genetic Algorithm, Rule Extraction

1. INTRODUCTION

The term "data mining" describes the process of obtaining information from enormous amounts of data. Knowledge mining from data or "Knowledge mining" are apt names for the process of data mining. Organizations may now gather enormous volumes of data more cheaply because to advances in data collecting and storage technologies. The overarching objective of the general activity known as data mining is to use this stored data in order to extract relevant and actionable information. The definition is as follows:

Data mining is the process of automatically or semi-automatically exploring and analyzing vast amounts of data in order to find significant patterns and rules.

The following definition is provided in [1]: Data mining is the process of automatically or semi-automatically exploring and analyzing vast amounts of data in order to find significant patterns and rules.

Data mining is an interdisciplinary area of computer science that deals with the computational process of finding patterns in huge data collections.

With the help of this sophisticated analytical technique, data may be mined for information and then transformed into a useful structure. Artificial intelligence, machine learning, statistics, database systems, and business intelligence are all combined in the techniques employed. By analyzing data that already exists in databases, data mining seeks to find solutions to issues. It is also said that data mining is a crucial procedure wherein intelligent techniques are used to extract data patterns.

Five main components make up data mining:

- Extract, modify, and load transaction data onto the system of the data warehouse.
- Use a multidimensional database system to store and manage the data.
- Give business analysts and information technology specialist's access to data.
- Utilize application software to analyze the data.
- Provide the data in an understandable format, such as a table or graph.

The kinds of patterns that will be identified in data mining jobs are specified using data mining functionalities. The two types of data mining jobs are descriptive and predictive. The general characteristics of the data in the database are characterized by descriptive mining tasks. To produce predictions, predictive mining jobs perform inference on the most recent data.

A data mining effort's goal is often to develop a descriptive model or a predictive model. A descriptive model outlines the key traits of the data set in a brief manner. It allows for the analysis of significant elements of the data set because it is essentially a summary of the data points. Undirected data mining, or a bottom- up technique where the data "speaks for itself," is

often how descriptive models are discovered. Undirected data mining identifies patterns in the data set but leaves it up to the data miner to interpret the patterns. The goal of a predictive model is to provide the data miner the ability to forecast the value of a certain variable, called the target variable, which is unknown or frequently future. The data mining task is known as classification if the goal value is one of a set number of discrete (class) labels. Regression is the task if the target variable is a real number.

As a result, the predictive model is built using known values for the input variables, maybe even past values for the target variable. The training data consists of measurement pairs, where each measurement pair consists of an input vector x(i) and a target value y(i). The predictive model, when given an input vector of measured values x and a set of estimated model parameters q, is an estimates of the function y=f(x; q) that may forecast a value y. The fundamental step in the data mining approach is determining the optimal q values.

The application of a data mining technique lies at the heart of the data mining process. Some data mining methods use descriptive data partitioning to acquire the information directly. However, data mining techniques are more frequently used to create prediction models from recorded data. General consensus exists among scholars and business leaders regarding the requirements that all data mining methods must satisfy. The techniques should, above all else, perform well. For predictive modeling, this requirement is interpreted to suggest that the method should result in models that will generalize well, i.e. models with high accuracy when conducting predictions based on novel data. Two types of data analysis—classification and prediction—can be used to develop models characterizing significant data classes or forecast upcoming data trends. We may gain a better comprehension of the data as a whole via such research. The categorical (discrete, unordered) labels, prediction model, and continuous valued function are predicted by the categorization.

2. PROCESSES FOR DATA MINING

2.1Decision Trees

A decision tree is a structure that resembles a flowchart, in which each node represents a test on an attribute value, each branch represents the test's result, and the tree's leaves stand for classes or the distribution of classes.

The most popular prediction model for categorization is a decision tree. The input space is divided into cells by decision trees, where each cell represents a different class. It is possible to visualize the partitioning as a series of tests. The branches from each interior node in the decision tree are marked with the potential outcomes of the test, and each interior node in the decision tree checks the value of some input variable. The leaf nodes indicate the class to return if that leaf node is reached and serve as a representation of the cells. Thus, a given input instance is classified by starting at the root node and moving down the relevant branches until a leaf node is reached, based on the outcomes of the tests. A decision tree is a prediction model that resembles a tree with leaves representing the division of the data set according to categorization and branches representing classification questions. A decision tree, according to the author, is a schematic tree-shaped diagram that is used to choose a course of action or display a statistical likelihood [6]. From a commercial standpoint, decision trees may be seen as segmenting the initial data set. Therefore, marketing managers employ customer, product, and sales area segmentation for predictive analysis. These decision tree- derived prediction segments additionally include a description of the traits that characterize the segment. The approach is a preferred way for creating intelligible models due to its tree structure and ability to simply construct rules.

