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A Study on Segmenting Brain Tumor MRI Images

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Abstract: Segmentation of image has traditionally been referred to as the initial stage in image processing. A successful segmentation output will make image processing analysis considerably further easier. There are several image segmentation techniques and methodologies available. Clustering is the most widely used segmentation algorithm for image processing. Segmentation of tumor using magnetic resonance imaging (MRI) data is a critical procedure yet time-consuming process manually carried out by medical specialists. Due to the considerable difference in the tumor tissue appearances across patients, as well as their occasionally similar resemblance to normal tissues, automating this procedure is difficult. MRI is a sort of sophisticated medical imaging that offers precise information on the human soft tissues. To identify and segment the brain tumor using MRI images, several brain tumor segmentation and detection approaches are analyzed. The benefits and drawbacks of these approaches for brain tumor identification and segmentation are analyzed, with an emphasis on illuminating the benefits and limitations of these techniques for brain tumor segmentation and detection. The MRI image usage in segmentation and detection on various processes is also covered. This analysis provides an overview of several segmentation methods for identifying brain tumors from MRI images of the brain, as well as the usage of various Clustering Techniques.

Keywords: Tumor Detection; Magnetic Resonance Imaging (MRI); Tumor Segmentation, Automated System, Pre-processing, Filtering.

I. INTRODUCTION

Segmentation is a method that divides an image into numerous segments to accurately identify its pixels in a decision-oriented application. It splits an image into many discrete areas, with strong similarity and contrast between the pixels in each zone. As a result, segmentation of image is used to change or simplify the image's representation, or to turn the features of an image into a most useful form, making it easier to study. It is a helpful tool in a variety of fields and applications, including medical image processing, health care, traffic image analysis, pattern identification, and so on.

Image segmentation may be accomplished using a variety of approaches and methodologies, including graph-based, threshold-based, and morphologically based, edges based, clustering-based, neural network-based, and etc. Among these strategies, clustering is one of the most commonly utilized and successful. These techniques each have their own set of benefits and drawbacks, therefore one must select an algorithm depending on their own needs. There are several clustering procedures, such as Fuzzy C-means clustering, K-means clustering, Subtractive clustering approaches, and so on.

In this study, a review was done on various clustering strategies and recent researches made on them. MRI of brain image computation has dramatically expanded the domain of medicine by offering various approaches for extracting and visualizing data from medical images obtained through different retrieval conditions. The method of extracting data from complex MRI brain images is known as brain tumor segmentation. In today's medical world, diagnostic imaging is a very valuable method. Imaging techniques such as MRI, computed tomography (CT), digital mammography, and others are useful in detecting various diseases. When the number of patients rises, automated detection methodologies enhance information of normal and abnormal examinations for medical testing and play a major role in diagnosis and

treatments. For evaluating brain MRI, anatomical structures like muscles, bones, tissue types, blood vessels, pathological regions like multiple sclerosis lesions, cancer, and splitting a whole image into sub-regions like grey matter (GM), white matter (WM), and cerebrospinal fluids (CS), segmentation has a wide range of applications in medical imaging. Thus, segmentation of brain tumor is important in MRI. MRI is especially well suited to brain studies due to its great contrast of soft issues, high spatial resolutions, and non-invasive nature. Segmentation of brain tumor divides a part of the image into collectively unique and channeled areas, ensuring that every ROI is locally contiguous and that the pixels inside the areas are homogeneous according to a predefined condition. Texture, concentration, color, surface normal, range, and surface curvature are examples of homogeneity conditions.

Many researchers have prepared important research in the field of brain tumor segmentation in the past, and it remains one of the most critical research topics today. Medical history, imaging scans, biopsy (a tiny brain tissue is removed and examined using microscope) are all essential for the brain tumor analysis. The diagnostic process can begin with standard x-rays and computed tomography (CT). On the other hand, MRI is very valuable since it offers more comprehensive details regarding the tumor types, location, and sizes. As a result, MRI is a better option for the diagnostic workup, surgery and procedure outcome monitoring.

II. RELATED WORK

In anomaly prediction, inaccuracies were a major issue in the medical image processing field. These issues have increased as a result of errors generated by the operator, device/instruments, and environment, all of which may be addressed using the innovative segmentation approach presented in this study. To correct the inaccurate predictions of anomalies in different topographical locations in MRI brain subjects, in [1] a new method combined the functions of the Interval Type-II Fuzzy Logic System (IT2FLS) and Spatially Constrained Fish School Optimization algorithm (SCFSO). This technique can readily interfere with and analyze huge datasets and complicated tumors (anomalies), and it may be the proactive estimation for being incorporated or implemented in clinical experience for the benefit of both physicians and the patients, and it may offer doctors with a meaningful experience. The SCFSO-IT2FLS method presented here was implemented on the BRATS-SICAS dataset. This approach provided the assessment parameters as Dice overlap index (DOI) with 96±2.1 and sensitivity value with 98±1.1. These results compared with existing approaches, and this method may be used to segment T1-weighted (T1-W), Flair (Fluid Attenuated Inversion Recovery), and T2-weighted (T2-W) MRI sequences of varying axis coordination. This approach allows for the separation of non-tumor (edema) and tumor areas, and such an advantage is the therapeutic pre-planning can be frequently done [1].

Detection of brain tumor and analyses are critical in medical imaging. The work in [2] focused on segmenting anomalies in axial brain MRI DICOM slices since this formation has the benefit of maintaining full metadata. The axial slices were based on the assumption that the right and left halves of the brain were separated by a LoS (Line of Symmetry). A semi-automatic system extracts normal and pathological features from every brain MRI slice in the DICOM analysis. Here, fuzzy clustering (FC) was utilized to extract distinct clusters for varying k from DICOM slices. After that, the silhouette fitness function was utilized to produce the best-segmented image with the maximum inter-class permanence.

Morphological procedures improved the tissue class's clustered boundaries even better. The FC approach was coupled with normal image post-processing approaches like marker regulated watershed (MCW) segmentation, distance regularized level set (DRLS), and region growing (RG). This approach was tested on the well-known BRATS challenge data set of several methods as well as the clinical data set of axial T2-w MR images. The metadata information contained in the DICOM header was utilized to do quantitative analysis on the slices. These segmentation technique's validation over ground truth images demonstrated that DRLS augmented brain images with FC have the better Dice similarity coefficient and Jaccard score. The average dice and jaccard scores for 10 patient trials in the BRATS dataset for segmenting tumor sections were 0.79 and 0.88, respectively, and 0.78 and 0.86 for the clinical analysis. Finally, DICOM data was utilized to create 3D visualizations and estimate tumor volumes [2].

Traditionally, human inspection was used to identify and detect computed tomography and magnetic resonance brain images. Computerized Tomography and Magnetic Resonance Imaging images generate extraneous noise caused by operator output, which can lead to significant classification errors. A new

technique for Brain Tumor Classification based on the usage of a Back Propagation Neural Networks (BPNN) with Fuzzy C Means (FCM) was presented in [3]. The processes followed were: decision making was divided into two stages like pre-processing and decision-making. Following that, analysis was carried out utilizing high-level segmentation (through FCM) and low-level segmentation (using BPNN). Twenty-five brain tumor images were utilized for assessment [3].

Image segmentation is essential in the domain of medical applications. MRI scans of brain without and with the diseases were recommended for the diagnosis and staging of Alzheimer's disease. Clustering was a popular image segmentation concept that identifies groups so that samples from the same group may be compared to each other rather than samples from different groups. There has recently been a consideration regarding the use of fuzzy clustering techniques, which retain more detail from the input images than clustering theory. The Modified FCM method was used due of its adaptability, since it allows pixels to belong to multiple groups with varied degrees of membership. The MFCM was utilized to establish the clusters, and the Binary Gravitational Search method was employed to improve the segmentation process's efficiency. Various brain topics like Grey Matter (GM), White Matter (WM), the hippocampal regions, and Cerebrospinal Fluids (CSF) were segmented to identify Alzheimer's disease. When compared to other current methods, the BGSA using the MFCM algorithm produced superior results. This method has an accuracy rating of 93.3 percent [5].

Segmentation of tumor using MRI data was a necessary but lengthy manual process carried out by medical specialists. Due to the significant difference in the formation of tumor tissues across individuals, as well as their near similarity to normal tissues, automating this procedure was difficult. MRI was a sort of sophisticated medical imaging that offers precise information on the human's soft tissues. To segment and identify the brain tumor using MRI, several brain tumor segmentation and detection techniques were utilized. The benefits and limitations of these approaches for brain tumor identification and segmentations were analyzed, with an emphasis on illuminating the benefits and limitations of these techniques for brain tumor segmentation and detection. The use of MRI segmentation and detection in various processes was also covered. An overview of several segmentation approaches for identifying brain tumors using MRI images is discussed in [6].

III. SYSTEM ARCHITECTURE

From MRI images, brain image segmentation is difficult and complicated, yet it is important for tumor diagnosis and classification, edema, hemorrhage detection, and necrotic tissues. MRI imaging is the most effective imaging technology for detecting abnormalities in brain areas early. MRI image acquisition settings, unlike CT, may be changed to generate high contrast images with varying grey levels for varied instances of neuropathology. As a result, MRI image segmentation is expected to be a hot topic in the medical imaging research community in the near future. MRI is a non-invasive method that may be performed as frequently as needed for brain imaging. MRI scans are used to provide accurate and detailed images of organs from various angles in order to identify any abnormalities. There are two forms of MRI: high field MRI, which produces high-quality images, and low field MRI, which produces the minor diagnostic conditions. MRI images enable doctors to see even hairline fractures and rips in ligament, muscle, and other soft tissue ailments. MRI works on the basis of energy absorptions and emissions in the radio free ranges of the electromagnetic spectrums. MRI was useful for detecting brain disorders like tumor, hemorrhage, multiple sclerosis, or lesion. Accurate anatomical three-dimensional (3D) models developed from 2D MRI medical image data aid in providing accurate and precise diagnosis about spatial relationship among critical anatomical structure like eloquent cortical area, vascular structure, and so on, as well as other pathological findings that would otherwise be unrecognizable by the human eye.

The following section comprise the method meant to identify brain tumors in their early stages and classify them as benign or malignant. Figure 1 depicts the process of system architecture during these periods.

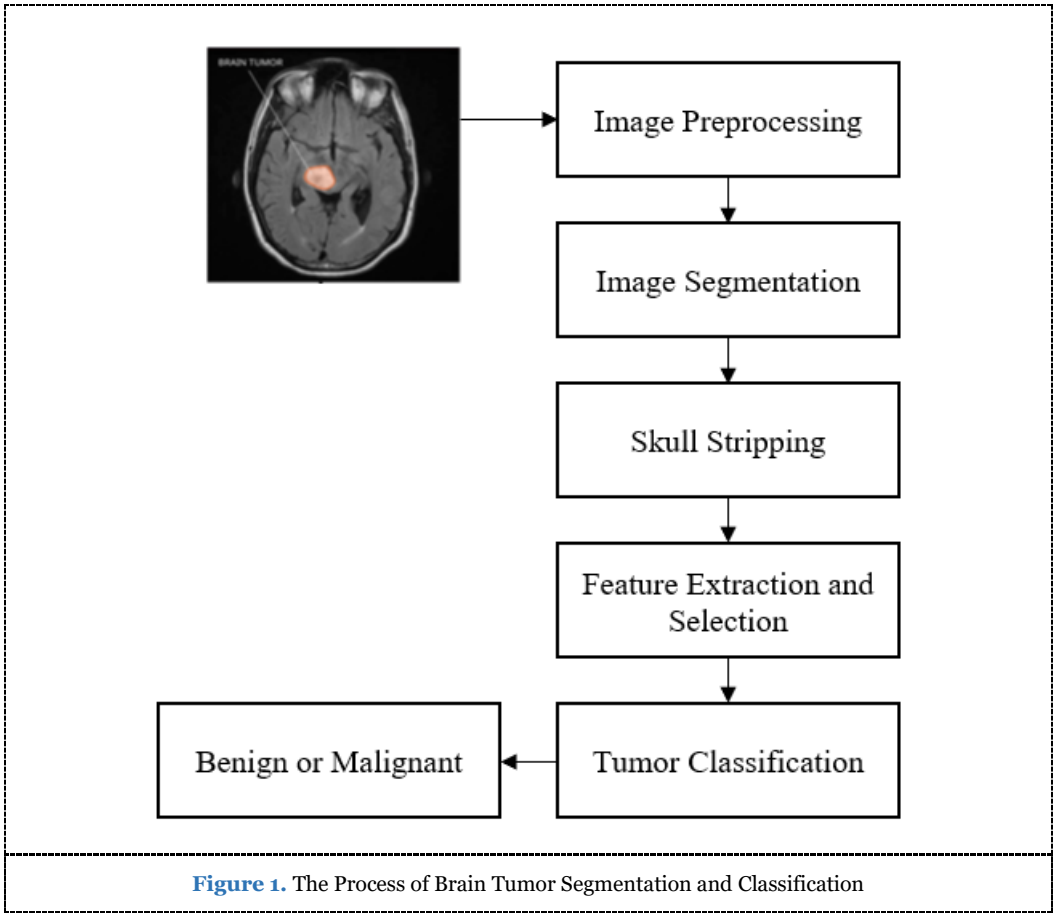

Figure 1. The Process of Brain Tumor Segmentation and Classification

A) Image Processing: It is the process of using a digital computer for processing digital images using the algorithms. As a subset or area of digital signal processing, digital image processing has numerous benefits over analogue image processing. It permits the applications of broader range of algorithm to the input data while avoiding problems like noises and distortions during the process. Due to images are specified in 2D, image processing may be modelled as a multi-dimensional system (or more). Three elements impact the genesis and production of image processing: the first is the computers development; the second is the development of mathematics; and the third is the growth of science (specifically the development and enhancement of discrete mathematical theory). Demand for diverse applications in the environments, agricultures, industry, military, and medical sciences has increased in the third phase.

B) Image pre-processing: Image pre-processing may significantly improve feature extraction and image analysis performance. A frequent stage in many feature descriptor approaches is mathematical normalization of a data collection, which is comparable to image pre-processing.

C) MR Brain Image Skull Stripping: Mathematical morphology-based techniques, atlas-based techniques, deformable surface-based techniques, intensity-based techniques, and hybrid techniques are the five types of skull-stripping methods discussed in the literature. The MRI device generates brain images as 3D volumetric data represented as a stack of two-dimensional slices for diverse brain image applications like study of anatomical structure, volumetric analysis, localization of anatomy, treatment planning, diagnosis, surgical planning, and computer-integrated planning. It is critical to study the information contained in these brain slices using computer-aided techniques.

D) Image Segmentation: Image Segmentation is the splitting of digital images into various subgroups (pixels) process known as Image Objects, which lowers the image's complication and facilitates image analysis. To split and group a specific collection of pixels from an image, several image segmentation techniques were employed. Labels were assigned to pixels as a result, and pixels with the same label are grouped together because they share a characteristic. Borders and draw lines can be used to define and differentiate the most

essential items in an image from the rest of the less important ones.

E) Feature Extraction: A stage in the dimensionality reduction process that isolates and lowers a large collection of raw data into smaller classifications is feature extraction. As a result, processing would be a lot easier. The most essential element is that these big data sets contain a high number of variables.

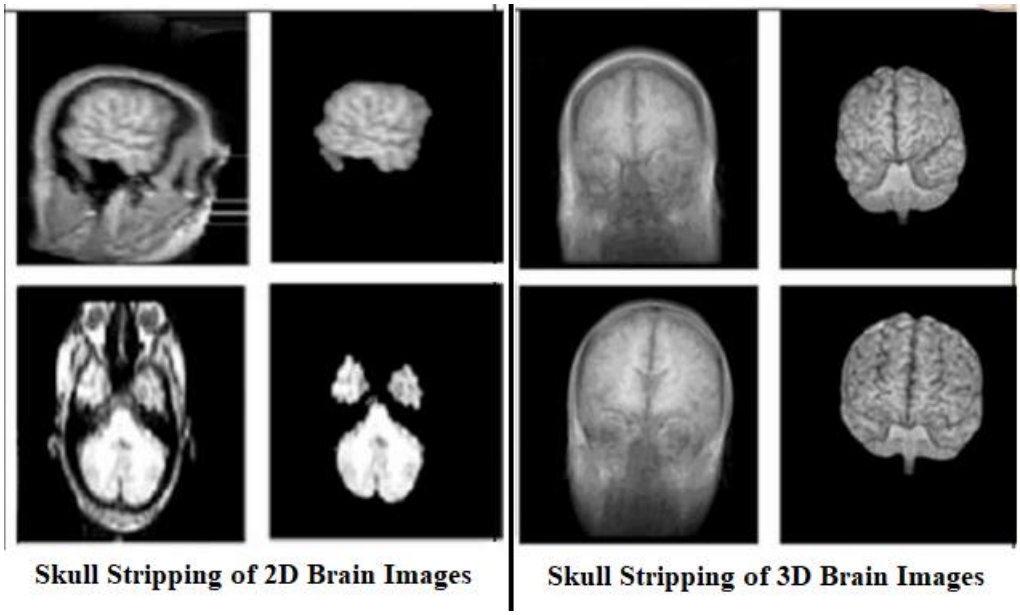

Figure 2. The Skull Stripping Process of Brain Images

F) Feature Selection: Feature selection minimizes the amount of input variables while creating the predictive model. The count of input variables must be decreased to minimize modelling computational costs and, in some circumstances, to improve model accuracy.

G) Tumor Classification: Deep learning is one of the most often used approaches in tumor classification to differentiate among benign and malignant types. CNN is an efficient learning technique for classification issues. Deep neural networks (DNN), particularly convolutional neural networks (CNNs), are frequently employed in image classification applications and have demonstrated considerable performance since 2012. CNN study on medical image classification has produced results comparable to human specialists. CNN outperforms in situations with fewer data and higher dimensionalities. The CNN classifier is capable of distinguishing among benign and malignant.

Recently, image segmentation has been the complex and active study topic in the domain of processing image. Despite the availability of a wide range of cutting-edge approaches for MRI segmentations of brain, segmenting MRI remains the difficult issue, with much room for future researches to increase the precision, accuracy, speed of segmentation techniques. Implementing parallelization and merging diverse algorithms might be the future roadmap for brain segmentation method advancement. Growing new understanding regarding the link between different illnesses and anatomical variation is emerging as a result of continuing study in the biological world. As a result, brain segmentation is becoming more popular as the initial stage in tools for detecting and assessing structural deviance. Alzheimer's disease and Multiple Sclerosis (MS), for example, are conditions that may be investigated based on changes in brain structures.

IV. CONCLUSION AND FUTURE WORK

This study analyzed an automated system that can correctly identify brain tumors as benign or malignant using MRI scans. Image processing and image segmentation techniques can be applied on MRI images. Both the machine learning and deep learning approaches can be utilized for the classification of brain tumor. If machine learning approaches were used means, during the segmentation phase, brain tumors may be segmented using s-FCM. The SF, FIF, and GLCM approaches may be utilized to extract features, and the PCA methodology can be used to pick features. If the deep learning-based approaches were used means there is no need to use additional techniques for feature extraction and selection. The deep learning techniques were capable of both feature

extraction and selection. The CNN approach may be utilized in the classification process. The larger the training database, the better the detection efficiency. This study is part of an integrated framework that allows for tumor identification, benign and malignant tumor classification, tumor rating, tumor tracking, and patient care stages. The analysis in future study will be focused on introducing new features and developing an interactive platform.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No animals/humans were used for studies that are basis of this research.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The authors confirm that the data supporting the findings of this research are available within the article.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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An Analysis of Deep Learning Techniques in Neuroimaging

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Abstract: Deep learning is a machine learning technique that has demonstrated better results and performance when compared to standard machine learning algorithms in relation to higher dimensional MRI brain imaging data. The applications of deep learning in the clinical domain are discussed in this study. A detailed analysis of several deep learning algorithms for the Alzheimer's disease diagnosis is analyzed, in which this disorder of brain that gradually spreads and destroys memory of the brain, and it is a typical disorder in elderly individuals due to dementia. When it comes to brain image processing, the most commonly used and represented method, according to most research publications, is Convolutional Neural Networks (CNN). Following a review of many relevant studies for the Alzheimer's disease diagnosis, it was shown that utilizing advanced deep learning algorithms in different datasets (OASIS and ADNI) combined to one can improve AD prediction at earlier stages.

Keywords: Neuroimaging Classification, Alzheimer's disease, ADNI, OASIS, CNN, Deep Learning.

I. INTRODUCTION

Alzheimer's disease (AD) is the most prevalent kind of dementia, characterized by brain or neurological disorders that cause cognitive declination and gradual loss of memory owing to the death of cells in brain. Typically, the indications of AD grow slowly and become severe enough to interfere with the patient's everyday life. However, the primary reason of this disorder is not just an oldness problem, in its beginning phases, the loss of memory is moderate and their skills of ability are radically transformed [1]. It is predicted that by the year 2050, one out of every 85 persons on the planet would be infected with this disorder [2]. Early detection and diagnosis of AD is a potentially successful therapy. It is a difficult work, particularly at the beginning stage of AD diagnosis. Previous research has revealed that the majority of Alzheimer patients lose their ability to communicate. Typically, a neuropsychological test is performed to make an initial diagnoses of AD. The precision of psychologic cognition tests was entirely dependent on clinician's competence and experience. Using this examination on a huge number of Alzheimer's patients would require lot of money and effort. As a result, it is critical to create an automated classification and detection technique [3].

Clinical specialists are capable of analyzing and interpreting medical information; however, because of the subjectivity and high complexity of the images, it is difficult for a clinical specialist to analyze images; therefore, in various fields of practical applications, the implementation of deep learning is successful in delivering better and precise results for medical images. Deep learning approaches can classify, extricate higher level features, and further aid in the correct diagnoses of AD patient in minimum time due to the rapid expansion of machine learning algorithms [4]. The first section provides a review of deep learning and its benefits in neuroradiology; the second section discusses the common algorithms utilized in deep learning for AD classification and comparison; and the third section concludes with the better and most precise approach for detecting AD. Finally, the limitations and future directions are discussed.

II. CONCEPT OF DEEP LEARNING AND NEURAL NETWORK

Deep learning (DL) is a part of artificial intelligence (AI) and machine learning (ML). It

is now tackling numerous issues in every field, particularly in medical image processing. It is a supervised ML approach that employs deep neural network (DNN) models and neurons, which was the fundamental computational units of the neural networks, with the notion derived from brain neurons of human. A conventional DNN is made up of three layers, every layer contains node. Input layer was initial layer, the center was hidden layers, and final was output layers, all these layers were used for learning and processing data. The count of hidden layers in the neural network is higher results in achieving higher accurate pattern detection. DL utilizes labelled data sets to automatically construct similarly a classifier for AD detection in image classification. Figure 1 represents a generic perspective of a neural network in which many inputs are provided and aggregated in linear form before being passed through non-linear operation to produce the result.

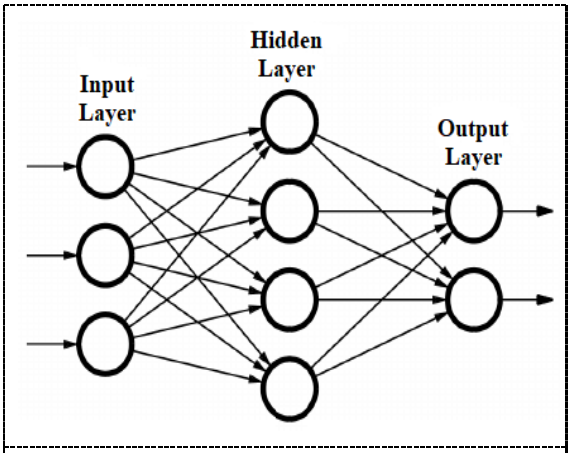

Figure 1. The Architecture of Neural Network

A DL is a versatile method in which the equivalent model may have several architectures and manipulate a variety of hyper parameters [6]. DL algorithms used in computer-aided detection and diagnosis can assist medical specialists in interpreting medical images, identifying features, and reducing interpretation time. Multi-model neuro imaging data was employed for AD's diagnostic classification to acquire improved performances and better outcome [7].

Many DNN methods are utilized in the field of AD diagnosis and were developed in numerous researches. These approaches were more powerful than other typical systems for data analysis and learning. The following are some of the neural network (NN) architectures that are utilized in DL:

2.1. Convolutional Neural Networks (CNN)

CNN is the form of ANN that was utilized for image, audio, and other categorization tasks. CNN works well with 2D data. It was constructed of 3 layers: inputs, hidden and output layers with numerous convolutions, fully connected, normalizing and pooling layers. Figure 2 represents the architectures of CNN.