2.2 Rule Extraction

The scope of application, the degree of dependence on the black box, and the structure of the extract description are the three key criteria for evaluating algorithms that are included in the Rule extraction taxonomy. The first dimension relates to the range of application of a regression or classification technique. The second dimension focuses on independent vs dependent methods for the extraction algorithm on the underlying black-box. The third criteria contrasts predictive and descriptive algorithms to determine which rules were obtained and may be valuable. In addition to this taxonomy, the assessment criteria—Quality of the extracted rule, Scalability of the algorithm, and Consistency of the algorithm—appear in practically all of these surveys [9].

Typically, a rule has two values. a right hand result and a left hand antecedent. While a consequent only has one condition, an

antecedent may have one or more conditions that must all be true for the consequent to be true for a certain accuracy. Thu, antecedent, consequent, accuracy, and coverage are all addressed during rule mining from a database. The term "interestingness" is occasionally employed as a rating indicator. When regulations diverge from standards despite having excellent coverage and accuracy, the scenario arises. It is also crucial to keep in mind that, although while patterns are generated by rule induction systems, they do not always imply that a left-hand side ("if") portion should lead to a right-hand side ("then" part). Once rules are developed and their interestingness is verified, they can be applied to business predictions. Each rule makes a prediction with a consequent serving as the target, and the accuracy of the rule serves as the accuracy of the prediction, providing a chance for the system as a whole to advance and perform well.

The absence of capabilities for explanation in the data mining field appears to be a significant disadvantage since it results in models that are opaque and necessitates precision. We propose rule extraction to construct an accurate, transparent model while addressing the shortcomings of ANN and decision tree. It is becoming more and more obvious that ANN systems' inability to provide an explanation constrains their capacity to realize their full potential, and the rule extraction procedure specifically aims to address this shortcoming. Expert system experience has demonstrated the importance of explanation capabilities as a feature of symbolic AI systems. In particular, it is essential for user adoption of such systems that they can create even brief explanations. The necessity for explanation facilities in these systems is obvious given that the majority of data mining systems are designed to help decision making. However, many systems must be seen as "black boxes," meaning that they are inaccessible to the user.

In addition to the actual rule, two further pieces of information must be provided for the rules to be useful:

- Accuracy: How frequently is the rule accurate?
- Coverage - When does the rule come into play?

The fact that a pattern in a database is expressed as a rule does not imply that it is always true. Therefore, it is equally vital to detect and highlight the uncertainty in the rule, much like with data mining techniques.

This is what accuracy means. The size of the database that the rule "covers" or "applies to" is indicated by its coverage. Five requirements for rule extraction were specified by Craven and Shavlik in their study [11], and they are as follows:

- Human comprehensibility: How well extracted representations may be understood by people.
- Fidelity: How closely extracted representations mimic the networks from which they were drawn.
- Accuracy: The capacity of extracted representations to produce precise predictions about instances that have never been encountered before.
- Scalability: The method's capacity to scale to networks with sizable input areas and plenty of weighted connections.
- Generality: The degree to which specialized expertise is necessary to use the procedure.

2.3 Genetic Algorithm

The goal of genetic algorithms is to include principles of natural assessment. The fundamental premise of GAs is that, much as nature does when merging the DNA of living things, we may create a superior solution if we somehow combine the "good" components of existing solutions (schemata theory) [7].

The main purpose of a genetic algorithm is to solve problems and offer the best possible answer. They are the most effective strategy to address the issue, which is little understood. They make up a fairly broad algorithm; therefore they perform well in any search area. The only thing that has to be understood is the specific circumstance in which the solution works exceptionally well, and a genetic algorithm will provide a high- quality answer. In order to generate a number of solutions to a particular issue, genetic algorithms employ the concepts of selection and evolution.

Genetic algorithms (GAs) [8] are biological applications that rely on evolutionary theory. When GAs are used to solve a problem, there are three separate phases:

- The answers to the issue are stored into representations known as chromosomes, which are as basic as bit strings and allow the essential variation and selection procedures.
- A fitness function determines which solutions are the "best" life forms, or those that are most suited to the challenge at

hand. These people have a higher chance of surviving and reproducing, which results in generation.