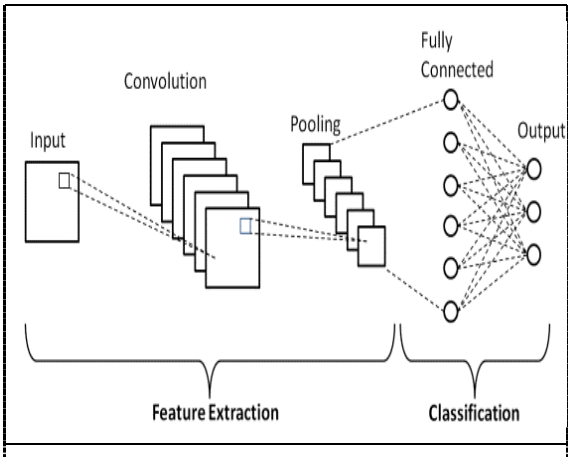

Figure 2. The Architecture of Convolutional Neural Network

2.2. Deep Neural Networks (DNN)

DNN was the neural networks architecture with many layers. There is an input, minimum one hidden layer among the output and input layers, all of which have complicated non-linear connections. It was utilized for regression and classifications and works with unstructured and levelled data. Figure 3 depicts the architecture of DNN.

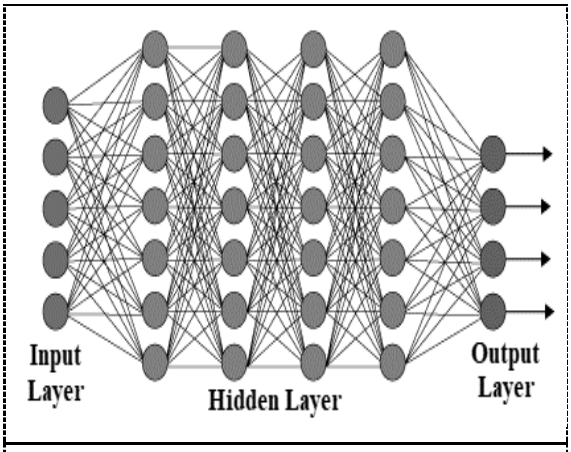

Figure 3. The Architecture of DNN

2.3. Deep Belief Networks (DNN)

DBN, a constructive graphical model in which hidden layer was unidirectionally linked and utilized for unsupervised and supervised

learning algorithms. The DBN design shows how each sub-network of the hidden layer acts as the visible layers to the following one. Figure 4 represents the architecture of DBN.

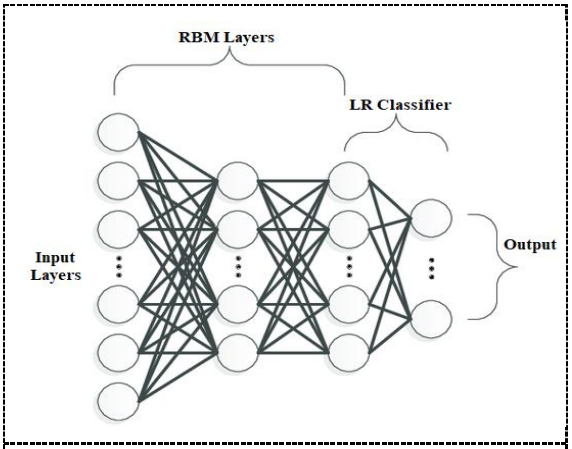

Figure 4. The Architecture of DBN

2.4. *Recurrent Neural Network (RNN)*

RNN was a sort of ANN that is frequently utilized in speech recognitions and natural language processing. In this network, the previous step's output is given as the next step's input, and the weight is distributed across each step and neuron. The primary characteristic of this network was its hidden state that can learn sequences. Figure 5 depicts the architecture of RNN.

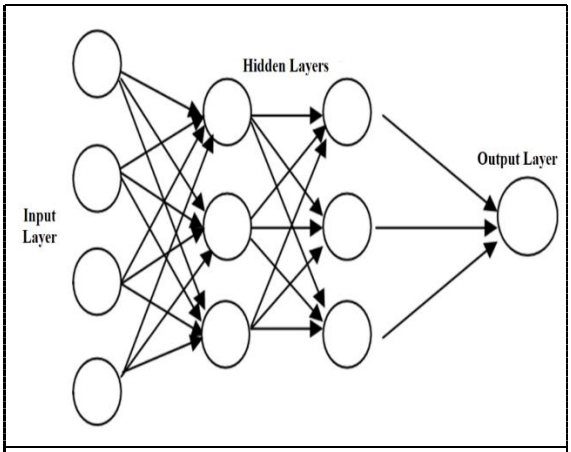

Figure 5. The Architecture of RNN

2.5. *Deep Convolutional Extreme Learning Machines*

This deep convolutional with ELM approach, which differs from traditional neural network learning algorithms, is an integration of CNN powers with quick training of ELM. It employs Gaussian probability, allowing for quicker training and completion without the need for time-consuming iterations. Figure 6 depicts this architecture of Deep Convolutional Extreme Learning Machine.

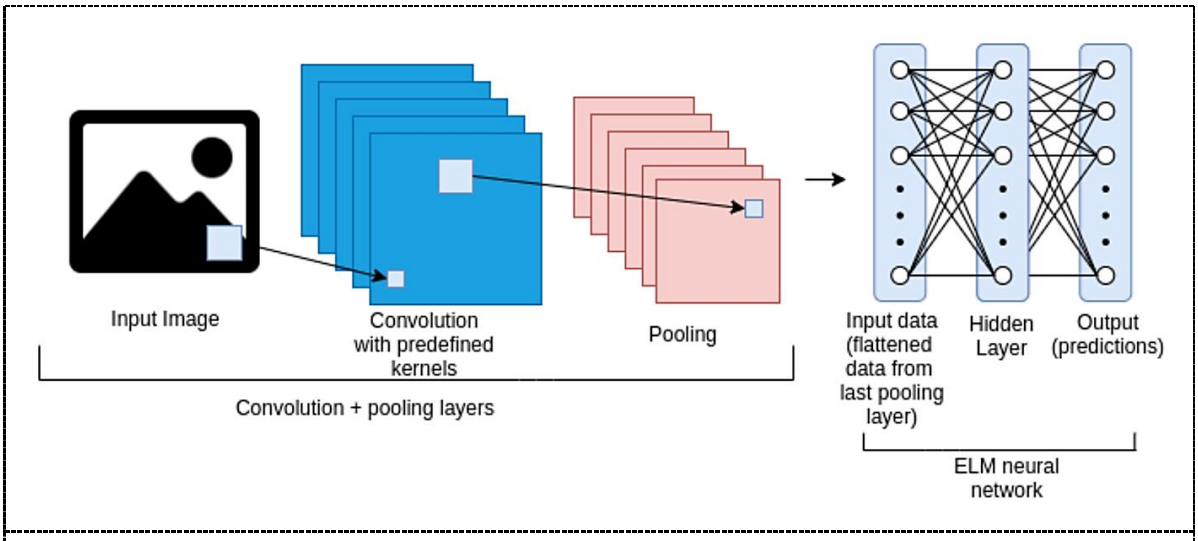

Figure 6. The Architecture of Deep Convolutional Extreme Learning Machine

2.6. *Deep Autoencoder (DA)*

DA is a ML algorithm that is unsupervised learning technique. It is constructed of 3 layers: input, the hidden (encode), and decoding layers. It was widely utilized to extract and redact the dimensionality of feature architectures. Figure 7 depicts the deep neural network's autoencoder and decoder architecture [9]. Contractive, Denoising, Variational, and Sparse autoencoders are the four fundamental types of autoencoders.

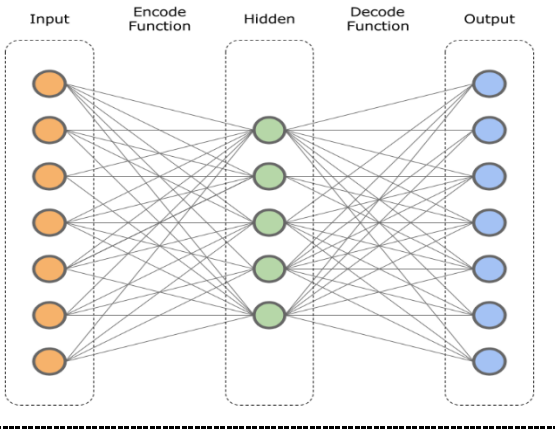

Figure 7. The Architecture of Deep Autoencoder

III. RELATED WORKS

Initially, This section presents a short summary of earlier relevant researches on DL-based diagnosis and classification of AD and moderate cognitive impairment (MCI).

In [4,] both fMRI and MRI pipeline were used in DCNN, employing two distinct sub sets of the ADNI data set, including 144 fMRI participants and 302 MRI patients. The fMRI volume comprised 52 AD patients (31 men, 21 females) and 92 normal patients (43 females, 49 males), whereas the MRI volume comprised 211 AD patients (85 females, 126 males) and 91 normal participants (43 females, 48 males). The accuracy score of both pipeline methods, as well as GoogleNet and LeNet, were examined. The accuracy rates achieved from both pipelines were 99.9 percent and 98.84 percent, respectively. Subject-level categorization was also conducted for clinical purposes, with average accuracy rates of 94.32 percent and 97.88 percent for two separate datasets. When applying a decision-making approach for subject level categorization, the accuracy value increased to 97.7 percent for fMRI and 100 percent for MRI pipeline.

A unique early diagnosis approach based on deep learning architecture was presented in [10] for the diagnoses of MCI, AD, and its earlier stages. This included stacked autoencoder as well as an output regression softmax layer. This approach was utilized to evaluate many classes in a single environment, requiring less previous knowledge and requiring fewer labelled training samples. The authors used neuroimaging data from the AD Neuroimaging Initiative (ADNI). The ADNI baseline cohort contained 311 subjects of MRI scans, including 65 AD individuals, 67 converter-MCI participants, 102 non-converter-MCI subjects, and 77 healthy participants. The output showed that combining PET and MRI images, 88.6 percent accuracy for binary classifications and 47.4 percent accuracy for four classes classifications were obtained when compared to SK-SVM and MK-SVM. It has been demonstrated that multi-layer parametric learning may be used on smaller bio-medical data sets to extricate higher-level biomarker [10].

A very high accuracy of 96.85 percent was achieved utilizing DCNN architecture in [11]. This method distinguished fMRI data from the AD brain data from the normal brain, and they chose 15 aged normal control patients from the ADNI dataset (19 males and 24 female). Finally, it was suggested that for increasingly complex issues, more convolutional neural layers be used.

A novel method was presented in [12], a deep learning-based approach to detect moderate cognitive impairment patients who are more likely to have AD within three years. The ADNI database was used to integrate baseline structural MRIs, demographic, neuropsychological, and APOe4 genetics data. The major goal was to distinguish an Alzheimer's case from a healthy case. The detection rate was quite high, with an average AUC of 0.924, 86 percent detection accuracy, 85 percent specificity, and 87.5 percent sensitivity.

As discussed in [13], a CNN-based approach was utilized to extract discriminative feature from structural MRI. With the goal of detecting Late Mild Cognitive Impairment (LMCI), Early Mild Cognitive Impairment (EMCI), and developing the classifications technique between normal participants and EMCI and LMCI groups. The feature extraction and classification model produced higher accuracy results for three groups (LMCI, EMCI, and Normal) using 600 individuals from the ADNI database. The best results were obtained in sagittal views for classifications of normal and LMCI sets, with higher accuracy attained for LMCI/EMCI pairings than Normal/EMCI pairs across each MRI view.

The authors of [14] created and tested a pattern classification system based on a sparse autoencoder and a 3D convolutional neural network to build an algorithm for predicting patients' disease state. This work indicated that the 3D convolution method in a CNN may captivate local 3D pattern, which might improve classification performances over the 2D technique. The conv layer was utilized in this experiment, and it was pretrained with the autoencoders. For evaluation 22,655 MRI images from the ADNI dataset were utilized and found that 3D-CNN outperformed other compared techniques.

In [15], an effective DCNN approach for detecting AD was proposed for brain MRI data processing. The primary emphasis of this work was structured MRI (sMRI). The work provided a considerable enhancement for multi-class classifications, whereas the majority of suggested research work only achieves binary classifications. It was capable of identifying distinct phases of AD and has

demonstrated better performances in diagnoses of initial-stage. The model was trained using a smaller dataset derived from the OASIS dataset, which comprised 416 data samples.

In [16] a DCNN-based model was proposed for diagnosing various stages of AD utilizing sMRI images. Using the ADNI dataset, a four-way classifier was utilized to classify MCI, AD, LMCI, and normal people. A total of 355 contents from 149 patients were utilized. MRI scan was first preprocessed to generate GM image before being sent to the CNN network. ResNet and GoogLeNet models were used for network testing and training. When compared to previous comparable research, the performance was improved.

In [17] a CNN model (DemNet) was implemented with a 16-layer VGG Network modification for the three-way classifications of MCI, AD, and HC using MRI from the ADNI data set. The results surpassed other techniques developed in previous research. The overall accuracy was 91.85 percent. This study also revealed that seventeen coronal slices out of the central portion of the brain were adequate for classifications.

The authors of [18] utilized SVM with two separate datasets (ADNI and OASIS). On two known datasets, the findings were superior to other state-of-the-art approaches employing binary classification (case vs control). The OASIS and ADNI datasets were utilized in the experiments. In the case of the ADNI data set, the central region of the brain was chosen based on classifications results from 6 months of data, but in the case of the OASIS data set, a compilation of 150 individuals was utilized.

As proven in [19], a multi-modal CNN framework for the classification AD was developed, with input comprising sMRI, clinical evaluation, and genetic (APOe4) measurements. The factorization layers technique was employed, which can keep network depth while decreasing the amount of network parameters. This approach was used to solve the AD/normal classifications challenge. The data was derived from ADNI1, which included 400 MCI, 200 NC, and 200 AD individuals in age varying from 55 to 90 years. This model was capable of successfully distinguishing between normal and AD patients with near-perfect accuracy.

IV. ANALYSIS ON RESULTS AND DISCUSSION

Various approaches used for AD classification were compared based on a review of the literature. A study of the accuracy of several approaches revealed that employing a DCNN learning strategy on fMRI and MRI datasets resulted in higher accuracy. Deep Learning may be applied in medical imaging for image classification, object classification, organ, region, and landmark detection, lesion or object detection, segmentation, and registration. Many deep learning classifiers are used to classify the many sorts of medical images. Table 1 shows the performances of deep learning classifiers that were utilized for AD classification, and the deep learning classifiers performed better in terms of classification accuracy.

Table 1. Comparison of Classification Accuracy

Ref	Technique	Modality	Dataset	Performance
4	DCNN	fMRI and MRI	ADNI	98.84% and 99.9%
10	Stacked-autoencoders	PET and MRI	ADNI	87.76%
11	CNN-LeNet-5	fMRI	ADNI	96.85%
12	CNN	• Structural MRI Base-line • Demographics • Neuropsychological • APOe4 genetics data	ADNI	86%
13	CNN	MRI	ADNI	94.54%
14	Sparse autoencoder and 3D CNN	MRI	ADNI	Three-way-89.4% HC vs AD-95.4% MCI vs AD- 86.8% MCI vs HC- 92.1%
15	CNN	sMRI	OASIS	93.18%
16	Multi-class DCNN	sMRI	ADNI	98.8%
17	CNN-DemNet	MRI	ADNI	91.85%
18	SVM	MRI	ADNI and OASIS	100% and 97%
19	Multi-modal CNN	sMRI and medical evaluation and genetic (APOe4) evaluation	ADNI	99%

Medical images obtained from various image modalities provide substantial data about the patient's varied states and are an essential component of the diagnosis process in medical facilities. Recent advancements in medical imaging techniques such as MRI, fMRI, PET, and others have resulted in a massive rise in the volume of these images, as well as an increase in the demand

for automatic ways of classifying, indexing, annotating, and interpreting these medical images. Deep learning classifiers were utilized to evaluate and classify medical images for diagnosis in those cases. CNN classifiers are often implemented for classification in all types of medical image processing. CNNs may be trained on medical images from a number of fields, including radiology, pathology, dermatology, and ophthalmology.

Deep learning differs from regular machine learning in the manner in which descriptions were learnt from the original information. Deep learning, in reality, enables computational approaches including several processing layers based on neural networks to learn data representation with various degrees of abstractions. The main distinctions between DL and conventional neural network are the count of hidden layers, their connection, and the capacity to learn meaningful abstraction of the input. Deep Learning is gaining popularity owing to its superior accuracy when trained with massive amounts of data. Deep Learning excels at difficult tasks like image classification, natural language processing, and speech recognition. CNN is well-known for its capacity to do very accurate medical image classification in deep learning. However, as compared to standard machine learning approaches, the most important advantage of CNNs is that it does not require human feature extraction since CNNs can automatically extract features and then classify the AD stages.

V. CONCLUSION AND FUTURE WORK

Different researches were evaluated to analyze between Alzheimer's patients and healthy controls for the diagnosis of the disease. The majority of prior research focused on the diagnoses of MCI and AD utilizing DL and the CNN techniques, and the origin of the data gathering is the ADNI data set. As the recent researches were reviewed, that several researches utilized the multi-class classification, multi-modal CNN, and binary classifications based on deep neural networks on a variety of populations, and effectively obtained higher accuracy. In [11], CNN architecture and the LeNet5 architecture on fMRI images were used and effectively obtained data of AD from healthy data with a detection rate of 96.8 percent utilizing ADNI data from 28 people and normal data from 15 individuals. In [4] DCNN model was used, but in this work fMRI and MRI data were used with 144 fMRI and 302 MRI data set. SVM used in [18] discusses how the machine learning approach was applied to identify AD patients from MRI using two separate data sets (OASIS and ADNI). The findings of this work were achieved on two known datasets utilizing binary classifications (control vs case) with a detection rate of 100% from the ADNI dataset and 97 percent from the OASIS data set.

Since examining all the researches, it was determined that machine learning and deep learning approaches are implemented on different datasets in the majority of the works. In the future, advanced deep learning algorithms can be utilized to combine many datasets into one, increasing the detection and accuracy of AD predicting at early stage.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No animals/humans were used for studies that are basis of this research.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The authors confirm that the data supporting the findings of this research are available within the article.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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Performance Analysis of Emotion Classification Using Multimodal Fusion Technique

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Abstract: As the central processing unit of the human body, the human brain is in charge of several activities, including cognition, perception, emotion, attention, action, and memory. Emotions have a significant impact on human well-being in their life. Methodologies for accessing emotions of human could be essential for good user-machine interactions. Comprehending BCI (Brain-Computer Interface) strategies for identifying emotions can also help people connect with the world more naturally. Many approaches for identifying human emotions have been developed using signals of EEG for classifying happy, neutral, sad, and angry emotions, discovered to be effective. The emotions are elicited by various methods, including displaying participants visuals of happy and sad facial expressions, listening to emotionally linked music, visuals, and, sometimes, both of these. In this research, a multi-model fusion approach for emotion classification utilizing BCI and EEG data with various classifiers was proposed. The 10-20 electrode setup was used to gather the EEG data. The emotions were classified using the sentimental analysis technique based on user ratings. Simultaneously, Natural Language Processing (NLP) is implemented for increasing accuracy. This analysis classified the assessment parameters as happy, neutral, sad, and angry emotions. Based on these emotions, the proposed model's performance was assessed in terms of accuracy and overall accuracy. The proposed model has a 93.33 percent overall accuracy and increased performance in all emotions identified.

Keywords: *Emotion Classification, EEG signals, Brain Computer Interface, Multimodal Fusion, NLP.*

I. INTRODUCTION

Humans are renowned for their behavioural oscillations controlled by their mental condition dependent by their emotions. New technologies hunger to enable machines to comprehend humans totally, and the accomplishment of real user-machine communications will be useless if a person's emotions are not managed correctly. As a result, the need for robots to comprehend human emotions has grown increasingly essential in recent years. Brain is the CPU of the human body, accessing it required to perceive what a person feels and thinks. Data from the brain may be gathered in various methods, including MRI scans, EEG, ECoG, MEG, and various other signals containing brain information. Among these, electroencephalogram (EEG) signals offer a wealth of information about a person's emotional state that may be used to understand brain psychology better. It is more beneficial to evaluate emotions using EEG signals since they are voltage-dependent signals, and it is challenging to affect the electrical activity tactically. Hence, classification of emotions using EEG data may support enhancing the BCI system. This system has received several uses in recent days, including medical and healthcare treatment. However, they might also be utilized as an assistive device for individuals who require physical and mental support to engage with the actual world.

This research examines current approaches for filtering gathered signals and provides a closer examination of existent EEG signals classification algorithms for effectively detecting emotion. This research further examines the usage of EEGs in numerous operations, as well as modern advances in interpreting signal features. The objective of this work is to provide an effective method for classification of EEG by employing the multimodal strategy, which not just examines EEG signals for emotions classifications, further checks results generated by the NLP techniques to achieve more accurate performances. The certain aspects under consideration are that the temporal channels pair (T7 and T8) and the higher-frequencies band

produced a greater outcome than was not reliant on the time of collected data. Multiple emotions may be classified using the proposed technique based on EEG data from the brain. To collect a wide variety of signals, the EEG signals capturing device with a limited channels was employed. The system is divided into three steps that entail acquiring the offline signals and doing pre-processing, which includes eliminating artifacts and outliers. Then utilizing that data for training the classifiers on a variety of emotions. Next stage was testing, which was gathered in practical and used by the classifiers to determine the subject's emotions. The individuals were then requested to view an image or listen to songs and remark on it as words in third step. The information is processed by NLP, and emotions are evaluated concurrently with the analysis of the EEG data collected at the moment. Both outcomes were merged to provide superior results.

Section II of the article outlines the fundamental ideas of the brain-computer interface. The in-depth literature study of current classification algorithms and the different uses of EEG data was dealt with in detail in the session that followed. Section IV delves further into the various signal gathering techniques and the proposed system, followed by Section V's conclusion and future development.

II. RELATED WORK

The EEG signal was utilized in a variety of studies for determining people's mental states. These signals aid in the analysis of the emotions of autistic children, who are typically considered to exhibit social and behavioural impairments, difficulty with stereotyped actions, and hesitation in interacting with others. The robot fixed to the laser sensors components was utilized for identifying the child and determine the range among them. The EEG wireless device was put on the child's scalp, and these signals were collected and analyzed to allow for additional interaction. Two modes of interaction were developed: dog mode, in which the robot detects child and travels around them, and follower mode, in which the robot walks away, enabling child to follow them based on the child's activity, as determined by monitoring EEG data. EEG signals may also be utilized to forecast how video advertising will be rated [1]. The multimodal method was presented in [2] in which EEG data was recorded while the patient watching an online video. Simultaneously, the video's worldwide rating was computed using NLP. The random forest-based strategy was utilized to predict rating using EEG data, and when tested on 25 participants, this fused approach produced promising results.

According to [3] EEG signals may distinguish between happy and sad emotions produced by images. PSD was used to extract features, while SVM was utilized as a classifier. The average accuracy of 71.20 percent was achieved after determining that the temporal pairs of channels and the higher-frequency bands produced the best results, regardless of the length of the data recorded. A multimodal approach was utilized in [4] to compare brain (EEG) and other peripheral data in order to identify emotion. The device used a variety of inputs, including an EEG, temperature, galvanic skin resistance, blood pressures, and breathing, to determine a person's emotions. Emotions were evoked using images representing various emotions of valance-arousal. This approach was employed to assess, and it was discovered that EEG signal performed greater than other secondary signals, leading to the conclusion that they are the best feature for interpreting a person's emotion.

According to the findings of the study [5] a person's inner state may be detected utilizing the EEG waves. The proper positioning of electrodes and selection of features for the test needs a more in-depth comprehension of each feature. On a self-recorded dataset, the experiment was carried out by comparing all of the characteristics using machine learning algorithms. It was discovered that characteristics chosen using multivariate techniques work better, and that the optimum site to put electrodes was above the parietal Centro-parietal lobe. In article [6] for BCI system, a novel functional system design was presented to address communication barriers caused by a lack of shared vocabulary. A taxonomy was created, which together provided a foundation for the BCI model, and its efficacy was tested against various comparable systems and discovered as efficient.

The BCI has gained popularity because it allows unhealthy individuals to act like normal people in the world. The study [7] examined all of the research efforts made to develop BCI research for persons who are abnormal with supporting benefits. The standard EEG-based BCI model was implemented to help physically challenged or paralyzed persons to accomplish their daily duties. The BCI system has progressed over several phases, and at this point, they might be employed in a broader range of applications. The BCIs began to comprehend a person's emotional state. Access to brain activity might give valuable information about the user's emotional condition. Understanding the emotion pattern, as described in [8], might be applied in two ways. Comprehending the emotional signals pattern allows them to be recognized and eliminated from the actual data stream. As a result, regardless of the user's mood, the user's goal is satisfied appropriately. Another benefit of a person's emotion is that it allows them to interact with other machines in a more natural manner.

The two alternative feature selection approaches for EEG data were proposed in [9], concluding the features typically employed for emotion detection. The implemented approaches include statistical features related to Power Spectral Density (PSD) and High Order Crossings (HOC), and the outputs were obtained. The PSD strategy obtained 70% while the HOC approach achieved 69.5 percent, proving that both techniques are equally effective for identifying features in EEG data. The signal generation standard was important to EEG signal researchers since noise-free signals were the main objectives. As a result, they limit face, ocular, and jaw movements and relied on maximum electrodes to capture EEG signal, which was not feasible in a practical setting. Experiments were carried out on severely infested, noisy data with fewer electrodes ranging from four to six and average accuracy of 33% for happy, 33% for fear, 38% for anger, and 37.5 percent for sad was obtained in paper [10].

The study of EEG signal classification garnered a lot of attention. The efficacy of classification approaches was investigated in [11] for a movie induction experiment in which individuals spontaneously evoked actual emotion conditions and the EEG dataset of 6 cases was collected. The results on the EEG dataset led to a conclusion, including that the power spectral feature was better and that a linear dynamic system-based feature smoothing approach increases accuracy. Subject-independent feature reduction with manifold learning can be used to show the course of emotional changes. A real-time multimodal BCI data collection metadata approach was presented in [12], which used the capacity to manipulate alpha waves deliberately through eye movements. Using alpha brain waves, this technology may be utilized to control external equipment such as wheelchairs. The reaction created by eye movement (detects and regulates the amplitudes of brain's alpha wave) was evaluated, analyzed, and sent into smart controller device. The occipital lobes send signal which distinguish the magnitude of alpha signals produced by the various motions. Individuals were instructed to shut and open the eyes during the testing time. They were able to use it to control the restricted motions of a robot. Similarly, the other movements were attempted as well. The system was able to complete the activity with the aid of the alpha waves.

III. PROPOSED METHODOLOGY

Human-computer interaction is in high demand, and the desire to do it organically has become the most significant requirement. The expectation of people that systems should comprehend what they think rather than just giving commands created the foundation for the BCI technology, which must be built efficiently to meet the needs of the present world. As seen in Figure 1, the BCI is broadly characterized:

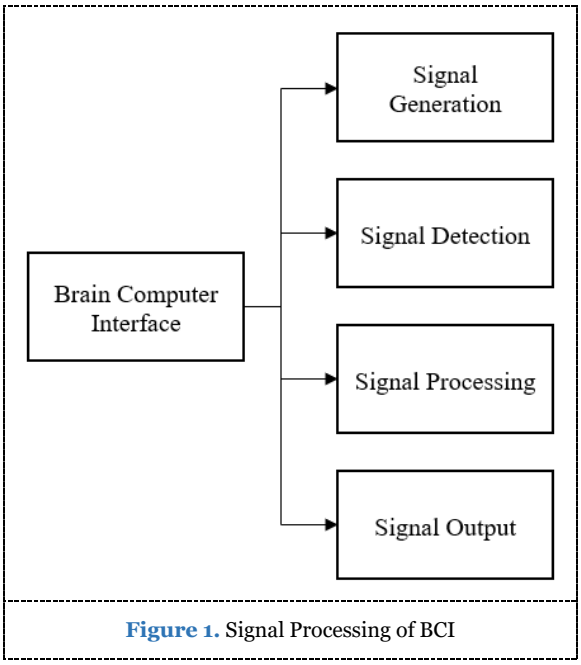

Figure 1. Signal Processing of BCI

Signal Generation: The source of the signals must be a subject.

Signal Detection: The EEG kit's electrodes should identify them among other signals.

Signals Processing: The signal could contain noises and outliers, and it should be treated before they could be used.

Signal Output: It is necessary to obtain some meaningful information from processed signals.

Each of them is a large study field, and a more complete description is discussed below.

3.1. Signal Generation

The first stage is signal production, in which the subject (source of signal) must create signals, and there are two ways to do so. Collecting active signals via giving forced stimuli, exhibiting visuals, or asking people to envision motions is an essential technique to aid in real-time signal gathering. The alternative option is a passive approach in which the signals previously gathered from the patient are used. Actively producing signals is helpful because signal detection is easier when you have total control over the stimuli. However, it has the drawback that noises and outliers were very prevalent in active input, and electrode corrodes readily during practical trial use. Passively produced signal needs examining the whole subject's brain signals since the areas of interest are difficult to locate.

3.2. Signal Detection

Different methods can be used to detect the brain signal. EEG signals are utilized to determine the brain's electrical activity, whereas fMRIs analyze the flow of blood in the brain. Aside from EEG and fMRI, there are additional signals such as MEG and ECoG. Each of them has its own benefits, thereby few rely on the temporal resolution and some special resolutions, like where and when it occurs.

3.3. Signal Processing

The primary issue with obtained EEG signal was that there is excessive noise in the data. Slight movements such as teeth grinding, eye and eyelid movements could result in a large variation in signal productions. The most essential task was to remove the noises, and then real signals may be utilized after this preprocessing. When the individual was actively participating in signals creation, the kind of signal and the moment of signal formation may be understood, making signal processing easier.

3.4. Signal Transduction

When the signal processing phase is completed, it indicates that the appropriate signals for analysis have been discovered. This signal must now be used efficiently to meet the subject's needs. The subject may have any purpose, such as moving a hand or legs, or, as in this example, it could just be aware of a person's feeling. The key point to keep in mind was that signals should be used effectively because they could not be gathered at any moment, and the whole system was inclined to error because the signals collected was too vulnerable.

The BCI is a direct communication channel that connects the brain to an external device. The objective of BCI is to assist, augment, or repair sensory-motor or cognitive functions, to develop applications for humans with disorders, to help visually impaired persons in visualizing external visuals, and to help paralyzed peoples in operating external systems without physical actions to decrypt the data stored on the brain. Human BCI EEG acquisition techniques are classified into three kinds. They are classified

- Invasive
- Partially invasive
- Non-invasive

During neurosurgery, the invasive kind involves placing electrodes exactly into the brain's grey matter. On the other hand, the partially-invasive approach places BCI device into the skull but keeps them externally on the brain. Because the electrodes are positioned outside the skull, the non-invasive technique is widely utilized in research. Electrocorticography (ECoG), which was a partly invasive method, and MRI and EEG, which were non-invasive and employ electrodes put on the head, are the most often used BCI techniques. EEG was utilized to monitor the brain's electrical activity, which was produced by nerve cells in billions known as neurons. This activity of EEG was monitored using electrodes attached to the head. EEG signals are classified into rhythmic frequencies varies from 0.5 Hz to 30 Hz. As illustrated in Fig 2, EEG waves were classified as Alpha, Beta, Gamma, Theta and Delta. Subjects create brain signals (features) after adequate training, and the features of the stable EEG output that the person could consistently produce (waves) is utilized; one may further elicit the EEG signal with the external stimulation (induced potential).

Alpha has a high amplitude in the relaxed state, and beta has a high amplitude in the stimulated state. When a person transitions from a calm to an excited state, the amplitude change from alpha to beta waves may be clearly detected. To collect the EEG waves, a standard "10-20 System" with 10-20% spacing is utilized. Figure 2 depicts four types of lobes by using letters to represent the various areas of the brain's lobes.

- F - Frontal Lobe
- T - Temporal Lobe
- C - Central Lobe
- O- Occipital Lobe

Odd numbers to the left and even numbers to the right represent the exact position of electrode placements. The EEG is used to assess cognitive workload since it is less expensive, easier to use, provides wireless connectivity, and has a minimum cost maintenance. The EEG's raw data are typically contaminated with different artifacts, trends, and noises caused by eye blinks, muscle movements, and so forth.

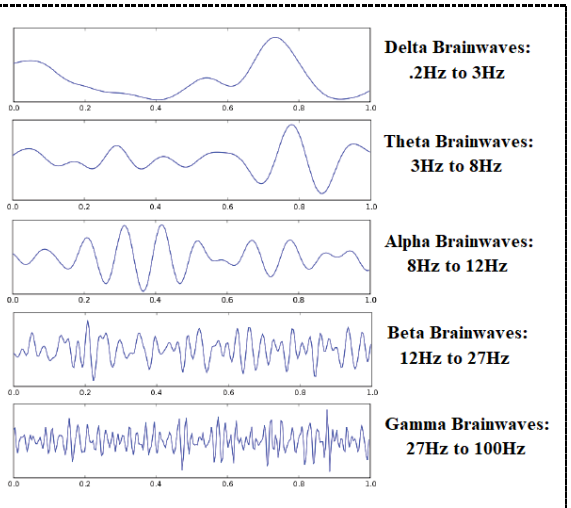

Figure 2. Brain EEG Signals

The proposed model classifies emotions by using EEG data, and its efficiency is tested using the NLP classification technique. The first stage is to perform two acts on the original EEG signals that were collected.

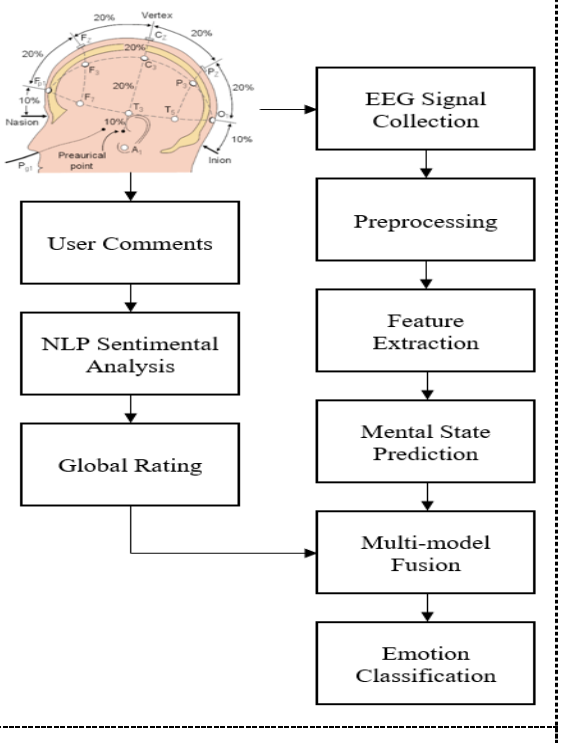

Figure 3. Block Diagram of Proposed Model

The first is independent component analysis, which breaks down multivariate arbitrary signals into collectively independent elements. Moving Average, in contrast was utilized for smoothing signals and changes every data value with surrounding average values. Before extracting features, the aforementioned approaches were employed to eliminate the influence of such undesirable artefacts. Later, random forest regression is used to do regression analysis on EEG data. The second stage is to use a natural language processing toolset to classify the subject's emotion based on their comments (text blob). Finally, to enhance the total predictions, the EEG-based rating was merged with an emotion score. Figure 3 depicts the whole planned model.

The proposed model was intended to classify four classes of emotions, every emotion has a count of subclasses, as seen in figure 4. The basic emotions were easily classified using EEG signals, while the subclasses were only discovered with the use of NLP. As a result, the algorithm was able to efficiently classify emotions into one of the categories.

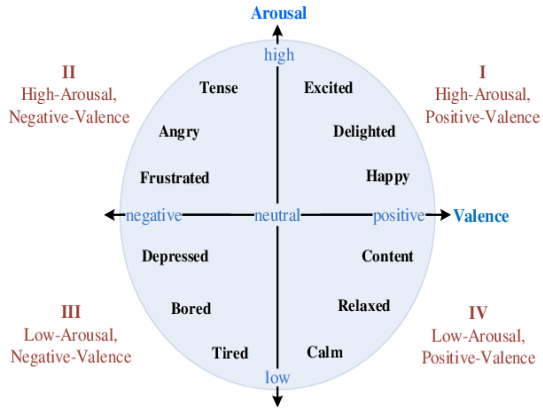

Figure 4. Different States of Emotions

IV. EXPERIMENTAL RESULTS AND DISCUSSION

In this section, the proposed model's performance is evaluated and compared with the existing techniques like ANN, Naïve Bayes, and SVM-DWT in terms of accuracy using different emotions like happy, neutral, angry, and sad. The proposed model is experimented with MATLAB Simulink tool. The performance analysis and the comparison of the proposed model is given in Table 1.

Models	Happy	Neutral	Sad	Anger	Overall Accuracy
ANN	89.24	89.92	88.34	91.16	89.66
NB	91.36	90.55	89.75	90.68	90.58
SVM-DWT	90.50	89.12	91.47	93.22	91.07
Proposed	92.34	90.76	93.38	96.85	93.33

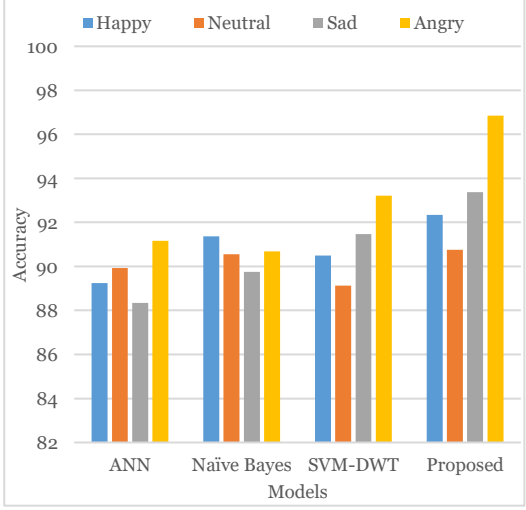

Figure 5. Comparison of Accuracy Performance

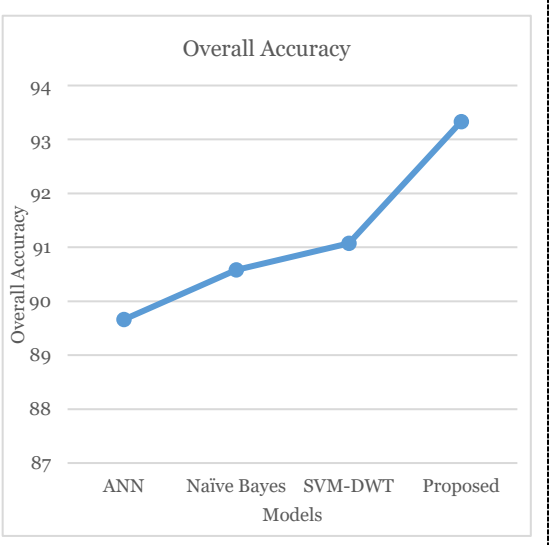

Figure 6. Comparison of Overall Accuracy Performance

Figure 5 represents the comparison of the proposed model's accuracy performance of different emotions with the other existing techniques. Figure 6 represents the comparison of the proposed model's overall accuracy performance with the other existing techniques. The proposed model outperforms the other classifier models in terms of emotional state classification accuracy. Happy, Sad, Neutral, and Anger are the emotions classified and measured in the classification performance. The proposed model has an overall accuracy of 93.33% and improved performance in all the emotions classified. The overall accuracy difference between the proposed model and the other classifiers is 2.26% to 3.67%.

V. CONCLUSION AND FUTURE WORK

Emotion identification is now provoking the attention of researches in a variety of areas, including those investigating the Brain-Computer Interface. This work proposed a multi-model fusion technique for emotion classification using BCI with EEG signals using different classifiers. The EEG signals were collected using the 10-20 electrode system. Using the sentimental analysis approach, the emotions were classified based on the user ratings. The emotions such as happy, neutral, sad, and anger were classified as the evaluation parameters in this work. The proposed model's performance was measured in terms of accuracy and overall accuracy based on these emotions. The proposed model has an overall accuracy of 93.33% and improved performance in all the emotions classified. The proposed model was compared with other models like ANN, Naïve Bayes, and SVM-DWT. The overall accuracy difference between the proposed model and the different classifiers are between 2.26% to 3.67%. There are several problems in hybrid BCI techniques, user-machine adaptation methods, and BCI reliability studies that take use of users' mental states. Future study anticipates that classification accuracy may be improved by extracting more significant characteristics from various domains such as frequency, time, or frequency domain.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No animals/humans were used for studies that are basis of this research.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The authors confirm that the data supporting the findings of this research are available within the article.

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None.

CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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A Study on Diabetic Retinopathy Detection Using Image Processing

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Abstract: This study provides an overview of the Diabetic Retinopathy (DR) detection in human eyes utilizing various preprocessing and segmentation approaches. There are various ways for segmenting the blood veins in the retina. It is possible to determine whether or not the eyes have DR if the retinal nerve fibers have been segmented. This detection is determined by the location of the Retinal nerve fiber layer (RNFL). DR affects nerve fibers with a small total area. If the nerve fiber is large, the eyes are not damaged by DR and thus it is healthy. It is a prominent truth that diabetes has a significant impact on human health and damage every organ, including the eyes. Because the optical nerve is linked to the brain, this DR will influence vision loss in humans. Images of the retinal fundus are frequently utilized to detect and analyze diseases on infected images. Machine learning algorithms struggle to analyze raw retinal fundus images. As a result, a survey is being conducted in this area. In this way, the most current works by diverse authors from across the world are presented in this context. DR is one of the severe infections that may occur in the eyes. According to the WHO – United Nations study, this disease is the second most common among humans. As a result, eye care must be given top priority. This disease is caused by a decrease in the nerve layer of the retina. If the RNFL shrinks, the optic nerve that connects to the brain gets damaged, resulting in vision loss. This document just provides a basic overview of diabetic retinopathy.

Keywords: Diabetic Retinopathy, Nerve Fiber, Retina, Histogram, Pre-processing, Feature Extraction, Segmentation, Image Processing.

I. INTRODUCTION

Eye diseases are subjected to a variety of infections in the human eye, as well as numerous factors that impact diabetes, blood glucose, and so on. These include retinopathy, cataracts, edemas, and other eye conditions. A variation in the retina's blood veins will cause the capillaries and veins to erupt, resulting in bleeding and the loss of human eyesight. The eyes are the most important organ of human; without them, there would be no vision, and the entire world would be black. The term DR is derived from the Greek word. It is a serious problem that has a direct influence on the human eyes, causing damage to the capillaries and veins since they were very sensitive to brightness because the retina is located at the eye's rear side [1-10].

The DR has no symptoms but only causes low vision difficulties, which means that eyesight will be reduced to begin with if the condition is present. When a person becomes diseased with the DR, the veins or capillaries begin to flow blood due to vein eruption. This is caused by diabetes in the circulation, which is extremely close to the retina. Blood vessels damage can result in eyesight loss. As a result of the fluid, the macula swells, resulting in impaired vision. DR develops when retina's blood vessels are damaged by abnormal blood sugar levels. Diabetics are therefore at risk of developing DR, a kind of eye disease. The cornea, iris, retina, nerve fibers, sclera, optic nerve, and other major elements of the eye are represented in Figure 1.

The initial step in detecting is segmenting blood arteries, which can support in classification. The walls of the retina's blood veins have a variety of characteristics, including colour, length, diameter, breadth, tortuosity, branching, and so on [12]. The various components of the human eye, such as the OD, macula, OC, and fovea, impact the blood vessels, which are smaller than the retinal walls [7]. Diabetic patients are more likely to develop Cataracts, Glaucoma, DR and Occlusions in the retinal veins. High blood pressure affects the eyes, resulting in visual loss [34].

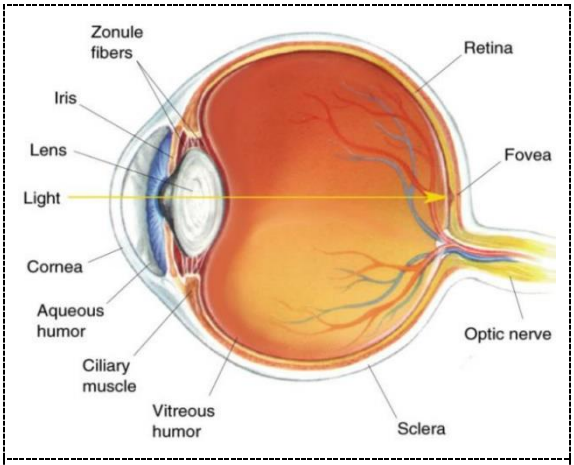

Figure 1. Human Eye Structure

In brief, DB occur due to a variation in the shape of human eye's blood vessel. The retina structure would be a thin, internal covering at the back end of eyes that was extremely light dependent. The damage was induced by an increase in the blood sugar levels, which can injure veins/capillaries. When these veins-capillaries grow and get large, they might cause spills, which causes vision loss in the human eye. Figure 2 depicts the four stages of DR in the form of a slide. Aside from that, it is also described one by one as follows. The four types of DR are described as follows.

- Mild-Initial,
- Moderate-Mid way,
- Severe/non-proliferative pre-final &
- Proliferative-final stages [21-30].

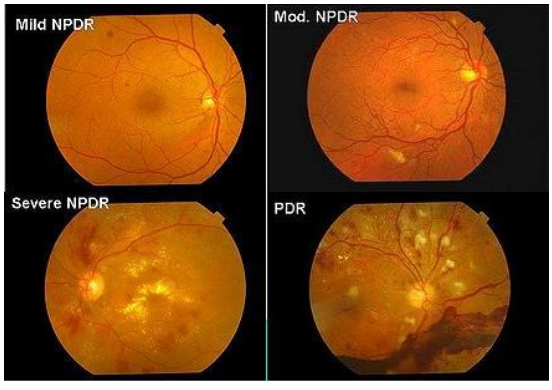

Figure 2. Stages of Diabetic Retinopathy

In the initial stage of DR, which is mild or non–proliferate, there would be inflation in the structure of a tiny bubble in some of the blood capillaries or veins present around the retina [31-35]. Then, second stage known as medium/moderate non-proliferative retinopathy, some retinal veins are defected as a result of the elevated sugar level, resulting in the occlusion [36-40].

In the third stage, severe or non-proliferative DR causes additional blocked veins/capillaries, resulting in many of the retina's zones never receiving adequate blood flow again, resulting in more retinal blockages. As a result, without adequate blood flow, the retina could not produce more or new capillaries/blood veins to replace injured blood vessels [41-45]. The fourth and last stage of DR termed as proliferative retinopathy. This is the advanced stage of the disease, when new blood vessels begin to emerge within retina, i.e., begin to expand, but they will be very fragile and unique (minor in structure). Hence, they can spill blood (leak out the blood), causing diluted vision loss and possibly blindness [46-49].

The study is organized as follows; relevant works concerning the problems addressed in this research article are offered in the introductory section. The next part provides an in-depth overview of the literature review. This follows the shortcomings of the work of many authors. The general technique for detecting diabetic retinopathy in human eyes is detailed in the next part, and finally the survey is concluded.

II. RELATED WORK

This section analyses and discusses different studies on diabetic retinopathy and its detection using retinal nerve fibers.

Some innovative approaches for analyzing retina images were proposed in [1]. This study incorporated both the IP and DM principles. [2] discusses a unique technique of supervisory classifications based on blood vessels filtering utilizing Gabor Wavelets Transforms. Novel ways of segmenting blood arteries of the same size, i.e., comparable diameters, were described in [3]. A hybrid technique in [5] was developed for blood vessel identification that relied on feature extraction. [6] describes how to prepare texts in the dictionary patterns for classifying capillaries/blood veins. [7] suggested mathematical models and clustering with k-means for blood capillaries segmentation. An identification technique was presented in [8] on the basis of blood veins classification (areas, shape, and undesirable regional volumes around the retina).

Ant bee-colony optimization and the FC-means cluster technique were used in [9] to locate small and coarse blood veins, from which the diagnosing the disease can perform. The breakdown of the tree approach was used in [10] to create a rapid methodology for identifying blood vessels in the retina for DR. A GL Spatial Co-relation idea for generating histograms based on the property of the image locally was discussed in [11].

The next sections focused on the segmentation techniques employed by different authors to segment the nerve fibers of retina prior to DR identification. A novel algorithm technique detects blood capillary ageing over time and further segments them for disease diagnosis [12]. In [31], an automated technique was proposed for identifying red colours (lesions) in diabetic fundus images to diagnose DR disease. In [30], extensive study was conducted on the segmentation of blood capillaries in images using an integration of center line detection and reconstruction based on morphological characteristics. In [29], the neural networks-based identification of hard exudation in retinal image was discussed. [28] addressed the segmentation of blood vessels in the retina with ANN principles to identify the diseases at the initial stages. An automatic lung module identification method was developed in [27] based on matching profiles and the BP algorithm in ANN.

A quick overview of full background material on the diagnosis of diabetic retinopathy was presented in [24]. It demonstrated how to make a diagnosis of a person suffering from this condition. The research in [23] performed excellent work on identifying the wall of blood capillaries/veins in retina images and tracking them utilizing the ideas of the combination of Gaussian and Kalman filters. The work in [22] conducted extended work on tracing blood veins utilizing extrication of blood vessel characteristics using quick automated techniques of tracing veins and how a direct algorithm may be built for detecting purposes.