By recombining traits from their parents, crossover and mutation create new generations of people. A generation of people will eventually be interpreted in relation to the original issue area, with the fit individual representing the answer.

2.4 Neural Network

Artificial neural networks, often known as neural networks, are biological systems that recognize patterns and forecast future events. The greatest advances in neural network technology over the past few years have come from using them to solve real-world issues like fraud detection and consumer reaction prediction. Data mining methods like neural networks may be utilized to increase business intelligence in a range of business applications because they can simulate the correlations that exist in data collections [4]. Even specialists find it challenging to comprehend the extremely complex models produced by this potent predictive modeling approach. There are many uses for neural networks.

Artificial neural networks are now an effective tool for tasks like pattern recognition, decision-making, and forecasting. One of the most recent signal processing technologies is it. The adaptive phase of an ANN, which is often the training phase when system parameters are changed as operations are being performed, is a nonlinear, adaptable system that learns to execute a function from data. The parameters are fixed after the training is finished. When there is a lot of data and the problem is difficult to grasp, the ANN model is a good choice because of its nonlinear properties, which provide it a lot of flexibility to produce an input-output map. The user may choose the network architecture, performance parameter, learning rule, and termination criterion using artificial neural networks.

3.CONCLUSIONS

If the idea that computer algorithms are based on biological development is unexpected, the extent to which these approaches are used in so many fields is nothing short of astounding. Data mining is now a novel and significant topic of research, and ANN is ideally suited to address the challenges of data mining due to its strong resilience, adaptive self- organization, parallel processing, distributed storage, and high fault tolerance. These approaches are becoming more and more important in the commercial, educational, and scientific applications.

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ENHANCED AMBTC TECHNIQUES USING BLOCK CLASSIFICATION FOR IMAGE COMPRESSION AND STEGANOGRAPHY

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Abstract
Block Truncation Coding (BTC) is a quick, simple and efficient lossy image compression technique that preserves moments of the input image blocks. In this paper, a two-level compression method is suggested. The input image is divided into small blocks of size 4 x 4 pixels. These blocks are classified into two types of blocks namely, the high- detail blocks and low-detail blocks in the first stage of compression. Two statistical moments—the high mean and low mean—along with a bit plane (16 bits) make up the high detail block. Low detailed blocks only record the mean values. The interpolation approach is adopted in the second level of compression for further bit rate reduction. A bpp of 2 is achieved with BTC and AMBTC compression techniques. But, the bpp achieved with the proposed method is 0.49, which is a significant improvement. Steganography is a method of hiding secret image as part of an image called stego image. This leads to extra overhead of time in transmitting the stego image. The proposed image compression method is implemented as part of Steganography to reduce the image data need for transmitting the secret data. The proposed method is tested with benchmark images such as Lena, Cameraman Boats, Bridge, Baboon, and Kush. The suggested method improves coding effectiveness while slightly degrading PSNR. Now-a- days, the technique of combining Image Compression with Steganography is becoming popular in maintaining secured transmission of data over Net. Steganography with the proposed compression technique leads to an embedding capacity of a maximum of 786432bits of secret data, which is a very good score.

Key words- Block Truncation Coding, Absolute Moment Block Truncation Coding, Mean Square Error, Signal to Noise Ratio, Peak Signal to Noise Ratio, Compression Ratio, Standard Deviation, Steganography, Stego image.

I. INTRODUCTION

Image processing is a technique for applying various procedures to an image in order to improve it or extract some relevant information from it. The storage cost associated with storage and transmission of digital images is high. Image compression plays a vital role in reducing such cost. The image compression techniques are classified into 1. Lossless image compression and 2. Lossy image compression.

A. Lossless Image Compression

The data can be retrieved via lossless compression without any information being lost. For archival purposes, lossless compression is recommended and is frequently used for medical imaging, technical drawings, clip art, etc. Lossless picture compression techniques include:

1. Run-length encoding is the standard approach for PCX and one of the options for BMP, TGA, and TIFF.
2. Image region compression
3. Encoding for entropy

II. LITERATURE SURVEY

The amount of data that users of digital image processing techniques typically need to manage is substantial. It alludes to the requirement for a significant quantity of storage space to keep this volume of data for upcoming projects. The goal of any image compression technique is to represent an image with fewer bits without significantly lowering the visual quality of the decomposed image.