A fuzzy vascular track method was proposed in [21] for retina images based on the notion of fuzzy clusters. The work in [20] addressed the identification and quantification of DR disease utilizing digital angiography, which provided good outcomes. The authors' computation relied on the coordinated filtering approach paired with previous knowledge regarding the retinal blood vessels characteristics to differentiate the vessels border boundaries, following vessel's midline, and concentrated on clinically important data. By showing the vessel profile using Gaussian capabilities, they improved vessel width assessments above previous estimates by creating innovative methods. Nonetheless, there was not a lot of variances.

A ridge-based vascular segmentation in the context of a coloured retinal image was discussed in [19]. The model was reliant on how the ridge of image was extricated and corresponded with the blood vessel centrelines. To distinguish between abnormal and normal images, the k-NN classifier was utilized. However, the method's accuracy for higher-order observers was not explored (more than a second). The work in [18] reported the related study of retina blood veins segmentation using innovative approaches on other publicly available database. Nonetheless, the approach produced good outcomes for the selected dataset. It did not offer any data regarding the support of procedures linked to other databases that were available.

The research in [17] performed mathematical modelling and assessment of curvature techniques, which were utilized to segment blood arteries and perform cross curvature assessments. One significant disadvantage was that the noise parameter was not addressed in the research. [13] [14] addressed the differentiation technique of segmenting the retina blood veins and development of the areas, as well as establishing a novel analysis for defining the retina blood capillaries. One limitation of the study was that it only worked for second-order derivative functions and did not fulfil higher-order derivatives.

The work in [33] provided a short summary of imaging approaches for detecting DR disease and its severity consequences, as well as classification strategies. This article evaluated the numerous techniques for DR detection and classification into several phases based on extremities levels, as well as different image DR used for performing the research. The classification difficulties for DR detection, i.e., the multi-class SVM automated identification and analyses of the DR, were explored in [34]. Even while the classifications produced excellent results, it did not satisfy when other classifiers were employed on the same collection of images from standard databases. In [40], a thorough review of current advancements in the diagnosis of DR disease was presented, providing a quick reckoner for DB researchers.

The work in [35] reported research on the DR phases utilizing retinal fundus images and several computer methods. It was utilized for detection; however, the severity of the instances could not be determined. A related group addressed higher demanding spectral problems for recognizing distinct stages of DR [36]. The work in [37] discussed a short analysis of the DR detection utilizing fundus images acquired by the camera. The goal was to create a computerized screening approach that would evaluate automated retinal images for notable feature of non-proliferative DR. Acknowledgment of exudate was calculated using thirty retinal images. For the finding of the HMA, the algorithm obtained 77.5 percent accuracy and 88.7 percent specificity. However, when noises in the fundus retinal images were taken into account, sensitivity and specificity were decreased, which was a serious disadvantage in this study.

The authors of [41] worked on retinal vascular segmentation techniques and presented novel approaches for the same. In general, there are as many approaches and algorithms for segmental

issues as there were specific cases and situations in the degenerative phases of eye. When everything was discussed and done, segmental ideas are used for medical reasons, and segmental concerns are too specialized for retinal anatomical structures.

A review of diabetic retinopathy and associated literature was conducted. Most studies did not take into account infected images. Limited databases, noise artifacts, the use of typical segmentation techniques, SNR, high computational time and other factors were also not considered.

III. STEPS TO BE FOLLOWED FOR DETECTING DIABETIC RETINOPATHY

The first and most important stage is to obtain images from the database or hospitals. Following that, the captured image must be preprocessed. In preprocessing, image conversion, filtering, and denoising can be made. The future challenge in studying retinal-based DR disease is feature extraction, and the following approaches are being employed to do so. After preprocessing, features may be extracted using a variety of approaches. Using image processing techniques, this was the extracting process of the new blood veins from the images. Segmentation, thresholding, smoothing, and morphological operations are the post-processing processes.

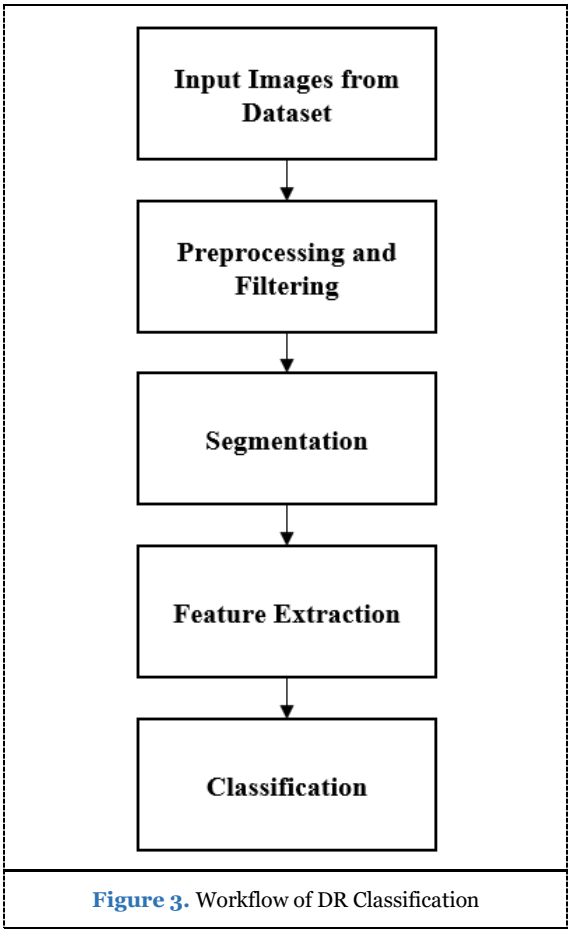

Figure 3. Workflow of DR Classification

The final step is feature extraction and classification, which is described below. Extraction of features in machine learning, image processing, and digital image processing begins with the basic procedure of evaluated data from retina images and parameters (attributes) designed to be informative and non-repetitive, enabling the following learning and theory processes at times producing better user interpretations. With a decrease in the size of the retinal images, the dimensions of the feature parameters may be determined. After the fundus retinal images have been pre-processed and segmented, there are several techniques for obtaining the features. Some of the approaches include independent components analysis, semantic analyses based on latency, the least square technique based on partial value, PCA, and others. Different classifiers, such as neural networks, machine learning, and deep learning algorithms, can be used to classify based on extracted features. Currently, the majority of studies employ deep learning-based approaches, especially CNN. CNN is a superior alternative for image classification and has produced better image processing outcomes.

IV. CONCLUSION AND FUTURE WORK

In this study, a quick summary of various principles pertaining to how the DR diseases can be diagnosed at the initial stage was provided in brief, which employed the preprocessing, segmentation, and feature extraction techniques. In this survey, many researchers who worked in this subject and made significant contributions to diabetic retinopathy were given in the form of a comprehensive literature assessment, along with their advantages and limitations. The information provided in this study was simply the work made by several authors, so that researchers can be aware of recent advancements in the work made on DR and its relevant aspects and also additionally refine the research with more information, defining the research problems while taking into account the shortcomings of the existing researches.

This survey examined the essential needs of numerous disease eradication schemes, evaluated suggested solutions for these issues, and emphasized the varied detection and performance strengths, as well as disadvantages and shortcomings, of the work done by various researchers. The major contribution of this work was to inspire additional researchers to propose and enhance possible ideas for different forms of DR disease detection utilizing various techniques. Finally, this study provides a brief overview of diabetic retinopathy disease and research findings. This study therefore provided a brief overview of the scientific effort on identifying the world's second most serious disease, which may be identified

utilizing innovative pre-processing and segmentation approaches.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No animals/humans were used for studies that are basis of this research.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The authors confirm that the data supporting the findings of this research are available within the article.

FUNDING

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The authors declare no conflict of interest, financial or otherwise.

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Imaging Modalities used in Prostate Cancer Detection

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Abstract: Prostate cancer (PCa) is reported as utmost common malignancy, causing substantial morbidity and mortality in men globally. PCa screening happens by digital rectal examination (DRE) along with usage of prostate specific antigen (PSA) examination. Rapid developments in imaging modalities in Ultrasound with multiparametric ultrasound (mpUS) and in Magnetic Resonance imaging with multiparametric magnetic resonance imaging (mpMRI) and also with nuclear imaging with positron emission tomography (PET) are adopted as well as utilized in PCa diagnosis and localizing also in staging as well as for active cancer surveillance and for monitoring cancer recurrence The paper is focused on understanding the recent imaging modalities advocated for PCa imaging.

Keywords: Prostate Specific Antigen; Digital Rectal Examination; Ultrasound; Magnetic Resonance Imaging; Computed Tomography.

I. INTRODUCTION

GLOBOCAN 2018 estimates indicate that new cases of Prostate Cancer PCa reported worldwide are 1,276,106 and for India are 25,696, with higher incidence in developed nations. For the current year 2020 GLOBOCAN 2018 estimates for USA, the new PCa cases are estimated at 191,930 and death due to the disease is estimated at 33,330 [1]. The national cancer registries projected number for India cases being 41,532 and estimated to be 47,068 by 2025 [2]. After cancer of lungs, PCa is the leads in the cause of death among men.

The Clinical management of PCa is complex and challenging due to its highly heterogeneous nature. If an increased prostate specific antigen (PSA) and or abnormal digital rectal examination (DRE) is identified, the customary approach for PCa diagnosis is based on regular random biopsy using trans rectal ultrasound (TRUS). These procedures lack clarity in PCa sensitivity and specificity and provide incomplete evidence about the aggressiveness and stage of the disease. For clinical decision making and to optimize patient care, there are effort taken to develop a risk stratification tools to assist in combining serum (PSA) levels, Gleason grade and assessment of primary tumor of its anatomic extent.

Management of PCa through imaging which is noninvasive way plays a critical role for assessment of occurrence as well as magnitude of the disease. Various imaging as well as multi modalities are adopted in diverse clinical scenarios globally based on assessment, availability, affordability, and regulatory restrictions of PCa imaging, benefiting clinical decision making with early detection and reducing its growth than before [3] and thus aiding in suitable management and follow-up. However, defining the ideal imaging to use is not possible and is debatable based on various studies of modalities and its usage. Though PCa Imaging is critical in managing patients but has also steered into over detection and over treatment.

II. ANATOMY OF PROSTATE

The Prostate gland is situated in the pelvis area. It is encircled by bladder superiorly, rectum posteriorly, urethra is surrounded by prostate gland. Prostate gland's part apex is closer to the external urethral sphincter and the glands' part base is closer to the bladder. Prostate is separated as four McNeal zones anatomically, Peripheral zone (PZ) having approximately glandular tissue is 70%, the Transition zone (TZ) having approximately glandular tissue of 5%, the Central zone (CZ) having approximately glandular tissue of 25% and anterior fibro-muscular stroma having no glandular tissue as in figure 1. Understanding of Prostate Glands Zones are important as it relates to the relative incidence rates of PCa with the PZ with 68%, TZ with 24% and CZ with 8% [4].

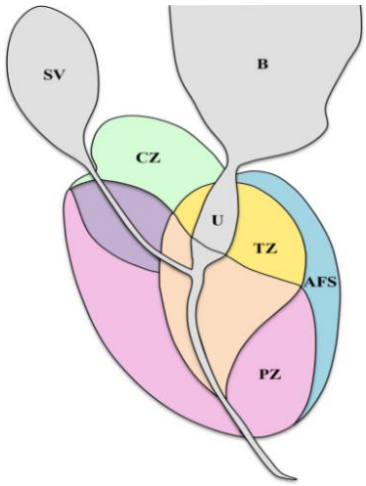

Figure 1. Prostate Gland Zonal anatomy as per the McNeal zones depicted in sagittal view: Bladder (B), Urethra (U), Seminal vesicle (SV), Central zone (CZ), Transition zone (TZ), Peripheral zone (PZ) and Anterior fibro-muscular stroma (AFS) [4]

III. PROSTATE SPECIFIC ANTIGEN (PSA) AND DIGITAL RECTAL EXAMINATION (DRE)

Serum marker used for PCa is PSA a natural enzyme which is generated by the epithelial cells of prostate exclusively. PSA remains organ specific and elevated PSA levels can be observed in conditions of benign such as prostatitis, benign prostatic hypertrophy (BPH), and other symptoms of urinary. It has to be noted that there is no specific PSA cut-off level that specifies PCa or is a guarantee that there is no PCa risk based on PSA level. Though it observed that a value ≥4 ng/ml is suspicious of PCa which can be a trigger for biopsies. Risk stratification of new patients are based out of PSA level and directed into predictive staging using nomograms and to monitor treatment response [5].

A DRE is a simple clinical procedure used to examine the lower rectum and other internal organs. DRE is a fast and easy way to check the prostate gland health and it detects enlarged prostate (benign prostatic hyperplasia) and prostate cancer. In PCa patients if tumor is palpable DRE is a basic clinical examination procedure. It is observed that 70 to 75% of lesions of cancer is situated in the PZ and above a definite size is palpable. DRE cannot reach the remaining 25% of the tumors due to the anatomical transitional zone location also if PCa is detected early, the size would be small, and the number of palpable tumors is also less and hence the DRE in such cases lack in both sensitivity and specificity. Nevertheless, DRE reports if found apprehensive are an indicator for more pathologically aggressive prostate cancer and calling for biopsies for better identification of PCa at even when PSA levels are normal. Hence DRE is customarily adopted for clinical tumor staging (cT) and also as risk stratification and part of predictive staging using nomograms [5].

Table 1. American Joint Committee on Cancer TNM Criteria Definitions [6]

Clinical (cT) category	
TX	Primary tumor cannot be assessed
To	No evidence of primary tumor
Tl	Clinically in apparent tumor that is not palpable
Tla	Tumor incidental histologic finding in 5% or less of tissue resected
Tib	Tumor incidental histologic finding in more than 5% of tissue resected
Tic	Tumor identified by needle biopsy found in one or both sides, but not palpable
T2	Tumor is palpable and confined within prostate
T2a	Tumor involves one-half of one side or less
T2b	Tumor involves more than one-half of one side but not both sides
T2c	Tumor involves both sides
T3	tumor that is not fixed or does not invade adjacent structures
T3a	Extraprostatic extension (unilateral or bilateral)
T3b	Tumor invades seminal vesicle(s)
T4	Tumor is fixed or invades adjacent structures other than seminal vesicles, such as external sphincter, rectum, bladder, levator muscles, and/or pelvic wall
Pathologic (pT) category	
T2	Organ confined

T3	extension
T3a	Extraprostatic extension (unilateral or bilateral) or microscopic invasion of bladder neck
T3b	Tumor invades seminal vesicle(s)
T4	Tumor is fixed or invades adjacent structures other than seminal vesicles, such as external sphincter, rectum, bladder, levator muscles, and/or pelvic wall
N category	
NX	Regional lymph nodes were not assessed
NO	No positive regional lymph nodes
N 1	Metastases in regional lymph node(s)
NX	Regional lymph nodes were not assessed
NO	No positive regional lymph nodes
M category	**M criteria**
MO	No distant metastasis
Ml	Distant metastasis
Mia	Non-regional lymph node(s)
Ml b	Bone(s)
Mic	Other site(s) with or without bone disease

IV. CLINICAL AND PATHOLOGICAL T, N AND M CLASSIFICATIONS

While trying to understand the imaging modalities required for detection and treatment it is significant to understand Clinically and Pathologically designated PCa staging, and classifications defined by the American Joint Committee for Cancer Staging and End Results Reporting (AJCC) [6]. The AJCC methodology aimed at classification defines T (tumor), N (lymph node), and M (metastasis) to group PCa patients. TNM staging as shown in Table 1. In grouping with grade of tumor and level of PSA becomes standard practice for PCa and is adopted as the base to guide decision making of the treatment.

V. IMAGING MODALITIES

Clinical management of PCa through imaging is supported with technological improvement over the last decade.

ULTRASOUND IMAGING

TRANSRECTAL ULTRASOUND (TRUS)

Ultrasound Anatomical Imaging is widely adopted method in PCa imaging. Combination of functional imaging and traditional ultrasound method has resulted in the improvement in mpUS for PCa detection.

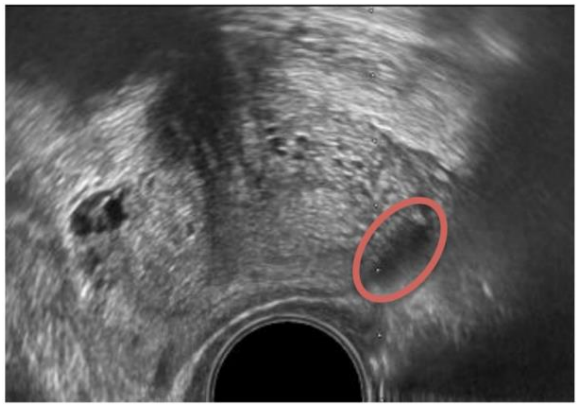

Figure 2. B-mode Ultrasound of the prostate showing hypoechoic lesion marked within red [4]

GREYSCALE OR B MODE ULTRASOUND

Ultrasound of Greyscale or B mode as in figure 2 is the most widely adopted imaging method for assessing the prostate gland and specifically to guide needle biopsies post suspecting of PCa due to higher PSA or abnormal DRE. TRUS guided biopsy is simple and offers moderately accurate assessment of the volume of prostate that is key in assessing of density of PSA. Greyscale ultrasound as in figure 3A lets outlining of the zonal prostate anatomy of peripheral PZ seems better echogenic in comparison to inner CZ and TZ [7].

COMPUTER-AIDED ULTRASOUND

Prostate cancer is conspicuous by variations in cellular structure which is captured by the backscatter feature of ultrasound signal, which is utilized to group malignant versus benign tissue.

Various computer aided realtime algorithms are developed for analysis of these ultra sound images for better detection and staging [4], [7].

DOPPLER ULTRASOUND

Hyper vascularization and angiogenesis also characterize PCa. When ultrasound waves reach the blood vessels - RBC there would be shift in frequency of echoed waves which is in proportion to the cell velocity in accordance with Doppler Effect which provides information about the PCa and this shift in frequency is color overlaid on real time greyscale or B-mode ultrasound images indicating areas of higher perfusion. This is the basis of detection of PCa imaging using Color Doppler ultrasound (CDU). It was also observed that in the Power Doppler ultrasound (PDU) imaging, the sensitivity is 98%, specificity is 78%, PPV is 59% and NPV is 99% [4], [7]. For detection isoechoic tumors it is observed that CDS and PDC examinations are helpful which are otherwise may be missed on gray scale ultrasound imaging [8].

ULTRASOUND OF CONTRAST-ENHANCED

Contrast-enhanced ultrasound (CEUS) imaging focuses on increase in the microvascular density (MVD) of impacted prostate gland area where hyper angiogenesis and disorganized neovascularization is observed. During biopsy procedure, highly echogenic gas filled micro bubbles are intravenously injected for imaging. And these micro bubbles are similar to the RBC, but can flow easily in the tumor microvasculature and can be imaged, which is an advantage. The malignancy is identified by asymmetrical rapid or focal enhancement as in figure 3B. It is also observed that using CEUS targeted biopsies has increased PCa detection more so with high grade PCa. Using CEUS imaging for PCa detection, it is found that a pooled sensitivity of 70% and specificity of 74% [4], [8].

REAL TIME ELASTOGRAPHY

PCa tissues in most cases are harder or stiffer than normal prostate tissue due to higher cell density. Real time elastography (RTE) offers an advanced and reliable detection of these stiffer regions. In RTE imaging, physician uses techniques by inducing excitation on stiffer tissues to image. The stiffer regions could be presumably representing malignancy foci are indicated in red areas as in the color elastogram map in figure 3C and appear dark and larger than the corresponding gray scale image as in figure 3D. A recent study using RTE showed 68% to 86% of sensitivity and 72% to 81% of specificity while diagnosis of Prostate for PCa [8].

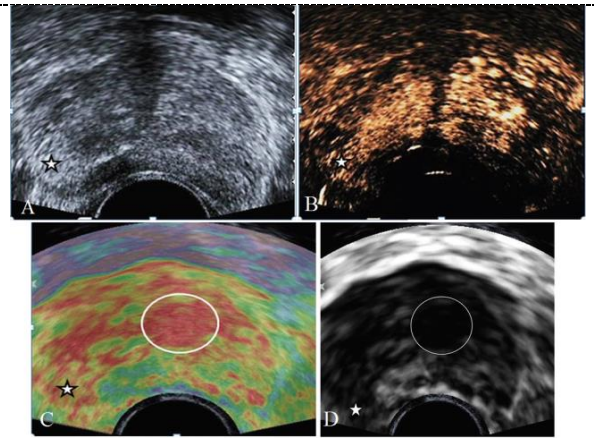

Figure 3. Ultrasound image of a 76-year-old person with symptoms of lower urinary tract and PSA of 32.2 ng/ml. 1A is Grayscale TRUS, 1B is CEUS images, Paired elastogram image having colour image with 1C & gray scale image with 1D [8]

MULTIPARAMETRIC ULTRASOUND

Previously mentioned ultrasound imaging techniques utilized various biological tumors characteristics. A combined functional ultrasound technique is the multiparametric ultrasound (mpUS) which is aimed at to improve the specificity of targeting. An example of the blending of RTE with CEUS lowered the false positive degree from 35% to 10% as well improved the Positive predictive value (PPV) to 90% from 65%. Likewise with the blend of various methods of mpUS, overall detection of PCa got improvised while it decreased the false positive rate and also increased the PPV. mpUS methods has presented early potential, and superior patient cohort examinations [4].

COMPUTED TOMOGRAPHY

Computed tomography (CT) scan for PCa detection has restricted role as imaging modality due to low sensitivity due of poor soft tissue contrast and absence of molecular information. CT is adapted to evaluated pelvic lymph node and detection of distant metastasis for high-risk PCa patients with T3–T4 weighted primary tumor or with nomogram specified chance of lymph node association greater than 20% [9], [3]. The standard approach used for evaluation of the presence of bone metastasis in those PCa patients with greater risk where in their PSA >20 ng/ml is Radionuclide 99 Tc bone scan [8].

MAGNETIC RESONANCE IMAGING

Ever since first magnetic resonance imaging (MRI) of prostate was done in mid-1980, magnetic resonance imaging is accepted as key diagnostic modality for PCa assessment. Prostate MRI is done with a 1.5 Tesla or with 3.0 Tesla scanners in combination with a pelvic phased array (PPA) coil located above the pelvis. While scanning based on the clinical situation endo rectal coil (ERC) may or may not be used. ERC placed in the rectum, near

posterior to the prostate gland reduces motion artefacts and can produce better image quality. But ERC has its own disadvantages due to patient discomfort and compliance as the coil is placed in rectum as well as enhanced scan time, adding to higher costs [5]. MRI of the prostate provides comprehensive anatomical evaluation and strong representation of zonal anatomy along with perfect soft tissue resolution. Currently MRI provides functional details by dynamic contrast enhanced imaging (DCE), the diffusion weighted imaging (DWI) as well with the magnetic resonance spectroscopy (MRS) along with anatomical that is T1 weighted and T2 weighted imaging. The anatomical as well as functional information is integrated in multi parametric magnetic resonance imaging [8] [3].

T2-WEIGHTED MRI IMAGING

T2-weighted imaging MRI (T2WI) with high resolution axial, sagittal and coronal sequences shows good soft tissue contrast and portrayal of the prostate zonal anatomy hence identifies abnormalities in PCa zonal anatomy. PZ tissue if normal is rich in water with many ductal and acinar parts and using sporadically intertwined plane muscle, which makes it brighter on T2WI. Conversely PCa PZ tissue appears as rounded or inaccurate low-signal intensity. Prostatitis, atrophy and previous biopsy infected hemorrhages of the PZ tissue can also cause low-signal intensity focus. On T2WI, compared to usual PZ tissues, the usual TZ tissue contains low water content but has extra dense smooth mus¬cle and thinner glandular components and is comparatively shadier. TZ give the impression of a consistent mass of low-signal intensity with unclear boundaries in case of PCa. There could appear low signal intensity inside the TZ because of the stromal BPH causing high muscular and fibrous contents [4].

DIFFUSION-WEIGHTED MRI IMAGING

Diffusion-weighted MRI imaging (DWI) is a functional method which measures random Brownian motion of water molecules and with PCa gets restricted due to high cellular density of tumor cells which restricts movement of water within the extracellular space. By changing magnetic field's interval and power, DWI images are acquired. On DWI PCa appears as bright hyper intense regions due to restricted water diffusion causing a reduced amount of signal loss. Apparent Diffusion Coefficient (ADC) map is constructed with multiple b-value, DWI where cancers appear as hypo intense dark spots. PCa aggressiveness could be predicted using ADC values [4].