Images typically require more storage space and take longer time to send the image over a network. Utilizing an image compression approach can lower the cost of storing, retrieving, and picture transmission over a network [1]. The amount of data required to preserve the image's requisite details [2] is huge in size. The reduction of size is one of the primary objectives of image compression. Lossless and lossy image compression techniques are the two different

categories. A lossy compression method offers lots of benefits leading to more compression per unit of data than a lossless technique.

The metrics used for measuring the performance of any compression technique are 1 Compression ratio (bpp), 2. Signal-to-Noise Ratio (reconstructed image quality) and 3. Encoding and Decoding Speed [3].

The redundant information can be compressed using the lossy image compression technique [4]. Block Truncation coding is one of the lossy compression (BTC) techniques. One of the more recent methods is BTC. The computational complexity of BTC is less when compared to that of other compression techniques [5].

A. Block Truncation Coding

Block Truncation Coding (BTC) is a quick lossy image compression technique that preserves moment. The feature of inter-pixel redundancy is exploited to achieve compression. The image is separated into non-overlapping blocks of size 4 x 4 pixels using the BTC algorithm. The average $\bar{x}$ is calculated utilizing Eq. (1) for each block.

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \qquad (1)$$

Each pixel value of the block is compared against the mean value $\bar{x}$ and the corresponding bit of the Bit plane is generated as 1 if the pixel value is greater than or equal to $\bar{x}$ otherwise 0.

Using Eq. (2), the standard deviation σ is calculated. The statistical moments ar produced.

$$\sigma = \sqrt{\frac{1}{n}\sum_{i=1}^{n} (x_i - \bar{x})^2} \qquad (2)$$

Two quantizing levels Q1 and Q2 are computed as $\bar{x} + \sigma$ and $\bar{x} - \sigma$respectively. Hence for each block, a set of bit plane and two quantizers are generated and stored/transmitted, leading to reduction in data representing the image. The quality of the reconstructed image is computed using the metrics MSE and PSNR.

B. Absolute Moment Block Truncation Coding (AMBTC)

Absolute Moment Block Truncation Coding (AMBTC) is an advanced form of BTC, where the PSNR of the decompressed image is improved, retaining the bpp. In AMBTC, two quantizing levels hMean and lMean are computed using the equations (3) and (4) for each input block [6].

$$\text{hMean} = \sum_{i=1}^{16} x_i/p \qquad (3)$$

where, p is the number of pixels, whose intensity values are greater than that of the mean of the block.

$$\text{lMean} = \sum_{i=1}^{16} x_i/q \qquad (4)$$

where, q is the number of pixels, whose intensity values are lower than that of the mean of the block. The preservation of hMean and lMean values for each block increases the quality of the reconstructed image.

C. Interpolative Technique (proposed)

This technique is an improvised one of AMBTC, where only the mean values are stored for low detailed blocks, ignoring the bit planes. The compression is achieved in two levels. In the first level, the input blocks are classified into to low details and high detail blocks based on the equation (5).

$$d = \sum_{i=1}^{16} (x_i - \bar{x})^2 \qquad (5)$$

If d is less than a threshold, the block is classified as low detail block otherwise it is treated as a high detail block. For low detail blocks, the bit plane is avoided and only the mean value is preserved thus leading to further coding efficiency. In the second level of compression, the interpolation approach is adopted for the high detail blocks.

In the second stage of compression, the inter-pixel feature is exploited, thereby the bits of the Bitplane in the highlighted positions as given in the Figure-1, are dropped, and hence a bitplane of 8 bits size is preserved for each block.

X_1	**X_2**	**X_3**	X_4
X_5	X_6	X_7	**X_8**
X_9	X_{10}	X_{11}	**X_{12}**
X_{13}	**X_{14}**	**X_{15}**	X_{16}

Figure 1: The pattern of dropping bits

While decoding the compressed image, the dropped bits are generated using theEq. (6).

$$\begin{aligned}
X_i &= \frac{1}{3}(x_{i-1} + x_{i+1} + x_{i+4}) \text{ for } i = 2\\
X_i &= \frac{1}{2}(x_{i-1} + x_{i+4}) \text{ for } i = 4\\
X_i &= \frac{1}{3}(x_{i-4} + x_{i+1} + x_{i+4}) \text{ for } i = 5\\
X_i &= \frac{1}{4}(x_{i-4} + x_{i-1} + x_{i+1} + x_{i+4}) \text{ for } i = 7, 10\\
X_i &= \frac{1}{3}(x_{i-4} + x_{i11} + x_{i+4}) \text{ for } i = 12
\end{aligned} \qquad (6)$$

Test photographs for the method's effectiveness include Lena, Cameraman Boats, Bridge, Baboon, and Kush. Generally and are given in the Figure – 2. A trade-off is maintained between the PSNR (quality) and bpp (compression rate). Comparing the suggested system to previous approaches, a little reduction in PSNR is achieved while a better coding efficiency is achieved.