DYNAMIC CONTRAST-ENHANCED MRI IMAGING

In dynamic contrast-enhanced MRI (DCE-MRI), 3D T1WI are developed in sequence earlier to intravenous injection of contrast media, during intravenous injection and after intravenous injection. Aggressive tumors stimulate the generation of angiogenic influences which intensifies microvessel progress and if it is new, these microvessels are disorganized with walls that are weaker walls making them porous. So PCa tissue often exhibits early enhancement due to tumor angiogenesis. These DCE-MRIs are evaluated for lesions qualitatively by visual for focal enhancement, potentially indicating cancerous spots or semiquantitatively through time–signal strength curve study of doubtful voxels and or quantitatively to govern amount of contrast agent wash-in (Ktrans) and wash-out (Kep) [4].

MAGNETIC RESONANCE SPECTROSCOPIC IMAGING

Magnetic reso¬nance spectroscopic imaging (MRSI) is constructed by identifying the metabolite absorptions in tissues of prostate. There is high level of Citrate in healthy prostate tissue, specifically in PZ and these levels decrease if tissue is malignant and due to higher cellular density chlorine levels rise. MRSI is established on identifying amplified choline-to-citrate proportion [4].

MULTIPARAMETRIC MRI (MPMRI) OF THE PELVIS

Mp MRI of the prostate is centered on the blend of anatomic as well as functional sequences. The combination of the functional sequences raises the sensitivity and PPV of MRI. The Prostate Imaging Reporting and Data System (PI-RADS) define procedures to manage disproportionate disparities in equipment, imaging acquisitions, its analysis and reporting between centers with an intend to detect clinically significant PCa (with Gleason grade of minimum 7 or with a volume > 0.5 cm3 [3]. It is important for PCa detection while using mpMRI to adopt good quality of scanning acquisition protocol and reading the scans accurately [4].

POSITRON EMISSION TOMOGRAPHY

The PCa with high metabolic rate will ingest glucose over glycolytic conduit wherein forms the basis for positron emission tomography (PET). PET uses tracer fluoride oxyglucose (FDG) to quantify tissue metabolic rate to isolate cancerous lesions.

VI. DISCUSSION

The traditional diagnostic approach is based on PSA testing and DRE monitored by TRUS biopsies.

TRUS is best suited for evaluating prostate gland volume and also for administering the needles used in biopsy. TRUS falls short in sensitivity and specificity for PCa detection and staging. With TRUS tumor can be missed and can cause repeated biopsy and can cause over detection and over

treatment. With the rapid development of prostate mpMRI by using a blend of various MR sequences, such as T2-weighted imaging (T2-WI), dynamic contrast enhancement (DCE) imaging and diffusion weighted (DWI) imaging. T2 weighted imaging is suitable method to research the prostate gland anatomy. DWI evaluates the free flow of water molecules within tissues if not controlled by PCa. The DCE-MRI while contrast administration provides information about the leaky and disorganized vasculature of new tumors.

Table 2. Summary of PCa imaging modalities, its clinical usage along with advantages disadvantages [4]

Imaging Modalities	Medical Use	Advantage	Disadvantage	Future
Ultrasound-based	Early detection, diagnosis	Office-based, inexpensive, extensively available, real-time imaging	Limited tissue contrast among benign and cancerous tissue	mpUS-based method (RTE, CEUS) might enhance contrast
mpMRI-based	Early diagnosis, staging, metastatic involvement, recurrence, active surveillance	Best tissue contrast for detection of medically significant PCa	High-cost due to in-bore time, lacking real-time imaging, requires advanced training	Alternative in-bore options with real-time imaging being advanced
mpMRI-ultrasound fusion-based	Early detection and diagnosis, active surveillance	Office-based, associates multimodality information	Costlier, needs either fusion-device specific training or ample experience to execute cognitive fusion, registration errors during MRI-ultrasound fusion	Gaining popularity worldwide, but additional enhancements to minimize registration errors required
PET-based	Staging, recurrence, metastatic spread	Offers ancillary details for tumor staging, characterization and metastatic involvement	High-cost, technological (i.e. attenuate +-ion correction) and/or medical challenges (i.e. radiation effects)	Development of specific radionuclides is an ongoing endeavour

VII. CONCLUSION

For Cancer of Prostate ultrasound, MRI, CT, PET is adopted to evaluate tumor, lymph nodes and metastasis. Ultrasound, MRI, CT, PET imaging has their advantages and flaws but with appropriate usage provide valuable information for treatment. TRUS is best for evaluating prostate gland volume and administering the needle for biopsy. Grayscale trans rectal ultrasound (TRUS) is utilized for administrating multiple random prostatic biopsies. RTE and CEUS are adopted for better detection and improving biopsies. The anatomical as well as functional information are available through DWI, MRS and DCE MRI and with MpMRI has capabilities to exclude significant cancers in major cases. MRI of Prostate is a beneficial and cost-effective method for early detection of PCa which reduces the effect of over detection and over treatment while enhancing the PCa detection benefiting from the treatment.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No animals/humans were used for studies that are basis of this research.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The authors confirm that the data supporting the findings of this research are available within the article.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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Intrusion Detection Attacks Classification using Machine Learning Techniques

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Abstract: Distributing numerous services over the internet is called Cloud Computing. Applications and tools like networking, data storage, databases, servers, software are examples of the resources. The service provider is required to provide the resource always and from any location. However, the network is the most important factor in gaining access to data in the cloud. When leveraging the cloud network, the cloud threats take advantage. An intrusion Detection System (IDS) observes the network and detects and reports threats. The anomaly method is significant in Intrusion Detection Systems. IDS monitors known and unknown data whenever a virtual machine is developed. If any anonymous data is detected, the Intrusion Detection System identifies it using an anomaly classification algorithm and sends a report to the administrator. Naive Bayes, Decision tree (CART), Support Vector Machine, and random forest techniques are utilized in this work to classify unknown data. These algorithms are assisting in reducing the percentage of false alarms. This proposed work was carried out utilizing the WEKA tool for generating the report, yielding a best result in less computing time.

Keywords: Anomaly Detection, Decision Tree, Naive Bayes, SVM, Random-forest, NSL-KDD dataset.

I. INTRODUCTION

Cloud computing exists at a remote place and delivers service through the networks. The applications like data storage, infrastructures, server, and database can be developed, accessed, and manipulated by the user [1]. The users could access everything as a service like infrastructures, platforms, and software from the cloud wherever in the global via the internet and the cloud-based connection with two ends. The front end should connect with the users and the user requires resources such as software/hardware to implement for application development, database maintenance, and service delivery through the network. The other end of the chain should communicate with a third party and cloud. On the physical layer, the virtual machine monitors (ex., IDS) and runs on several virtual machines. The development tools, database server, web and application servers are completely maintained by the third party [2].

Cloud computing is rapidly being used by the government, corporate sector, institutions, medical, and other organizations. However, they must provide a high level of security because many network attacks target the cloud. Conventional attacks include DDoS, IP spoofing, Port Scanning, User to Port, and so on. An IDS is a novel efficient technique for protecting packets in a regular network. The function of an intrusion detection system (IDS) is monitoring the networks and forecast harmful behaviour before reporting it to the cloud administrator. If an intrusion is identified, the IDS generates an alert signal to keep a constant observation on the event, whether it is a false alarm or true positive. The cloud network IDS has been installed on the cloud servers and is maintained by the service providers. The IDS manage large scale computer systems, scalability, automation, and synchronization [3-5].

The network IDS should choose and limit the count of features that may be easily derived from high data speed. Because the local area network's ability to forward packets at one gigabit per second is dependent on the speed of hard disk. Though, the speed of the hard disk is slower. The framework's minimum size is 64 bytes. As a result, 1 to 14.8 million frames per second may be transmitted. The network is monitoring the data during this transaction, which is a key problem in cloud computing. The most essential problem is data detection in practical [6].

The primary objective of this work is to predict data utilizing four algorithms on anomaly-based approach. These techniques are used in cloud computing to create an effective system for detecting intrusion and selecting features from dataset properties using various tools. The anomaly-based approaches are covered in detail in this work. The remaining part of the work is organized as follows: The anomaly-based approaches are briefly described in related works. The proposed technique then discusses several algorithms used for classification, followed by a discussion of datasets in the next section. Section four summarizes the experimental data, while the final section concludes and discusses future work.

II. RELATED WORK

A hybrid network intrusion detection system was intended to be installed in each host layer of a virtual network. The network-IDS has observed the network traffic and reported onto the upper layers using signature and anomaly-based methods [7]. Only distinguished attacks from the signature database were detected by the misuse approach. To identify the attacks, the snort rule fast multi-pattern matching method was used. However, the anomaly-based method supported in the detection of unknown threats. Statistical modelling, data mining, and machine learning approaches were employed in anomaly-based systems. Different machine learning classification methods were employed. These approaches were used in anomaly-based intrusion detection systems, and they provided improved accuracy and secrecy, as well as lower computational time and false alarms [8-9].

Mohammed et al. developed two methods for classification in [10]. For classifying attacks, one technique was the Support Vector Machines, while other was the Random Forests. 90% of the data set was utilized to train the models and 10% was used to test the models, which was inadequate to validate the attack detection rate. Although the computational time was short, the detection rate was not as high as predicted. As a result, more test case results were required.

In [11], Nabila F et al. implemented a random forest technique in IDS. The NSL-KDD data set was utilized to compare the performances of a random forest model in detecting attacks such as DoS, U2R, Probing, and R2L against other conventional attacks. However, they were increasing the classifier's accuracy in features selection measures. The data mining idea combined with IDS was proposed in [12] and finds related data, concealed data, and associated data with reduced execution time. They utilized several classification methods on the KDD dataset. This method performed well in terms of false alarm and accuracy rates. However, two difficulties like inadequacy of user data and the approaches have prevented the development of an autonomous IDS.

In [13], Xueyan J et al. implemented the Fuzzy C-Mean technique for clustering to train from data set and the K-Nearest Neighbor approach to classify attacks unknown. However, additional testing and training data were required for better outcomes. Rahimeh R et al. presented an anomaly detection approach in [14]. This approach was evaluated utilizing the KDDCup-99 data set. The output showed that this model, when used in feature selection from the KDDCup-99 dataset, efficiently recognized attacks. This study employed the feed-forward neural networks model that has been trained to detect the attack/normal packets in the data set. However, more training and testing datasets were required for this study.

Opeyemi O et al. presented the decision tree method for classification in [15] to identify DDoS attack. This work used features selection techniques; however, the confusion matrix values were not employed. The detection rate and accuracy were not specified. There was no explanation on how to use the decision tree categories. In [16], Ozge cephelli et al. presented a detection method that used traffic packets and sensitivity settings from a network. To identify the DDoS attack, the presented Hybrid-IDS was deployed. As a result, when training performance was necessary, the model's performance was reduced. For assessment, limited samples of the DARPA-2000 dataset were used. The proposed model was unclear; therefore, the detailed commercial bank dataset was obtained via a penetration testing tool.

III. PROPOSED METHODOLOGY

The IDS are divided into two types: signature-based approaches and anomaly-based techniques. The snort rule was used to detect known attacks in signature-based and anomaly-based detection. In anomaly detection, several classification approaches such as Nave Bayesian, Decision tree, SVM, and random forest algorithms are utilized to identify unknown threats.

It is difficult to identify infiltration during severe load by observing real-time traffic. It provides a network intrusion detection solution. Snort is a very adaptable rule, and it is simple to change, unlike commercial NIDS. Snort supports four methods (packet logger, sniffer, intrusion detection system, and prevention system) [16]. In Snort rule, the users can write their own rules for outgoing and incoming network packets, and it consists of two segments: "The Options" and "Header." If the packets should fulfil the threshold conditions, the snort rule is all that is required [18].

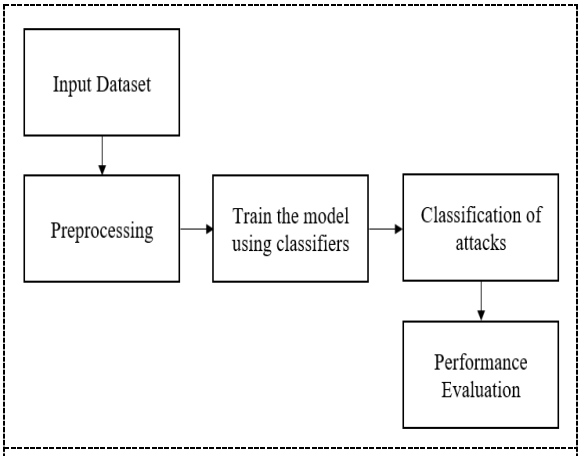

Figure 1. Workflow of Proposed Model

3.1. Naïve Bayes Classification

Naïve bayes is a supervised learning classifier and a statistical approach for classification. The learning process generates a functionality that predicts the values of output. Following training data, the model produces target for new values of input. Given that this approach represents the class variables and that the collection of characteristics is $h_1, h_2 \dots, h_n$.

$$p(g/h_1, h_2 \dots, h_n) = \frac{p(h_1, h_2 \dots, h_n/g)\, p(g)}{p(h_1, h_2 \dots, h_n)} \qquad (1)$$

For all $i = 1, 2, \dots, n$ it becomes $p\left(\frac{h_i}{g}\right)$

$P(h/g)$ denotes the g given h probability. P(g) denotes the hypothesis g's previous probability. $P(h)$ represents the training data h's previous probability. $P(g/h)$ was the g's probability given h in the following equation classification technique to aid in the improvement of IDS speed and accuracy [19].

3.2. Decision Tree

Decision tree was the part of algorithms for supervised learning. The principles of DT are simple to comprehend and use in learning systems like the Weka tool. In this work, the CART (Classification and Regression Tree) method is used. The main goal of this DT rule was to build the training and prediction of class value model. The information gain ratio was a value utilized to choose the splitting feature in this case. The decision tree is characterized as a tree structure, with a decision and leaf nodes. The decision node was the root node, with every internal nodes representing a feature and each leaf node representing a class value. The windows are made up of numerous classifiers such as bayes, meta, functions, and trees. The following equation is used to calculate the entropy of a feature E.

$$Entropy\ (E) = -\sum_{i=1}^{n} p(E,i) \log\big(p(E,i)\big) \qquad (2)$$

Let A be the total number of intrusion classes in the provided dataset, and $p\ (E,\ i)$ represents the percentage of instances in E allocated to the i^{th} class. The dataset G's information gain is computed as in following equation:

$$Gain(D,T) = I(D) - I(D,T) \qquad (3)$$

Gain (D, T) of a feature T is impacted by the domain size of T and is greatest when each subset D_i contains just one record.

A feature's split information *Split* (D, T) has a larger domain size, typically increases. Each feature's split information is calculated as follows.

$$Split(D,T) = -\sum_{i=1}^{k} \frac{|D_i|}{|D|} \times log_2 \frac{|D_i|}{|D|} \qquad (4)$$

Where the domain size of T, $|T| = k$.

To choose the feature with the highest gain ratio, the optimal split node was chosen in equation 4. This decreased the complexity of computation [20].

3.3. SVM Classifier

For classification and regression, mostly the SVM learning method is used. However, it is mostly employed in classification issues. SVM operates in two classes using a hyperplane. The classification is completed by utilizing a hyperplane, which was developed by the greatest margin in the training data [10][21].

The network intrusion detection system detects network intrusion. At times, the Network-IDS was unsure if the network packets were abnormal or normal. Machine learning approaches are utilized to classify normal and abnormal packets in that important scenario.

Step 1: Input the data set that includes 41 characteristics and features.

Step 2: Preprocess the data to remove unnecessary and redundant information.

Step 3: Use machine learning classification algorithms (Nave Bayes, CART, SVM and Random Forest) to classify data.

Step 4: The classification algorithms that were utilized to construct the models (trained model)

Step 5: Determine if the data was abnormal or normal.

Step 6: Finally, the performance of the classifier approaches was compared.

IV. EXPERIMENTAL RESULTS AND DISCUSSION

The NSL-KDD dataset, an enhanced version of the KDD dataset, is employed for assessment in this case. The features of the NSL-KDD dataset classified in this work can detect attacks such as DOS, Probe, R2L, U2R, and so on. It is also mostly utilized for detecting abnormal attacks. The benefits of the NSL-KDD dataset were described individually. First, because the training set does not include unnecessary entries, the classification cannot provide a partial output. The following step was to process the unnecessary entries with the testing dataset. NSL-KDD has resulted in higher reduction rates [22]. Each record includes 42 features that contain data as well as the network's five different classifications. One is the original class, and the other four are assault classes, which were Probe, DOS, U2R, and R2L. Table 1 displays the most common forms of attacks in the testing and training datasets [23].

Table 1. Dataset Description

Class	Training	Testing
Normal	67343	9711
DoS	45927	7458
Probe	11656	2754
R2L	995	2421
U2R	52	200
Total	125973	22544

To undertake classification testing, the experimental setup utilizes the NSL-KDD data set and the automated data analysis WEKA tool. Weka was a data mining technique that includes clustering, preprocessing, regressions, features selection, and classification model. It is compatible with the Windows operating system. To accomplish the classification, just 20% of the NSL KDD data set was needed. The presentation of the classifier is assessed using modified metrics like true positive, false positive, accuracy, and computational time.

The dataset was initially classified before preprocessing, and the classification range was 0 to 1. (i.e., can chose this range similar to 0.01, 0.05, or 0.10). The dataset has almost 41 features available for selection. This classification effort employs the Naive Bayes, CART, SVM, and Random Forest methods. The experiment was carried out with the help of WEKA (Waikato Environment for Knowledge Analysis) tool. The initial stage was to preprocess only samples of data before classifying them with the algorithms.

The data from the NSL-KDD data set has been accessed. In the Weka tool, the machine learning algorithms were used to detect diverse outcome results, and just 20% of the data set was used to evaluate the training set. The Weka tool produces superior results, and Table 2 shows the percentage performance of the classification methods produced: TPR, FPR, Accuracy, and computational time.

$$TPR = \frac{TP}{(TP+FN)} \quad (5)$$

$$FPR = \frac{FP}{(FP+TN)} \quad (6)$$

$$Accuracy = \frac{TP+TN}{(TP+TN+FP+FN)} \quad (7)$$

The accuracy value is the percentage of correctly classifies cases in relation to the total number of occurrences.

Table 2. Performance Analysis of Proposed Models

Classifiers	TPR	FPR	Accuracy	Computation Time (ms)
Naïve Bayes	88.66	0.8	92.51	520
CART	97.92	1.5	97.18	186
SVM	98.35	0.6	98.27	120
Random Forest	98.87	0.5	99.02	135

Many intruders attacked the virtual machine while packets out of the source IP addresses to the destination IP transit the networks. When compared to Naïve Bayesian classification, SVM, CART, and Random Forest algorithms produce superior results. Below is a graphical depiction of the performance result. Figures 2 and 3 show the TP and FP rates based on the machine learning method and the NSL-KDD dataset, respectively.

Table 2 compares the TPR utilizing 41 features for training to four methods, with the random forest achieving 98.87 percent. It also displays the FPR findings utilizing 41 features for data training, where the random forest classifier achieved the lowest false positive rate.

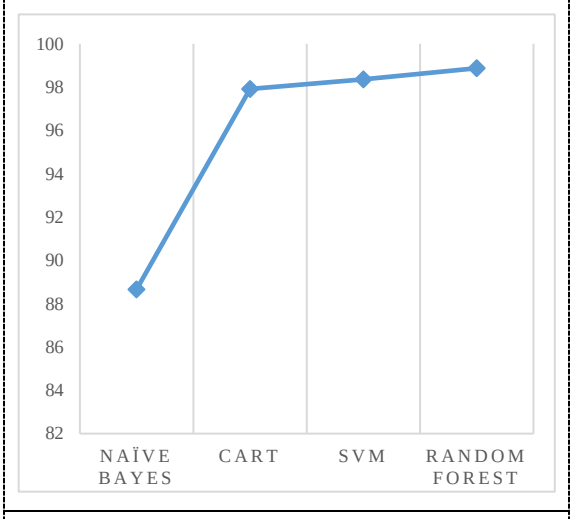

Figure 2. Graphical Plot Comparison of TPR

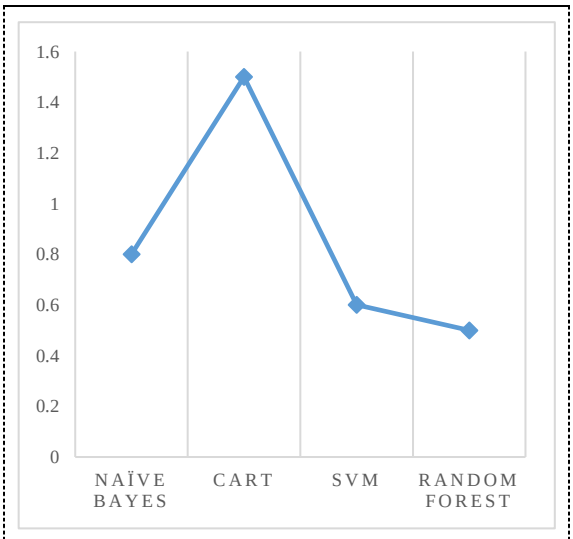

Figure 3. Graphical Plot Comparison of FPR

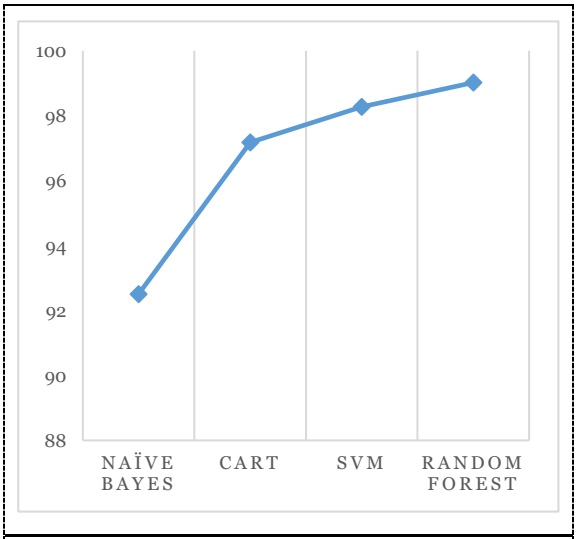

Figure 4. Graphical Plot Comparison of Accuracy

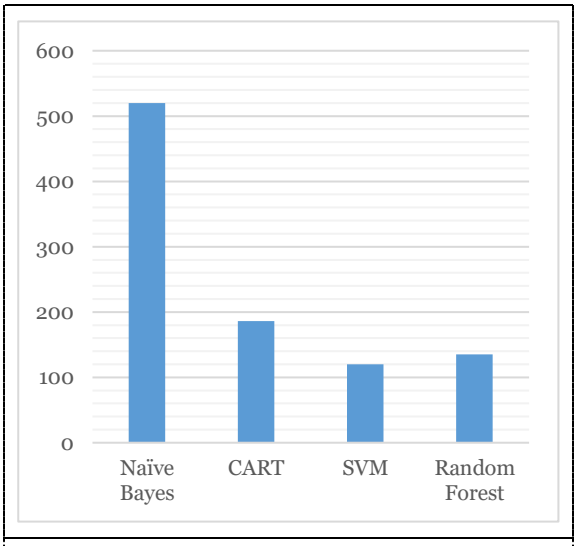

Figure 5. Graphical Plot Comparison of Computational Time

The accuracy and computational time are compared in Figures 5 and 6. Random-forest has a greater accuracy value than SVM, CART, and Nave Bayesian classifiers. And when the computational time was compared to others, the SVM comes out on top.

The graphical representations illustrated the performance of the four machine learning algorithms with the results. The maximum TPR for any algorithm is 90%, however the random forest has 98.87 percent TPR and an extremely low FPR. When compared to the other classifiers, the random forest outperformed them all. Its accuracy is 99.02 percent, and the random forest computing time is minimal.

V. CONCLUSION AND FUTURE WORK

In this research, the performance of an intrusion detection system based on various machine learning algorithms was analyzed. The NSL-KDD dataset was used in this work to test Naive Bayes, SVM, CART, and Random Forest algorithms. There are 41 features accessible in this dataset. It mimics the training data by replicating the pre-processed dataset. Conventional attacks include DDoS, IP spoofing, Port Scanning, User to Port, and so on. The IDS has a novel effective approach for safeguarding packets in a conventional network. To increase the accuracy and lower false alarm, dataset samples for anomaly approaches were employed. The simulation results revealed that

random forest outperforms in terms of TP rate by almost 0.5 percent to 10.2 percent. The random forest has a higher FP rate than others, although it is 1% lower than CART. The random forest classifier outperforms other classifiers in terms of accuracy, with an increase ranging from 0.7 to 6.5 percent. SVM also has a faster execution time than others. The key finding is that random forest outperforms alternative classifiers. According to the proposed research, an effective network IDS technique in cloud computing was established. In the future, the optimum feature selection method may be used to minimize the attributes and construct the training model.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No animals/humans were used for studies that are basis of this research.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The authors confirm that the data supporting the findings of this research are available within the article.