Figure.2: Benchmark images taken for the study

Level-1 Compression Encoding Algorithm

Step1: Split the input image into small blocks of size 4 x 4 pixels.

Step2: For each block, perform the following:

(a)Compute the mean using "Eq. (1)".

(b)Compute the sum of differences using "Eq. (5)".

(c)if d >= threshold, declare it as a high detail block else it is a low detail block

(d)if high detail block

i.generate the bit plane

ii.compute xh using "Eq. (3)" and xl using "Eq. (4)".

iii.store/transmit the set {bit plane, xh and xl}

(e) if low detail block, store and transmit only the mean.

(f) The interpolation approach is included in the suggested method at the second level of compression. As depicted in Figure 1, some portions of the bit plane are omitted, which lowers the bit rate.

Level 2

Step1: For each high detail block, perform the following (a) Drop the elements of the bit plane as in Fig. 1.

The compressed bit plane (8 bits), high mean (8 bits), and low mean (8 bits) for high detail blocks are all used to save or transmit the compressed image, but just the block mean values are stored for low detail blocks. At the receiving end, the compressed image is rebuilt (decoded) as follows: The bit plane's 1s and 0s for high detail blocks are changed to xh and xl, respectively. The Eq is then used to rebuild the dropped elements (7). Only the mean values are used to recreate the low detail blocks.

Decoding Algorithm

Step1: Reconstruct the image as follows:

Step2: if high detail block,

(a) Replace all 1's in the bit plane with xh and 0's with x.

(b) Interpolate the dropped elements using the "Eq. (7)".

Step3: if low detail block, generate a block of 4x 4 pixels with mean for all pixel values

$$X_i = \frac{1}{2}(x_{i-1} + x_{i+4}) \text{ for } i = 2, 5$$
$$X_i = \frac{1}{2}(x_{i-1} + x_{i+4}) \text{ for } i = 3, 8 \quad (7)$$
$$X_i = \frac{1}{2}(x_{i-1} + x_{i+4}) \text{ for } i = 12, 15$$
$$X_i = \frac{1}{2}(x_{i-1} + x_{i+4}) \text{ for } i = 9, 14$$

D. Steganography

Steganography is a technique where any secret image is hidden in images while being transmitted. The image with the embedded secret data is called the stego image. Generally, the images need more data. This image data can be reduced using any one of the compression techniques. Now-a-days, the technique of combining Image Compression with Steganography is becoming popular in maintaining secured transmission of data over Net. In this work, the proposed compression work is adopted in Steganography.

III. AMBTC BASED STEGANOGRAPHY (ABS - PROPOSED METHOD)

AMBTC (Absolute Moment Block Truncation Coding) is one such efficient compression algorithm that could be used in information hiding. The efficiency of any Information Hiding technique is measured in terms of the capacity of data that can be hidden and the complexity involved in extracting the hidden information. The LSB bits of both the quantizers that are generated for high detail blocks are replaced with two bits of secret data and the LSB of mean of low detail blocks are replaced with the data bit. This is repeated for all the bits of the secret message.

Secret Data: 11100101 01100010 10101011 10010101 11110001 11101010

For example, if the above is secret data, it consists of 48. If two bits are stored per block, then it requires 24 blocks to hide the data. Embedding the data in this way also is difficult to guess where the data bits are embedded. The embedding capacity of the proposed technique is computed as follows:A color image of size 256 x 256 pixels, comprises of 3 2D Image plans of size 256 x 256 pixels. Each image plane is divided into 4096 blocks of size 4 x 4 pixels. A total of 3 x 4096, equal to 12,288 image blocks are possible with a sample color image of size 256 x 256 pixels. A total number of 12288*2 = 24576 bits of secret data can be embedded in an image. There are images of different resolution available and the embedding capacity that can be achieved with various images of various resolutions are given in the Table 1:

Table-1: Embedding Capacity with respect to images of different resolution

S.No.	Image Size	Total No. of Blocks	Embedding capacity
1.	128 x 128	24576	12288
2.	256 x 256	98304	49152
3.	512 x 512	393216	196608
4.	1024 x1024	1572864	786432

The extraction of secret data from the cover image is difficult to guess when compared to that of the existing method that is discussed in this work.