FUNDING

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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Improving The Performances of WSN Using Data Scheduler and Hierarchical Tree

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Abstract: Users of data-intensive implementation needs intelligent services and schedulers that will provide models and strategies to optimize their data transfer jobs. Normally sensor nodes are connected to consecutive sensor nodes depending on frequent transmission. To enhance end-to-end data flow parallelism for throughput optimization in high speed WSNs. The major objective is to maximize the WSNs throughput, minimizing the model overhead, avoiding disputation among users and using minimum number of end-system resources. Data packets are broadcasted from sender node to target node. Though, all nodes operate concurrently in various communications, the analysis shows that more packet latencies are occurred and priority-based transmission tasks are performed. Then the proposed Bearing parallelism-based Data Scheduler (BPDS) is used for data scheduling to enhance the end-to-end throughput input parameter. Sensor nodes are fast working node, it verifies each and every node before allocating packet transmission for that node. Busy resources are monitored to inform the nodes that are in processing, based on the schedule it allocates various paths to particular node and monitors the node capacity. Sampling algorithm supports for fixing threshold value, based on the values, they are further allocated to communicate between channels. It assigns the routing path with minimum resources and reduces end to end delay, to improve throughput, and network lifetime.

Keywords: WSN, Bearing Parallelism based Data Scheduler, Busy Resource Allocation, Frequent Data Flowing, Hierarchal Tree Alternative Path.

I. INTRODUCTION

Wireless sensor networks (WSN) are normally deploying huge amount of sensor nodes, which are capable of recognizing the collected data, and packet broadcasting in overload of wireless routing path. Prearranged network should be utilized as a sector, overload manager, network infrastructure monitor and battleground observation. Wireless Sensor nodes work together in a dispersed, self-governing and self-sorted scheme to end a specific process [1]. It mounds the communication by combining variable wireless networks, which results in uneven characteristics, when over load and fluctuations are occurred. Situation of network becomes critical, since modification in the proposed scheme is required to avoid connection breakdown or intended misbehaviour in the WSNs [2].

Normally wireless sensor network functions below load, it will warn the WSN in reply to an analyzed or identified packet error. Performance report is a creation of more unpredicted packet impulse it transfers minimum amount of data to a target node without lengthily disturbing the sense characteristics of WSN. If huge set of data is been transferred lengthily the data packet is naturally unrestrained and frequently induced in jamming. There are different rules and invented surveys are introduced to reduce traffic rate in WSNs. In an authentic condition, traffic is brought on by intrusion links or packet drop since traffic on the intra channel nodes significantly influence the transmission rates and cause peak energy usage. Traffic rates are accelerated, rebroadcasted, when certain packet in the upper layers or MAC, an occasion that tire out the existing imperfect power of network environment. A minor test operation, exists for managing traffic in WSN [2].

Hence, this kind of congestion directly affects lifetime and has a direct impact in networks. The parameters such as Factor, bit fault, crash and struggle results are obtained in connection with the ranges of traffic rate. Therefore, traffic and transmission rate for sink node is reduced. For this

method, in order to strengthen transmission rate of target point, crash must be banned by utilize a proper medium access control-based traffic estimation. The traffic occurrence in WSN is made at various levels of connection plan traffic. According to node level traffic, amount of packet received is higher than rate of packet provision, it causes traffic. The traffic happens in most part of sensor nodes that are faster to the target node. Capacity of node traffic increases when packets drop and misuse of energy is carried out in network. Therefore, those kind of traffics honestly losses availability of network and increase network lifetime. While, traffic is control to distinguish with various sectors: first blocking and intrusion identification, and second A rate organize scheme that modifies the rate of performance result. Different parameters are utilized as a part of survey for traffic identification, path failure, packet latency, maximum size of packet. [3].

Traffic is a way taken for managing the transfer inside the network and also to avoid down falls in a network. An incorporated Traffic Control method cannot be normally applied because it incites various main difficulties. Initially, this scheme accelerates overhead of excessive communication in the network that are losses its energy level. In addition, central reports are been used to manage the traffic that performs a poor output reaction to vary in congestion and network conditions [4].

Hierarchal Tree Alternative Path (HTAP) does not consume the network management ability of WSNs performs efficient communication and individual node result creation. Finally, when at communication breakdown, the entire environment should be in functioning. In recent survey, HTAP scheme examines the improvement in exclusive infrastructure, and unbalanced situation. HTAP techniques are activated to seem traffic in wireless sensor network by utilizing alternative ways for the crowded node prevention in the network [5].

The advantage of HTAP scheme is that they are does not add any critical traffic rate to the existing scheme, which is approved for serious traffic in network for traffic occurrence. On the other hand, the problem with HTAP scheme is that the mode packet broadcasting latency to target node among various paths that improves under exact conditions. Study of various transmission channels for all packets is vital to analyze and understand the characteristics and liveliness in a fine-grained networking scheme. In sequence, routes have been used in existing process [5]. HTAP is introduced as a scalable and fruitful technique for performing large scale of broadcasting data packets, and energetic network.

Rest of the paper is constructed as given below. Section II illustrates on related works. Section III, briefly describe the details about proposed Bearing parallelism-based Data Scheduler (BPDS). It allocates the routing path with frequent data packet movement. Section IV is meant for simulations and performance reports monitored via various parameters. Finally, section V concludes the work with future updates.

II. RELATED WORK

Interference-Fault Free Transmission Tree (IFFTT) algorithm was proposed in [6] to achieve a damage free time slot-based communication for each connection in data collection hierarchy, and logically indicate the scheme was best and absolute. Experimental results detected an error occurred in packet transmission. It denotes the fault for packet organized in tree-based hierarchy; whether error arise due to PIs that were not acknowledged by this representation, reproduce into the hierarchical sensor network.

A better path in sensor networks based on the count of hops used for packet forwarding was proposed in [7]. It discovered the optimal routes along with normal Distance Based Linked K-neighborhood Inactive Forecasting (DBLKIF) method. The best possible route has minimum energy usage with maximum data packet transmission rate, optimal path with reduced packet latency. Minimum distance route was obtained by choosing optimal routes along with loop free path. This Novel scheme operated to maintain minimum delay and decreased the energy usage in entire process and rebroadcasting resource usage.

Power Aware Scheduling and Clustering method considering on Ant Colony Optimization (PASC-ASO) was used in [8]. This scheme was meant for less energy consumption by preparing, quantity of nodes in the working state to create packet and maintain node links, when remaining nodes are inactive. Then, ACO scheme was used for forwarding message packet in the network in direct, to reduce the energy exhausted while broadcasting the error data transmitted by sensors in a thickly fixed in environment. This method works as an important position in the improvement of network lifespan by choosing the optimal robust route to achieve the target node.

In [9], an energy-efficient relaying method to conquer the difficulties of WSN was implemented. In this technique it launched a best key by decoupling the route of energy steadiness and data rate altered. Experimental output verified that, in terms of network produced a way, this scheme indistinguishable to the optimal robust output, as compared to greedy algorithms. A packet forecast method in sensor network was used in [10] which could powerfully improve packet delivery ratio through wireless connection. A few schemes have

chosen for packet allocation of original information to obtain conventional and surrounded point to point delay when meeting the limit of questions, that Nearest Job Next with Combination (NJNC), outperforms in speed assisted data organization with grouping of many requirements serve collectively in a demand manner, without starvation issues as in the case of previous methods were First-Come-First-Serve (FCFS), Shortest-Job–Next (SJN).

A base station assignment method was proposed in [11] to collect experiences about sensor node thickness in a coverage range at various period depends on these clarifications, it presented candidate base station positions in direct to minimize base station traffic rate. It was continued based on time slot. It was applied in a network simulation distinguish with an additional famous method, specifically GSP-Geographic Sink Placement. It was experimental that the present method exhibited best result with respect to base station traffic rate and also packet drop as distinguished with GSP method. In [12], a Sleep Scheduling and Tree-Based Grouping (SSTBG) method for routing algorithm for energy-efficient in Sensor network was proposed. It conserved energy by stop range like inactive mode of either not possible or redundant nodes that monitor approximately the similar details, depend on the position details to reject unwanted information. Then additionally minimized the energy indulgence of packet transmission in sensor environment, to construct minimum spanning tree with the root as the Cluster Head (CH) from active nodes in a group to broadcast information to sink node.

An Enhanced Dynamic Multilevel Protocol (EDML) for DMP queuing in packet transmission was presented in [13]. This method operated on the notion of transmitting data packets depends on probability. It enhanced the QoS, to prolong network lifespan and monitoring energy usage. Dynamic Multilevel Priority Queue (DMPQ), operated on priority assigned time slot for packet broadcasting. The opportunity of original information was minimized, to keep the characteristics of a network. This condition supported to enhance QoS. An energy efficient communication protocol was implemented in [14] with minimum traffic rate and organization of data packet was also major role for the prolong network lifespan. Present a CRT2FLACO-clustering routing protocol on the basis to control the network traffic with improved the lifetime in WSN. Fuzzy logic supports to obtain reduced the traffic rates compared with previous scheme in sensor infrastructure. This methodology also improved the transmission rate.

A concurrently enhanced fidelity for high-integrity with reduced packet latency for latency receptive was proposed in [15], while the environment was jam-packed. A dynamic queue organization method was performed using fuzzy logic to Quality of Service (QoS) condition in Data Integrity and Delay Differentiated Routing (DIDDR). Experimental output shows that the presented method considerably minimized the packet latency and improved transmission rate distinguish with previous scheme. A scheduler was used in [16], which dedicated a series of successive time period of an access Point to receiving data packet from a sender node, during the time, delay for acknowledgement from the target node in its coverage area, that are communicated to assign a data packet to the neighbor node as an access Point among various routing path. Throughput rate increased based on the selection of each path, which has a highest priority. The Access point may manage communication node, that consumed minimum energy.

III. PROPOSED METHODOLOGY

Sensor node senses the information from high speed WSN environment. Here nodes are not updated its position, they are fixed constant. Such high-speed nodes consume more resources. Transmission control protocol provides the efficient communication between source nodes to destination node. Figure 1 shows high Block diagram for bearing parallelism-based data scheduler. High speed sensor nodes operate faster and easy to schedule the communication between source nodes to the target node present in the network. Bearing parallelism-based communication scheme finds the irrelevant data transmission and filter out infrequent data packet transmission. It supports to schedule frequent data broadcasting from one end to another end in network environment. In some cases, while performing a task, time busy resource gives alert signal to relay nodes, it accepts and schedule the transmission task, to enhance the throughput and minimizing packet latency.

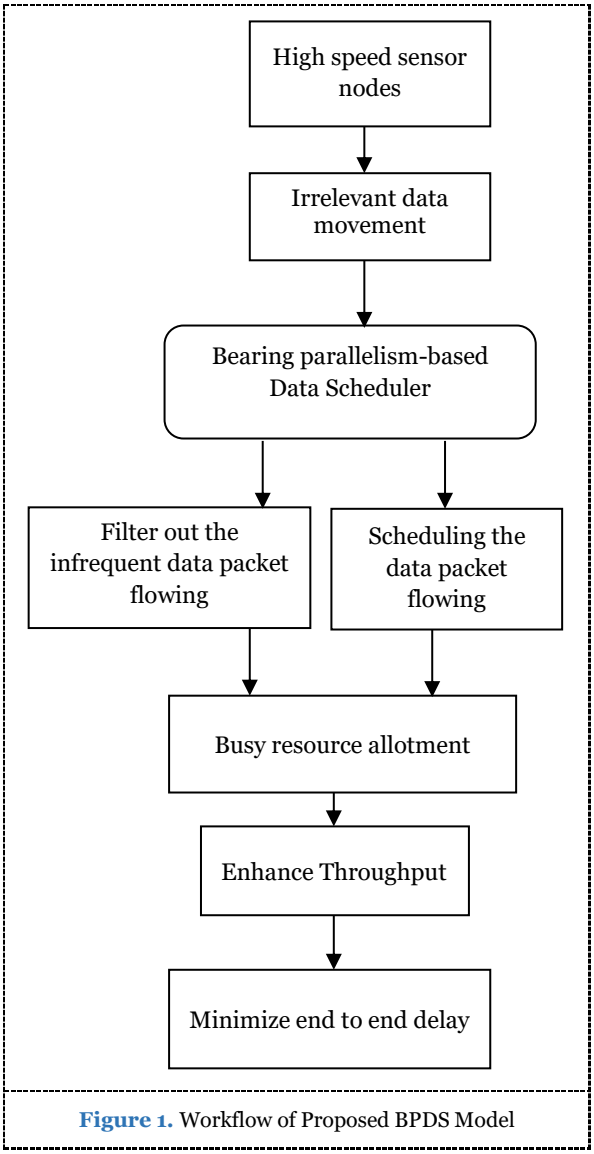

Figure 1. Workflow of Proposed BPDS Model

Source sense the normal information from real time environment, and forwards toward the sensed information in destination node. As to find the optimized routing path, there may be huge distortions or losses, which affect the communication, the intermediate node cause delay, since some of nodes may have minimum capacity to transfer frequent data packets to overcome these irrelevant data packet broadcasting to present BPDS.

Normally, nodes bottleneck data packets are forwarded from one end to another end, since it is a high-speed node. If any packet delay that affects the entire communication process, bottleneck data will be lost, the inaccurate data packets are received from receiver node. The missed data are not accurately collected since irrelevant data broadcasting is performed. Present scheme supports to remove infrequent data and obtain frequent data packet transmission.

3.1. Bottleneck Data Transmission in High-Speed Network

Sender node sense data, which are bottleneck data packets, they are forwarded through intermediate node to target node. Those intermediate nodes use more resources, so threshold value is fixed, to filter out infrequent data packet transmission based on threshold value. In this technique various defence threshold values are used to preserve intermediate relay nodes. Data packet transmission rate should be equal to each other with guaranteed accurateness, it is a recent scheme to reduce packet latency period.

In this technique, heavy load data packets are transmitted by source node to destination node they use multiple paths, so it consumes more energy for each packet transmission. That information is maintained in the buffer storage place. The buffer conditions are permit status, clean status and discard status, to construct two threshold standards to limit values. Various strategies to accept or decline data packets are adopted in various conditions, by using this scheme. Loss rate is recognized resourcefully with them individually. Data packet probability is a vital role in traffic control, though it does not compensate sufficient concentration. Performance output and the issues are distance-based buffer dissimilarity in the intermediate relay node as the provided resolution is irrelevant data movement for frequent transaction. It works on buffer-based scheduling, transmit data packet as FIFO manner and analyzes the characteristics of subjective equality. The infrequent data transmission causes bandwidth allocation as minimum for nodes at the various penetration of network environment.

$$FDAT(n) = \frac{DAT}{Dur} \qquad (1)$$

Where, FDAT is the frequent data and DAT/Dur is the data travel duration. The intermediate relay nodes have more probability to transmit its own created data packets to the destination node. It checks the node capacity before allocating the routing path communication. Though nodes are good in behaviour, it is nearest to the target node which needs to forward its individual data packets among the various hops to knowledge more latency for packet transmission. And provides solution for irrelevant data transmission issues, to introduce comfortable data Scheduler, with the help of queuing system, which distinguish with normally created irrelevant data packet and transmit through infrequent data packet from source node to destination node. All data packets have dual types of probability: constant probability and update probability, that are distinct. Packet constant probability is indicated as an integer and the minimum constant probability node is indicated by

its packet size zero. Updating probability modifies with the count of hops and packet latency. Whether the traffic made two metrics and are used for edge buffer to improve rate and clean the information.

3.2. Multipath Bearing Parallelism Based Data Scheduling

Multipath communication is performed on the explicit or implicit packet messages, which are transmitted from every hop node at the destination energy level of each node. It is maintained as constant range with controlled traffic rate; the source data transmission rate is attuned to mitigate traffic forwarded to destination node from intermediate relay nodes present in network environment. This technique does not provide correct regulated source data transmitting rate. The present scheme states, all nodes can decide communication channel from relay node to target node condition. The T_r transmitter can discover efficient route to broadcast data packet and the variable source data forwarding rate.

$$T_r = INrelay(Route) \quad (2)$$

INFDAT-Infrequent data packets are caused based on bottleneck data transmission by high-speed sensor nodes. These nodes operate quickly with every packet transmission, its characteristics are analyzed and stored in buffer. Packets are also maintained in queue buffer, further data packets forwarded in Last in Last out (LILO) manner. Information's are maintained secretly, that cause delay so bearing parallelism-based data scheduler is used to schedule the packet transmission from source node to target node along with the intermediate relay nodes present in network environment.

$$INFDAT(n) = DAT/Dur \quad (3)$$

The individual node capacity is also analyzed it is helpful for further communication between sensor nodes available in WSN. Each node was connected with wireless link, hence coverage range also limited. The threshold value fixed by buffer to separate the node status, some nodes transmit data packet frequent manner that data are accepted, some nodes forward infrequent data packets, such are decline condition. Missing data packet transmission are clear condition of node characteristics, so based on the details to arrange transmission between sensor nodes the throughput rate is improved and end to end delay is reduced.

$$INFDAT(n) = DAT/T_r \quad (4)$$

$$INFDAT(n) = DAT/INrelay(Route) \quad (5)$$

All data packets do not broadcast irrelevant data, they are broadcasted based on node capacity, so data scheduler, allocates the routing nodes, the data is allotted without any delay for each packet transmission, time details are taken from a queue buffer, all details are stored in First in First out (FIFO) manner with available link address, based on address, the information of intermediate relay nodes that deployed in network environment. Time period is assigned for each transmission, infrequent data transmission cause packet latency from one end point to another end point. This scheme supports source nodes to broadcast frequent data packet with support of bearing parallelism technique through intermediate relay node to target node.

$$FDAT(n) = \frac{DAT}{DINrelay(Route)ur} \quad (6)$$

Source search for best paths

for each source, which monitors various channels

if {Sr==Path}

Sr starts to forwards data packet

if {Node==infrequent packet movement}

Waiting data in queue buffer, Q=DAT

else

if {Node==frequent packet movement}

then it continues packet exchange

the same process will be repeated until it reaches destination node

end if

Source node optimize efficient routing path

end if

end for.

3.3. Busy Resource Allotment

Sensor network packet transmission is carried out, busy resources are allocated when nodes perform task, and time packet waits for a long period of time for transmission in Queue. The buffer queue stores huge amount of communication and node capacity details in network environment. The path allocation plays a vital role with the support of busy resource allotment scheme. That busy condition gives alert signal to sender node present in network environment. The probability of each sensor intermediate nodes is verified initially and then allocates the packet during particular time slot. It obtains maximum frequent data broadcasting between source nodes to destination nodes.

$$DAT(n) = PcK(TxRx) \quad (7)$$

$$Bs = DAT(n) - INFDAT(n) \quad (8)$$

$TxRx$ are transmission and receiving packets, maximum probability of neighbour node is selected to perform communication among sensor

nodes. Minimum probability nodes are rejected and denoted as decline condition. Hence the throughput rate and network lifetime is improved and the energy consumption and end to end delay is minimized.

If {packet flow==infrequent} is calculated

Sender node analyses the characteristics of a neighbour node

Allocate busy resources to that node

It creates a busy alert signal

Threshold value is fixed to verify those nodes. Packet transmission is frequent or infrequent

else

If {packet flow==frequent}

It continues packet transmission on the assigned routing path

Communication is carried on a best routing path

end if

$$Ps = FDAT\_(flow) \quad (9)$$

Sensor nodes sense the information depends on coverage and connectivity rate. All nodes are not easily been connected and communicated with other nodes present in the network environment. It provides the best routing path use busy resource allotment technique. It allocates the busy signal to nearest neighbour node from starting to end point of network communication. It increases the transmission rate.

Packet ID: Packet ID contains each and every sensor node characteristic details. It has nodes that are arranged randomly along the WSN environment.

Table 1. BPDS Packet Format

Source ID	Destination ID	Bottle-neck data transmission	Multipath Bearing parallelism	Scheduling data packet transmission	Busy resource allocation
4	4	3	5	6	4

In table 1, the BPDS packet format is present. The source node ID field occupies 4 bytes and the 4 bytes are occupied by destination node ID field. Third one is Bottleneck data transmission, which is carried out in 3 bytes. When sensor nodes are arranged in fixed environment, node forwards bottleneck data packets. Fourth field Multipath Bearing parallelism consumes 5 bytes and sender works as to select various paths; target node collects the network information through intermediate nodes from sender node. Fifth occupies 6 bytes for scheduling the data packet transmission between sensor nodes present in network environment. The last filed is Enhanced stable channel allotment consumes 3 bytes, to allocate busy resource, routing path among sender to target node in WSN environment.

IV. EXPERIMENTAL RESULTS AND DISCUSSION

The proposed BPDS scheme is simulated by using Network Simulator tool (NS 2.34). In the simulation, 100 sensor nodes move in a 900-meter x 800-meter square region for 32 milliseconds simulation time. Each sensor node goes in a random manner along the network in different speed levels. Sensor nodes have coverage area is 250 meters. Constant Bit Rate (CBR) provides a constant speed in packet transmission in networks to limit the traffic rate. Ad-hoc on-Demand Distance vector (AODV) routing protocol is used to obtain enhanced stable channel for packet transmission between senders to sink node. Table 2 indicates Simulation setup.

Table 2. Simulation Setup

No. of Nodes	100
Area Size	900 X 800
Mac	802.11
Radio Range	250m
Simulation Time	60ms
Traffic Source	CBR
Packet Size	150 bytes
Mobility Model	Random Way Point
Protocol	AODV

The proposed BPDS scheme, which provides the frequent data broadcasting from source to target node as compared with the existing DQMA, TARA, and TMSP [19-20]. BPDS monitors the node character, node transmits infrequent data packet that cause packet latency. It gives busy alert signal, when time delays occur. Those behaviours are analyzed and further throughput is enhanced and end to end delay is minimized.

Table 3. Pause Time vs End-to-End Delay

Pause Time (ms)	End-to-End Delay (Sec)			
	DQMA	TARA	TMSP	BPDS
20	23.50	15.80	13.00	11.00

40	25.00	17.23	14.05	12.01
60	25.26	19.00	15.30	13.24
80	26.04	19.60	16.42	14.09
100	27.50	22.01	18.50	16.02

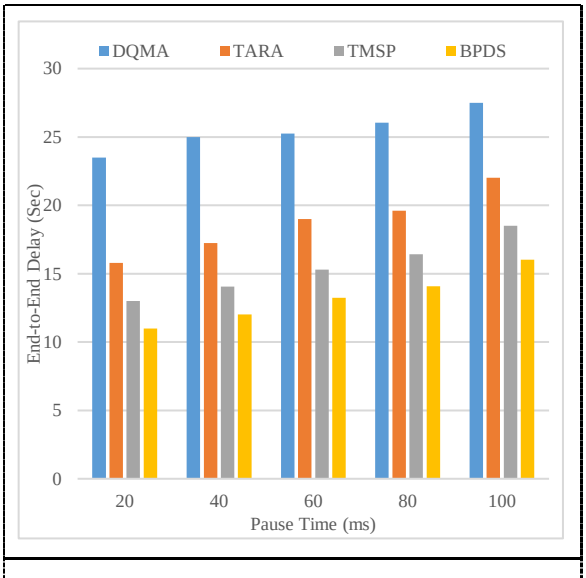

Figure 2. Comparison of Pause Time vs End-to-End Delay

Figure 2 shows the end-to-end delay, calculated based on time taken to forward data packets from source to sink node, all node information is maintained in routing table. In proposed BPDS scheme end to end delay is minimized and distinguished with previous scheme DQMA, TARA, and TMSP.

Table 4. Nodes vs Network Overhead

Nodes	Network Overhead (%)			
	DQMA	TARA	TMSP	BPDS
20	53.86	41.00	28.10	23.86
40	54.90	43.50	29.80	24.00
60	55.00	45.00	31.00	26.02
80	57.02	46.90	32.20	29.00
100	59.82	47.01	33.45	30.90

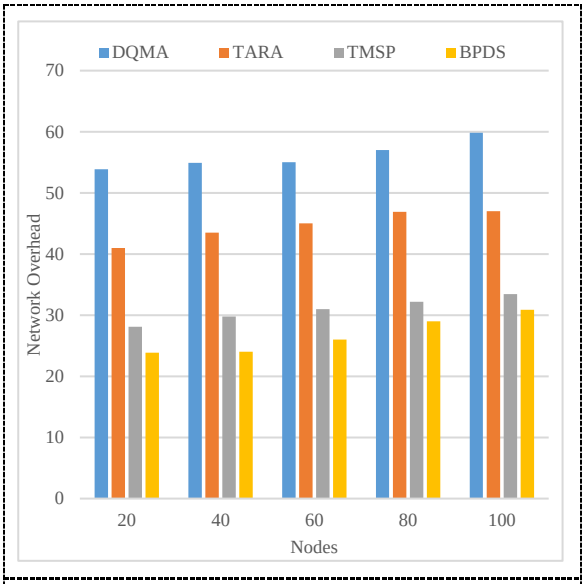

Figure 3. Comparison of Nodes vs Network Overhead

Network overhead is minimized in which the sender transmits the packet to the receiver node. The BPDS controls unwanted packet drops when the sender node initiates its packet transmission along with the network nodes. Fig. 3 and table 4 represents the performance of network overhead. The proposed technique obtained reduced network overhead compared to the existing method DQMA, TARA, and TMSP.