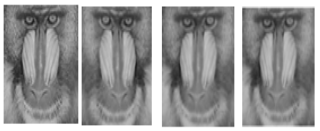
IV. RESULTS AND DISCUSSION

The input image blocks are classified into high detail and low detail blocks based on three different threshold values and the PSNR and bpp that are obtained are shown in Table-2. The results in Table.2 demonstrate that, at the expense of PSNR, the coding efficiency has been improved significantly from 2 to 0.7, 0.5, and 0.48 for the Lena image. With the threshold value of 50, Lena image achieves a minimum of 0.70 bpp. It has been noted that there are less high detail blocks in each image, which causes the bpp to decrease. Boats image contains a large number of high-detail blocks, and the bpp obtained is 1.12, which is the highest possible value.

When the threshold values are increased from 50 to 100 and 150, the bpp is further decreased. When the threshold values are raised, there will be fewer high detail blocks. If the amount of high detail blocks declines, the bpp will also do so. With a threshold value of 150, a minimum of 0.40 bpp is obtained for the baboon image, which is a huge improvement. In Fig.3, the reconstructed pictures are provided.

Table-2: 1The PSNR and the bpp values obtained with respect to BTC, AMBTC and the proposed method for different Threshold Values.

Images	BTC		AMBTC		Threshold 50		Threshold 100		Threshold 150	
	PSNR	Bpp	PSNR	bpp	PSNR	Bpp	PSNR	Bpp	PSNR	bpp
Lena	34.62	2.00	34.85	2.00	32.27	0.70	31.64	0.55	30.91	0.48
Cameraman	32.07	2.00	32.13	2.00	28.73	0.70	28.53	0.57	28.24	0.50
Boats	32.77	2.00	33.15	2.00	28.25	1.12	27.85	0.82	27.15	0.60
Bridge	30.68	2.00	30.94	2.00	29.80	0.81	29.52	0.64	29.10	0.56
Baboon	37.14	2.00	37.46	2.00	35.31	0.78	33.25	0.47	32.26	0.40
Kush	35.41	2.00	35.55	2.00	33.31	0.73	32.30	0.52	31.44	0.45



Original Threshold 50Threshold 100 Threshold 150(bpp : 8.00) (bpp : 0.78) (bpp : 0.47) (bpp:0.78)

OriginalThreshold 50 Threshold 100 Threshold 150(bpp : 8.00) (bpp : 0.73) (bpp : 0.52) (bpp : 0.45)

Fig.-3 Reconstructed images obtained with different Threshold values 50,100 and 150.

Table-3: Compression Rates, PSNR with respect to BTC, AMBTC, Proposed techniques.

Images	BTC		AMBTC		Threshold 150	
	PSNR	Comp. Rate	PSNR	Comp. Rate	PSNR	Comp. Rate
Lena	34.62	75%	34.85	75%	30.91	94%
Cameraman	32.07	75%	32.13	75%	28.24	94%
Boats	32.77	75%	33.15	75%	27.15	93%
Bridge	30.68	75%	30.94	75%	29.10	93%
Baboon	37.14	75%	37.46	75%	32.26	95%
Kush	35.41	75%	35.55	75%	31.44	94%
Average	33.78	75%	35.55%	75%	29.85	94%

V. CONCLUSION

By using the suggested technique, a two-stage compression is accomplished. By dividing the blocks into high detail and low detail blocks in the first stage, the bit rate is decreased. In the second stage, the interpolation approach is utilized to further lowering the bit rate. The compression rate achieved by the proposed method is increased by 19% on an average which is a significant improvement. The BTC and AMBTC yields a compression rate of 75% and 75% respectively. But the proposed method gives an average compression rate of 94%. The proposed method thus used for compressing gray

scale images are also employed for steganography for hiding secret information as part of compressed images. This reduces the size of the stego image which carries the hidden image while being transmitted over Net. A color image of size 256 x 256 pixels is capable of holding secret information of size 49152 bits. When compared to other steganography techniques, the method of hiding information will be difficult for the intruders to extract the data. The compression technique that has been proposed in this research work is also applicable for color image compression and video compression.

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