Table 5. Nodes vs Packet Delivery Ratio

Nodes	Network Overhead (%)			
	DQMA	TARA	TMSP	BPDS
20	57.00	40.22	72.23	83.91
40	58.20	41.09	73.75	84.10
60	59.18	42.23	74.86	83.20
80	60.88	44.91	75.02	86.20
100	62.05	46.70	77.20	88.22

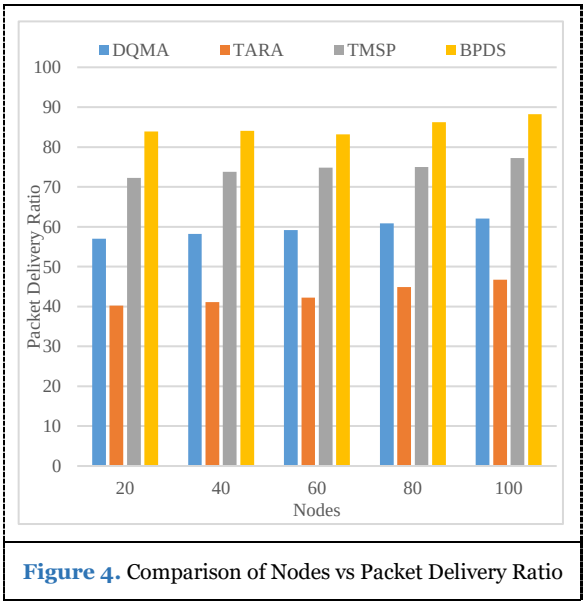

Figure 4. Comparison of Nodes vs Packet Delivery Ratio

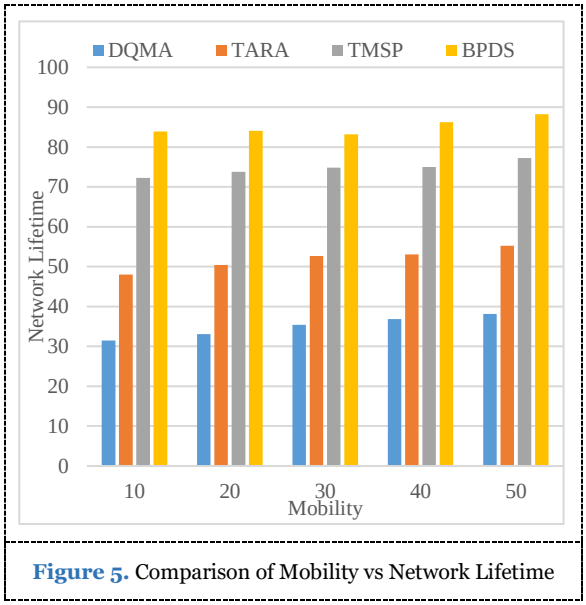

Figure 5. Comparison of Mobility vs Network Lifetime

Figure 4 shows Packet Delivery rate, nodes transmit data packet with Overall time taken to finish the particular communication. Those communications take place in an optimal routing path. The proposed BPDS Scheme Packet Delivery rate is increased and compared with existing schemes of DQMA, TARA and TMSP.

Table 6. Mobility vs Network Lifetime

Mobility	Network Lifetime (%)			
	DQMA	TARA	TMSP	BPDS
10	31.50	48.02	68.00	83.08
20	33.09	50.45	69.25	83.92
30	35.42	52.68	70.90	84.20
40	36.89	53.07	72.33	84.06
50	38.10	55.21	74.09	85.01

Table 7. Nodes vs Energy Consumption

Nodes	Energy Consumption (J)			
	DQMA	TARA	TMSP	BPDS
20	411	372	218	128
40	424	386	225	135
60	437	401	244	160
80	448	416	263	174
100	464	432	270	185

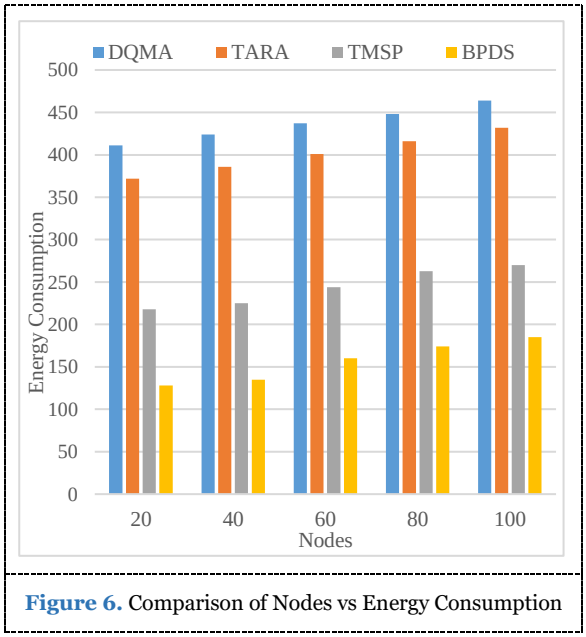

Figure 6. Comparison of Nodes vs Energy Consumption

Figure 5 shows the estimated Lifetime of a network, which is computed by calculating the resource utilization at a particular time instance from source to destination from the total energy available. In the proposed BPDS Scheme Network Lifetime is improved as compared to previous schemes of DQMA, TARA and TMSP.

Figure 6 shows the entire energy consumption, amount of energy spends for communication between source nodes to destination nodes that is meant to estimate energy usage from source energy level to destination energy level. The proposed BPDS Scheme have generated an optimal routing path in the network, energy consumption is minimized and distinguished with previous scheme of DQMA, TARA, and TMSP.

Table 8. Nodes vs Throughput

Nodes	Throughput (%)			
	DQMA	TARA	TMSP	BPDS
10	24	27	59	73
20	25	29	60	75
30	27	31	62	76
40	28	32	64	78
50	32	35	66	80

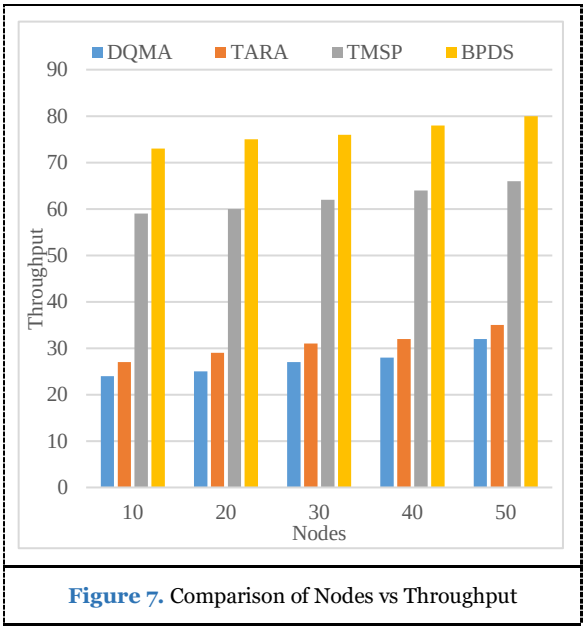

Figure 7. Comparison of Nodes vs Throughput

Figure 7 shows the estimated throughput depends on the number of packets received from no of a packet sent with a certain velocity by setting simulation mobility to 100 (bps). In proposing BPDS method throughput is increased as compared with other models like TARA, DQMA, and TMSP.

V. CONCLUSION AND FUTURE WORK

Sensor nodes are deployed in a high speed WSN source node, which transmits information to destination node through intermediate nodes, when the data transmission for that node capacity is very low, frequent delays will be occurred for packet transmission. The proposed BPDS scheme provides frequent packet data transmission between source nodes to destination, some abnormal condition nodes provide busy alert due to busy situation. It reduces the end-to-end delay and improve throughput rate. The major objective is to maximize the WSNs throughput, minimizing the model overhead, avoiding disputation among users and using minimum number of end-system resources. Sensor nodes are fast working node, it verifies each and every node before allocating packet transmission for that node. Busy resources are monitored to inform the nodes that are in processing, based on the schedule it allocates various paths to particular node and monitors the node capacity. Sampling algorithm supports for fixing threshold value, based on the values, they are further allocated to communicate between channels. It assigns the routing path with minimum resources and reduces end to end delay, to improve throughput, and network lifetime. In future, this data scheduler is further executed using Fuzzy computing-based communication, to measure the different parameters in WSNs.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No animals/humans were used for studies that are basis of this research.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The authors confirm that the data supporting the findings of this research are available within the article.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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A Brief Overview of Context Aware System

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Abstract: Context Awareness emerged as a concept from Ubiquitous computing, which is becoming a reality by emphasizing the integration of the data space and the physical space. With its aid, people may receive and analyze data at any time and from any location using a device that can connect to the internet. As a result, it can reduce the complexity of using the gadget and make people's life easier and more efficient. Context aware systems (CAS) are an effective approach for dealing with day-to-day tasks. Context aware frameworks provide up completely new possibilities for applications developers and end users by collecting contexts data and changing system behaviour respectively. This survey presents an overview of context aware systems. This study analyzes the concept of context aware systems, network architecture, application, and user interface, as well as thorough information of every layer of context aware system. As a consequence of the survey, a general procedure layout in CASs is provided, and the architectural contemplations of CASs are clarified.

Keywords: Context framework; Context-awareness; Sensors; Context middleware; CAS Architecture.

I. INTRODUCTION

Context awareness is the ability to utilize context data. A system is contexts aware if it could understand, extract, and utilize context data and adjust its performance to the present contexts of use. The name context aware computing was often known by people who work in contexts aware, where it was believed which context was a source in its endeavours to disperses and directly interlace computers innovation into our life. By detaching users from devices, developing pervasive or ubiquitous computing technologies enables "anytime, anybody, anywhere" computing. To provide adequate user assistance, services and applications must be aware of their contexts and, as a result, respond to their changing circumstances, which was referred to as context awareness. The context is important because it provides information on the current state of people, places, technology, and natural phenomena. The context is a data that may be utilized to explain the condition of a material. An element is a place, person, or object that was thought to be important to the communication among a user and application, such as time, locations, activity, and the priorities of every entity [1].

One objective of CAS was to collect and use data on the contexts of a device to offer services that were suitable to the unique persons, time, location, events, and so on. These frameworks intend to offer contexts-aware communications, data, and computational access [2]. CAS differs from traditional frameworks in that it provides remarkable characteristics like as heterogeneity, high complexity, and AI [3]. Because the characteristics that define a contexts-aware framework like area and day length, were rapidly changing. As a result, the usage and relevance of CAS was growing, and it is already playing an important part in future wireless systems.

It has been identified as essential and highly beneficial for a variety of reasons, including the fact that the context may reduce input costs, provide an invigorating user experience with little efforts on the user's side, and users could benefit from sharing contexts [4].

II. CONTEXT AND CONTEXT AWARE SYSTEM

"A system is context-aware if it utilizes context to give related data and/or services to the client, where relevancy based on the client's work." Where, context is any data which could be utilized to classify the present condition of a user [5].

The presented context is made of many elements, out of which can be simply distinguish as:

Location: Position, direction, speed, and so forth.

User Identity: Profile, inclinations, biometrics, social data and so forth.

Time: Present date and time or future occasions, duration and so forth.

Activity: Walking, resting, sitting, and so forth.

Current Task: Work or social gathering, wellness, studying, and so forth.

Environment: Temperature, humidity, light and noise levels.

Hardware: Present device data, network, and encompassing devices [6].

CAS may be divided into two broad categories: local and distributed. Local systems serve as frameworks in those applications, and sensors are tightly integrated (by a direct physical association). A distributed framework, on the other hand, does not have the direct physical link among the application and sensor. Because of the improper link, it could have many applications taking data from a single sensor. Furthermore, data generated by the multiple scattered sensors can be utilized by a single application. There are two types of distributed systems: collaborative and non-collaborative. Distributed collaborative framework is a system that enable more than two distant persons to work together to obtain a common target. Non-collaborative frameworks, on the other hand, exclusively promote individual goals.

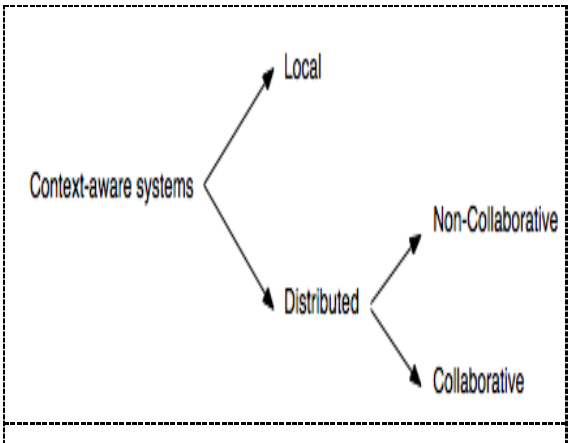

Figure 1. Types of CAS

From a practical standpoint, CAS may be viewed as a tiered system comprised of raw data retrieval, sensors, preprocessing, an application layer, and storage. The Context Management System (CMS) is in charge of collecting original data from sensors, abstracting and aggregating the discovered data into high-level contexts, and making it accessible to contexts-aware application [7].

Table 1. Architecture Types of CAS

Author	Winograd	Chen et al.	Perera et al.
Year	2001	2004	2014
Architecture Type	Widgets Blackboard Model Networked Services	Direct Sensor Access Context Server Middle ware-Based	Component-Based Node-Based Service-Based Distributed Client-Server Centralized

III. ARCHITECTURE OF CAS

CASs representative architectural styles may be classified into three types: distributed architecture, stand-alone architecture, and centralized architecture. Because each style has unique characteristics, benefits, and downsides, it is critical to choose the appropriate architecture style while designing context-aware frameworks. Several components of the context-aware framework may be dependent on its design approach [8].

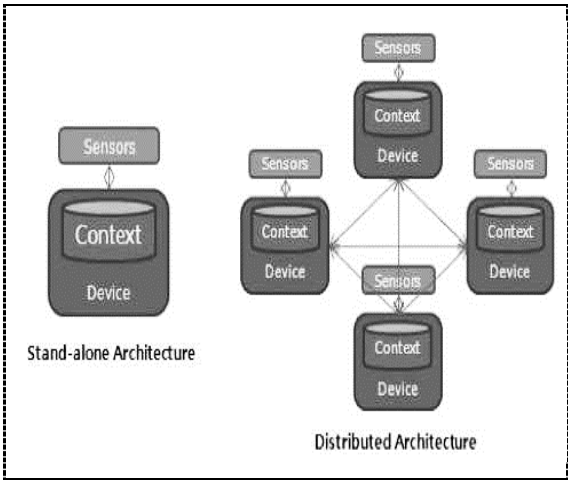

Figure 2. Stand-alone and Distributed Architecture

Stand-alone, which is a critical architecture that specifically gets to sensors, does not take into account device context sharing. This architecture could be usually easily realized, but it had limitations due to the fact that it could not operate device coordinated effort. This design is appropriate for less

complex, simple, or domain-specific applications.

Distributed architecture Context-aware frameworks with distributed design may store context data in a large number of isolated devices, with no additional central server. Every device is free of diverse devices; hence, the CAS might disregard certain less important devices that have a blockage issue and still proceed with context aware activities. Every device deal with context data and exchanges context data with other devices by interacting via different devices; hence, ad hoc communication protocols are necessary. In any event, using ad-hoc communication standards makes it difficult for devices to understand the overall situation of each device. Cell phones often require computation control and resources; moreover, a distributed architecture is one of the constraints in handling computationally significant applications [9].

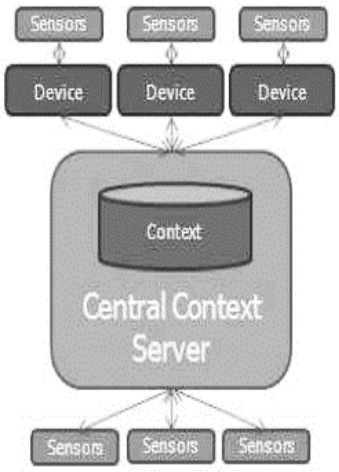

Figure 3. Centralized Architecture

Devices and sensors are connected with a centralized context server that has rich resources and computational control, and context data may be kept in both a central server and user devices. If a device needs context data from another device, it requests it from the central server and receives the result. Because each communication in this architecture is conducted by querying the context server, the transmission protocol might be simpler than in a distributed design. Many applications that need a lot of resources and money might be handled by using a computationally powerful device as a central server. Regardless, there is a disadvantage to this technique in that it can be significant if the central server fails or there is congestion [10].

IV. GENERAL PROCESS IN CONTEXT AWARE SYSTEMS

Various CASs have complex structures and multiple subcomponents that are in charge of representing, reasoning, controlling, and analyzing context data, and they provide their capabilities by the combination of the subparts in the frameworks. Regardless of the fact that there are numerous types of contexts aware frameworks, CAS typically follows four phases to process context awareness [11].

Similarly, the personalization and suggestion ideas into Schilt's classifications are:

- Context-Aware Personalization- Providing customized substance or data dependent on user's present context data.
- Context-aware Suggestion- Providing recommendations to user's conduct dependent on the user's present circumstance.
- Automatic Device Configuration- Automatically setting up device's specifications as per user's present circumstance.
- Context-aware User Interface Optimizing UI dependent on the user's present context [5].

Context-aware systems may be realized from a variety of perspectives. The approach is dependent on certain conditions and requirements, for example, the sensor's location (local or wireless), number of potential customers (one or more), resources available from devices used (hi-fi PCs or smartphones), or the decision to expand the framework. Furthermore, the technique for acquiring context information is critical when constructing CASs since it predetermines the compositional design of the framework to a limited extent in any scenario. Chen [14] outlines three distinct techniques for obtaining context data.

Direct sensors access- This method is frequently utilized in sensor devices that are in-built. The user programming accumulates the optimal data from the sensors directly, i.e., there was no extra layers for gathering and preparing data from sensor. Sensor drivers are built into the application. Therefore, this tightly linked technique is only viable in exceptional circumstances. As a result, it is unsuitable for suited frameworks due to its access quality directly, which falls short a component equal to coping with many concurrent sensor's access.

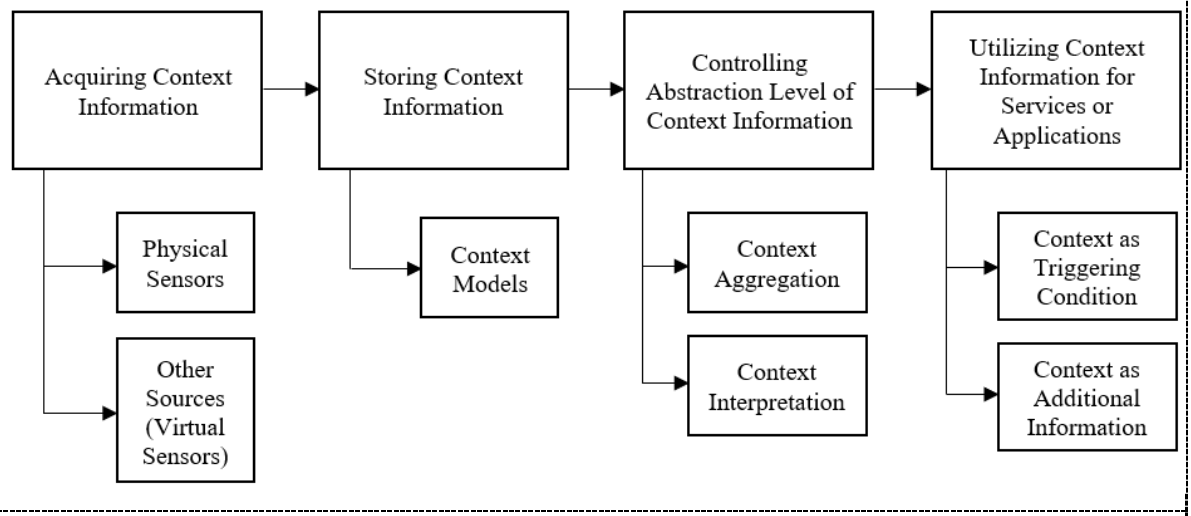

Figure 4. General Process in CAS

Middleware infrastructures- Present programming configuration use review strategies to segregate, for example, graphical user interfaces and business logic. The middleware-based technique familiarizes a structured design with CASs with the goal of covering lower-level sensing information. In contrast to sensor access directly, this method allows for greater flexibility when the user code no longer has to be altered, and it rearranges the hardware-dependent sensing codes reusability due to the stringent inspection.

Context servers- The following consistent process was used to grant numerous users accesses to wireless data source. This technique extended the middleware-based design by offering accesses monitoring wireless segment. The collection of sensor data was transferred to this pretended context servers in order to assist simultaneous multiple accesses. Aside from sensor re-usage, the usage of a context server offers the advantage of relieving users of resource intensive chores. This is an important topic to consider because most of end devices utilized in CASs were likely mobile devices with limited memory, processing powers, and so on. As a result, while designing a CAS based on user server architecture, one must consider appropriate conventions, network execution, the type of service parameters, and so on [11].

The first layer is made up of a collection of diverse sensors. It's worth noting that the term "sensor" refers to both sensing equipment and any source of data that might provide useful context data. Sensors may be classified into three types based on how information is captured. Physical sensors are the most prevalent type of sensor. There are several equipment sensors available these days that can be used for recording all physical information. Table.2 represents several physical sensors with examples.

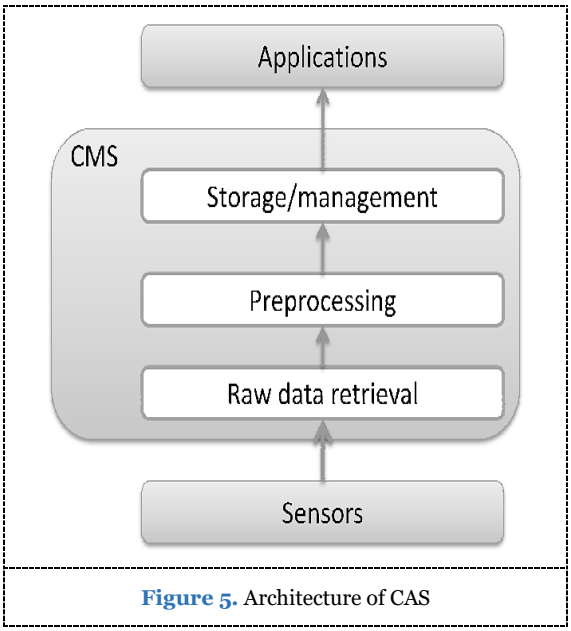

Figure 5. Architecture of CAS

Sensors that operate virtually- Virtual sensor obtains contexts information from services or programming applications, i.e., it can be determined a representative's location by utilizing tracking system (physical sensor) as well as the virtual sensors, for example, by utilizing the electronic logbook, emails, travel booking system, and so on, for location data. Another context's features that virtual sensor could detect include, for example, the client's behaviour via watching movement of mouse and input from keyboard.

Logical sensor- This sensor utilizes a limited number of data sources and integrate virtual and physical sensors with more data from other sources or databases to explain high-level operations. A logical sensor, i.e., may be created to determine a representative's present position by analyzing login

at computers and devices database mappings to location data [12].

Table 2. Types of Physical Sensors

Context Type	Available Sensors
Light	Infra-Red, Photodiodes, Ultraviolet, Colour Sensors, etc.
Audio	Microphones
Visual	Different Cameras
Location	Indoor: Active Badge System, etc. Outdoor: GPS, GSM
Motion, Acceleration	Angular Sensors, Magnetic Fields, Accelerometers, Mercury switches, Motion detectors.
Temperature	Thermometers
Touch	Touch sensors
Physical	Biosensors to measure blood pressure, skin resistance, etc.

Table 3. Context Types and Related Virtual and Physical Sensors

Context	Physical Sensor	Virtual Sensor
Time	Clock	Operating system timer
Identity	Retina scanner, Fingerprint reader, microphone, RFID, Smartcard reader	Various authentication models at the application level or operating system.
Location	Indoor: Bluetooth, 802.11 cells Outdoor: GPS, GSM	User's login on locations aware system, Networked calendar system, IP subnet, Travel booking system.
Activity	UV-sensors, camera, accelerometer, mercury switch, thermometer, motion detector.	Mouse or Keyboard activity, application usage.

The second layer is in charge of regaining real-world background information. It generates appropriate drivers for APIs and physical sensors for logical and virtual sensors. The query utility is frequently actualized in reuse programming parts that make low-level hardware access details simple by providing numerous review techniques, for example, getPosition(). These components become replaceable by utilizing interfaces for components in charge of equivalent types of contexts. As a result, to change an RFID framework with a GPS while making no substantial changes to the present and above layers.

The preprocessing layer was not run in all CAS; nevertheless, if the original information is overly coarse-grained, it may offer important data. This layer is in charge of reasoning and contextual data translation. The sensors questioned on the basic layer frequently produce technical information that application builders cannot use. As a result, the output of layer two is increased to the maximum contemplation state by this layer. The modifications include quantization and extraction operations. For example, an individual's precise GPS position is unlikely to be useful to an application, but the room name in which the individual is located may be.

In CASs with a varied set of context information sources, single context atom might be linked to higher state data in the layer. This method was also known as 'total' or 'combination.' The value of the single sensor was frequently not significant to the applications, but associated data may be highly valuable and precise. In this approach, the system may identify, for example, if a user was inside or outside by evaluating different physical variables such as light and temperature, or whether an individual is now heading to a meeting by gathering location and noise level. To ensure that this analysis works well, a large variety of statistical techniques are used, and some type of preparation stage is usually required.

Obviously, the application may also directly implement this review tool. Regardless, for a variety of reasons, this action must be evaluated and transferred to the context server. The evaluation advances reuse and, as a result, helps the enhancement of user applications. Furthermore, by developing such aggregators, users can wirelessly access network execution increments (as opposed to associating with many sensors) and limited user resources are stored [17].

Table 4. Types of Context Models

Context Models	Examples
Graphical model	Vector Space Model, Context extension of ORM
Key-Value Model	Context Toolkit, Schilt's Approach
Ontology Model	CoBrA, SOCAM, CoCA, CASS
Object-oriented Model	Hydrogen
Mark-up Scheme Model	GPM, CSCP, UAProf, CC/PP
Logic-based Model	McCarthy's Approach

The issue of detecting conflicts that may arise when using several information sources must also be addressed at this layer. For example, if a system is made aware of an individual's location by smartphone instructions and the camera identifying this individual, it may be challenging to select which

data to utilize. This debate was frequently brought closer by the use of additional information such as resolution data and time stamps.

The fourth layer, Storage and Management, organized the gathered information and makes it available to the user via an open interface. Users can gain accesses in two ways: asynchronous and synchronous. The user is scanning the server for changes in a synchronous manner via wireless method calls. In this manner, it transmits a message requiring a limited set of given information and waits for the server's response. Subscriptions are used in the asynchronous manner. Every user subscribes to explicit events that they are interested in. In the case that any of these incidents occurs, the user either made informed or the user's approach was directly incorporated employing the call-back. Because of quick alterations in the basic context, the asynchronous approach is becoming sensible in the majority of cases. The surveying technique requires more resources since context information must be requested on a frequent basis and the program must demonstrate for changes by itself, employing just a few types of context history [15-16].

Application layer, the final layer where the user is recognized. The actual response to numerous situations and context instances is carried out here. Data recovery and applications explicit context managements and reasoning are sometimes examined in the sort of operators that communicates with the context servers and acts as the extra layer among the application and the preprocessing layers. The display on mobile phones is an example of contexts logic at the user level: if the light sensor recognizes poor lighting, material might be shown in a greater contrast colour [12].

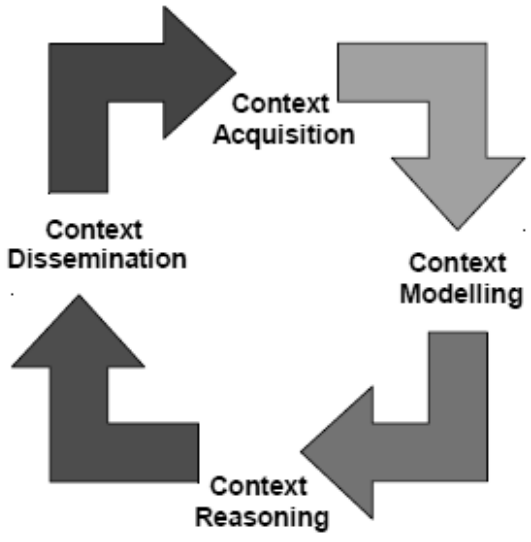

Figure 6. Basic Form of Context Life Cycle

This context's life cycle is divided into four parts. To begin, the context should be gathered from several sources. The sources might be either virtual or real sensor (context collection). Second, the acquired data should be modelled and presented in a meaningful fashion (context modelling). Then, modelled information should be used to infer higher-level context data from lower-level original sensor data (contexts reasoning). Finally, both low and higher-level context should be supplied to context-interested users (context distribution) [13].

The first-generation context aware systems focused primarily on realizing location aware domain explicit applications, whereas the second and third generation context aware frameworks are similar in that they achieved more consensus and adaptability. They support a broader range of domains and context data. Recently, the ontological context model has been widely used in a variety of contexts since it provides convention and intelligent processing techniques [11]. Ensuring user privacy, as well as achieving execution and flexibility, have emerged as key problems in current frameworks [18-20].

V. CONCLUSION AND FUTURE WORK

In this survey, several context architectural standards and models for context aware frameworks were addressed, as well as various server-based and existing middleware techniques to deal with facilitating the evolution of context aware applications. The survey introduced the CAS idea, network architecture, application, and user interface, as well as thorough information of each CAS layer. The literatures for the concept and applications were evaluated and assessed using dimensions associated with progressing and emerging problems in CAS. Because only journal papers were extracted and analyzed, the study did not include the functions and cooperation approaches for logical components in the architectures of CoBrA, SOCAM, Hydrogen, GUIDE, CASS, Context Toolkit, Gaia, and others.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No animals/humans were used for studies that are basis of this research.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The authors confirm that the data supporting the findings of this research are available within the article.

FUNDING

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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Smart Logistics using Internet of Things (IoT)-Study

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Abstract: Smart logistics is one of the most important advantages offered by Internet of Things technology. Logistics services seek to automate their work to reduce manual labour costs and take advantage of available technical services. In this research, we present the details of the administrative processes in the logistical fields, in addition to the details of the types of logistical services in general to clarify what the logistical processes are and how they are used. What is new is to mention that we will explain how the Internet of Things is used in the field of smart logistics, in addition to clarifying the most important studies in smart logistics services in the field of smart transportation, delivery and storage of products using the Internet of Things. Moreover, we discuss the most important developments in smart logistics services in the Kingdom of Saudi Arabia that it seeks to achieve in Vision 2030. In addition to discussing the most important technical components that the Kingdom of Saudi Arabia possesses for the success of smart logistics projects.

Keywords: Internet of Things, Smart logistics, RFID.

I. INTRODUCTION

The meaning of logistics services Logistics is the science and management of the flow of different materials such as goods, energy, information, and various human services from the area of production to the area of consumption. It is difficult to carry out any global trade, whether it is import or export, or a process to transport various goods and resources without professional logistical support, and logistics services include several axes, including transportation, inventory, warehousing, physical processing, packaging or boxing [1]. The Oxford English Dictionary defines logistics as "the branch of military science related to the maintenance and movement of materials, personnel, and facilities". However, the New Oxford American Dictionary defines logistics as "the detailed coordination of a complex process involving many people, facilities, or supplies", and the Oxford Online Dictionary defines it as "the detailed organization and execution of a complex process". As such, logistics is generally viewed as a branch of engineering that creates "human systems" rather than "automated systems".

According to the Council of Supply Chain Management Professionals, logistics is the process of planning, implementing and controlling the efficient and effective transportation and storage of goods including services and related information from point of origin to point of consumption for the purpose of conforming to customer requirements and includes incoming, outgoing, inbound and outbound movements.

Academics and practitioners traditionally refer to the terms operations or production management when referring to the physical transformations that occur at a single business location (factory, restaurant or even a bank clerk) and reserve the term logistics for activities related to distribution, i.e., moving products over the area. Thus, the management of the distribution center is seen as related to the field of logistics, since in theory, the products made by the factory are ready for consumption, yet they still need to be transported along the distribution network according to some logic and distribution central aggregates and orders coming from different regions from the region. However, from a modelling perspective, there are similarities between operations management and logistics, and sometimes companies use dedicated professionals, for example an “operations manager” or a “logistics officer” who works on similar problems. Moreover, the term supply chain management originally referred to, among other things, having an integrated view of both production and logistics from the point of origin to the point of production. All of these terms may suffer semantic change as a side effect of advertising [2].

Currently, work is being done on smart logistics that relies on modern information and communication technology. The logistic system can be achieved through modern technologies with high efficiency, great speed and lower cost. Intelligent logistics can provide a comprehensive view, improve the way of logistics transportation, warehousing, distribution processing, distribution, information services, etc.

The Internet of Things plays a major role in managing logistics operations, as it works on changing the structure of previous systems and replacing more sophisticated systems in managing logistics operations. The Internet of Things provides control over all processes, starting from production, where sensors check raw materials and know the favourable conditions for production well. In addition, the Internet of Things helps in packaging operations, as it can detect errors that occur and strive to reduce the error rate. Moreover, it works on managing warehouses better, as it monitors incoming and outgoing products and production control [3].

The origin of logistics the word "logistics" comes from the ancient Greek language, which meant an account, a reason, or a letter. In 1991, the Board of Logistics Management in the United States of America defined the word logistics as the process of planning, implementing, controlling the flow, and storing the necessary goods, services and various information from the point of origin to the point of consumption in order to reach consumer satisfaction with the goods or service provided. As for the Oxford Dictionary For language, he defined this word as a branch of military sciences concerned with the transportation, management and preservation of various materials.

II. BACKGROUND

In this section we will display the objective of logistic service and the most type of logistic. The objectives of Logistics Services are,

- Improving the physical flow from source to estuary.
- Introduce the purchasing and production programs in a country.
- Organizing after-sales services and distributing various spare parts.
- Advise officials to enable them to make the most of business operations.
- Optimizing the investment.
- Help organizations to master the complexity and various problems.
- Creating an atmosphere of competition by providing better logistic services [4].

The different types of logistics are,

Administrative Logistics: This type is considered complementary to the well-known logistics services of transporting and supplying various materials, and is based on planning, implementing, auditing, and controlling the storage of different goods in a flexible manner. Third-party logistics, where the first party in this type of logistics receives goods for a particular company, arranges, stores, preserves, transports, and distributes it, and then the second party, or known as (a service developer) provides additional advanced services to customers, such as: search, follow-up and packaging. The private party, as for the third party, is the one who undertakes the logistics activities of the company but does not develop them, and the fourth party is the one who undertakes the development of the logistics activities applicable in the company.

Business Logistics: It is the logistics services provided in a specific field of work, such as: airlines. Production logistics: It is the services related to the production line such as transporting goods, supplying them, and distributing them.

Emergency Logistics: These are the services that are provided in the event of transportation of goods or products in emergency situations [5]. Considering the services performed by the logisticians, the main areas of logistics services can be divided as follows:

- Purchasing logistics.
- Distribution logistics.
- After-sales logistics.
- Disposal logistics.
- Reverse logistics.
- Green logistics.
- Global Logistics.
- Logistics of housemaids.
- Concierge Service.
- Reliability, availability and maintainability.
- Asset Control Logistics.
- POS Materials Logistics.
- Emergency logistics.
- Production logistics.
- Construction Logistics.
- Capital Project Logistics.

- Digital Logistics.
- Humanitarian logistics.

Procurement logistics consists of activities such as market research, requirements planning, buy or sell decisions, supplier management, requisitions, and order control. Objectives in procurement logistics may be contradictory: to maximize efficiency by focusing on core competencies, outsource while maintaining company independence, or reduce purchasing costs while increasing security in the supply process. Advanced logistics consists of the activities required to prepare or make a plan for the logistical activities that take place.

Global Logistics is technically the process of managing the "flow" of goods through the so-called supply chain, from where they are produced, to other parts of the world. This often requires a multimodal transportation system, ocean, air, rail and truck transportation. This is perhaps one of the most complex and time-consuming forms of logistics. Logistics distribution tasks, as the main tasks, are the delivery of finished products to the customer. It consists of order processing, warehousing and transportation. Distribution logistics is essential because the time, place and quantity of production varies with time, place and quantity of consumption.

Reverse logistics refers to all those processes related to the reuse of products and materials. The reverse logistics process involves managing and selling surpluses, as well as returning products to sellers from buyers. Reverse logistics represents all operations related to the reuse of products and materials. It is “the process of planning, implementing and controlling the efficient and cost-effective flow of raw materials, inventory in process, finished goods and related information from the point of consumption to the point of origin for the purpose of value recovery or proper disposal. More precisely, reverse logistics is the process of moving goods from their typical final destination with the purpose of Get the value, or dispose of it properly. The opposite of reverse logistics is forward logistics.” Green Logistics describes all attempts to measure and reduce the environmental impact of logistics activities. This includes all forward and reverse flow activities. This can be achieved through multimodal freight transportation, route optimization, vehicle saturation and city logistics. RAM Logistics combines both business logistics and military logistics since it is concerned with highly complex technological systems for which reliability, availability and maintainability are essential, eg: weapons systems and military supercomputers.

Asset control logistics: Companies operating in retail channels, whether regulated retailers or suppliers, often deploy the assets required to display, maintain and promote their products. Some examples are refrigerators, suites, displays, seasonal equipment, and poster and frame stand.

Emergency logistics (or humanitarian logistics) is a term used by the logistics, supply chain, and manufacturing industries to refer to the specific, time-critical means of transportation used to quickly move goods or objects in an emergency situation [6]. The reason for the inclusion of emergency logistics may be production delays or anticipated production delays, or the urgent need for specialized equipment to prevent events such as grounding (also known as "Aircraft on the Ground" - AOG), communications delays or failures. Humanitarian logistics include governments, the military, aid agencies, donors, NGOs, and emergency logistics are usually obtained from a specialized provider.

The term production logistics describes the logistical processes within a value-added system (for example: a factory or a mine). Production logistics aims to ensure that each machine and workstation receives the right product in the right quantity and quality at the right time. Taking care of production, testing, transportation, warehousing and supply.

Production logistics can operate in existing and new plants: since manufacturing in an existing plant is a constantly changing process, machines are exchanged and new machines are added, giving the opportunity to improve the production logistics system accordingly [7]. Production logistics provides the means to achieve customer responsiveness and capital efficiency. Production logistics becomes more important as batch sizes decrease. In many industries (such as mobile phones), the short-term goal is a single batch size, allowing a single customer's demand to be efficiently met. Track and Tracing, which is an essential part of production logistics due to product safety and reliability issues, is also gaining importance, especially in the automotive and medical industries. Construction logistics has been employed by civilizations for thousands of years. Various human civilizations have also tried to build the best possible constructions for sustenance and protection. Construction logistics has now emerged as a vital part of construction. In the past few years, construction logistics has emerged as a different field of knowledge and study in the subject of supply chain management and logistics.

III. KEY TECHNOLOGIES IN SMART LOGISTICS

The Internet of Things (IoT) describes the network of physical objects - “things” - embedded with sensors, software, and other technologies for

the purpose of communicating and exchanging data with other devices and systems over the Internet [8]. The Internet of Things is the main seed in the development of intelligent logistics services [9]. The idea of IoT is that many objects can communicate with each other to reach a specific goal with the help of sensors and data obtained during the operation of the system. The intelligent logistics system can obtain information on products, freight vehicles, transportation and storage methods at anytime and anywhere, and data can be sent from one party to another through the network.

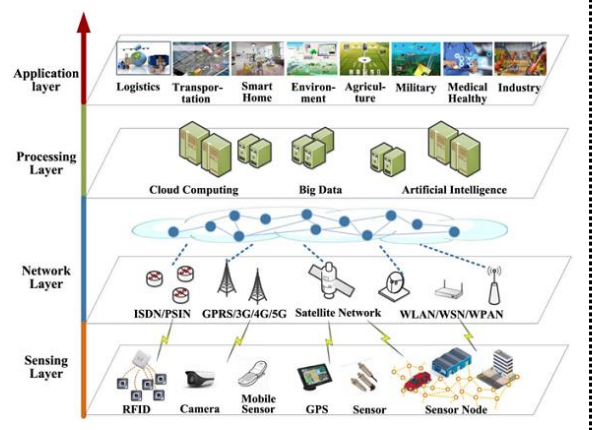

Figure 1. Architecture of IoT

Systems that depend on the Internet of things consist of four layers as shown in Figure 1, namely the sensing layer, the network layer, the processing layer, and the application layer. The sensor layer collects data from the medium in which it is placed, such as temperature sensors, sound measurement sensors, color sensors, and others. The network layer connects devices to each other, as it communicates the collected data and sends it to the upper layer. The processing layer receives and stores data from the network layer and works on processing it using artificial intelligence algorithms. The application layer makes it easier for users to access the data being processed and allows them to control the settings of the previous layers [10].

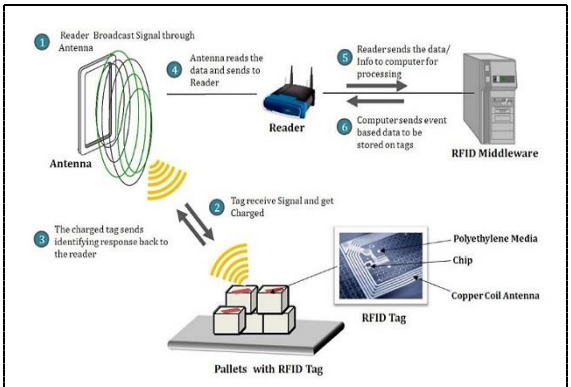

Figure 2. RFID Technology

Stand-alone, RFID technology plays an important role in smart logistics projects, as hardly a project is devoid of the use of this technology in identifying products or vehicles and capturing information in various fields of logistics as shown in Figure 2.

This electromagnetic technology is used to detect objects, where Identification tags are placed on products and are detected from a distance of several meters. RFID tags store identifying information RFID tags store identifying information. RFID tags store identifying information e.g., product number, product name. It is worth noting that it can be equipped with sensors to perform a specific function, such as temperature sensors. According to the energy used, RFID types can be divided into two main types as follow:

Active Chips: This type is based on a battery the presence of the battery makes this chip communicate up to 100 meters. Some of these chips are completely independent of the reader field, as they are integrated with a special transmitting unit, which makes them able to communicate over a distance of several kilometres [11].

Passive chips: This type does not depend on a battery, the lack of an independent power source limits the transmitting power of these chips to only several meters, this chip is fed by electromagnetic wave energy. The reader's field capacity decreases rapidly with increasing distance, which limits its reading range to a distance of 4-5 meters using very high frequencies [11].

Wireless Sensor Network is a group of sensor nodes that are wirelessly connected to each other to collect data in a given environment. In logistics projects there are many sensor nodes that must work together to organize data collection and control terminals as shown in Figure 3. Therefore, WSN acquires great importance in solving the problems of logistics projects such as monitoring production lines, warehouses and transportation vehicles [12].

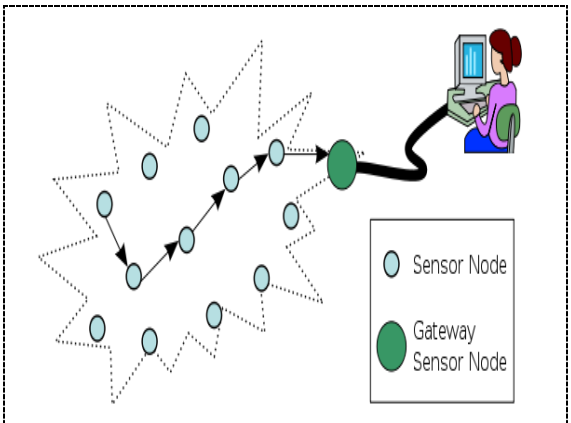

Figure 3. Wireless Sensor Network

The elements used to configure a wireless sensor node are different units such as sensing, processing, transceiver, and power. It also includes additional application-dependent components such as power generator, positioning system, and packager. The sensors here produce analog signals that can be switched into digital signals through the "ADC", and then move to the processing unit [10].

Sensor Node Components: The sensor node is a device that contains a microprocessor and has the ability to monitor and wirelessly communicate, and it suffers from small memory size in addition to limited power reserve. The sensor node, as shown in Figure 4, consists of the following units [13]:

- Sensor unit.
- Data storage and processing unit.
- Transmitter & Receiver unit.

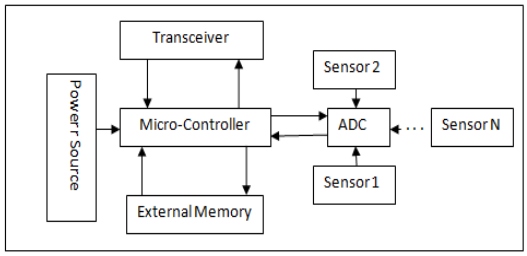

Figure 4. Structure of Sensor Node

Energy: Modern applications in the fields of wireless sensors require, on the one hand, devices with a long lifespan, and on the other hand, these devices usually contain a limited source of power. Each sensor is usually supplied with two AA rechargeable batteries. Several factors affect the its energy consumption:

- The number of device inputs.
- Number of services.
- Transmit and receive time
- Ambient environmental conditions such as temperature.
- Accurate readings required.
- Radio waves used.

Memory Size: Sensors contain memory modules of small size, which leads to a short period of time required to store data before it is analyzed or sent to nearby devices. Older types of sensors also use memory technologies, both types SRAM and SDRAM, while new sensors contain these two types of the memory together, but they are integrated with the chip of the device itself, in addition to the use of an external memory.

Data Processing: The processor in the sensor plays an important role in analyzing and processing the data observed by the device itself or received by other devices, and after the completion of the analysis process, this data is sent in a message which may be encrypted to neighboring devices, and this requires controlling radio waves and dealing with a code message and stored. The processor performs another function, which is data collection, and this collection usually is the responsibility of a particular sensor that integrates local and received data, some of this collected data may be rejected and others may be sent to neighboring devices.

Connection: The broadcast device is one of the most important components of the sensor, and it is also the most energy consuming unit, as 97% of the energy consumed is related to transmission and reception, either using the broadcast unit directly or as a result of the processor waiting for the broadcast unit to finish sending or receiving [13].

Cloud Computing: Due to the complexities in logistics systems, traditional centralized methods may be limited in many parameters that must be considered such as computational effort, storage capacity, and sharing. Therefore, cloud computing represents a flexible solution for logistics services to facilitate communication between all components as they can be accessed from anywhere and provide storage capacities and a very large computational effort [14].

So, cloud computing offers many services, whether for companies or individuals. Figure 5 show the most important resources offered by cloud computing (for example, networks, servers, storage, applications, and services). It is worth noting that cloud computing users do not need maintenance or resource management, and their information will not be damaged or lost. Cloud computing has five main characteristics (self-service on-demand, wide network access, resource aggregation, rapid resilience, and scaled service).

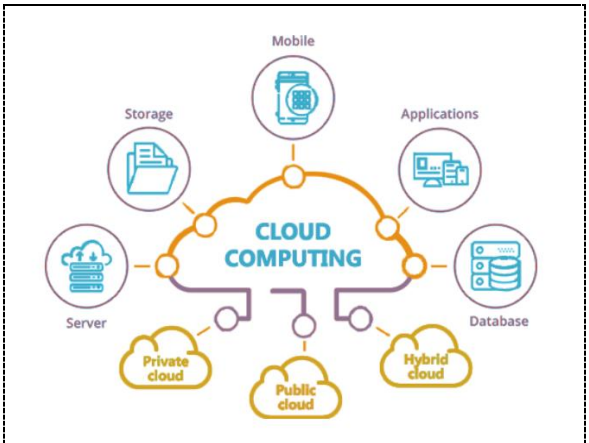

Figure 5. Cloud Computing Services

Moreover, computing has different models, the most important of which is software as a service - SaaS, which is the ability of consumers to use software without having to purchase it, as the cost is based on use. Infrastructure as a Service - IaaS is the ability of consumers to use processing, storage, networking, and other basic computing resources where the consumer is able to deploy and run software, which can include operating systems and applications [15].

IV. APPLICATIONS OF IOT IN SMART LOGISTICS

In this section, we focus on the most important applications of IoT technologies in smart logistics

Smart Logistics Transportation: The study [16] suggested using the genetic algorithm in planning the most appropriate path for the distribution staff. The study also used some criteria in annealing algorithms to determine the paths that enter into each stage. The simulation results showed that it effectively shows the optimal solution, moreover, it shortens the execution time to one third of the original time.

The paper [17] proposed a new algorithm to work on determining the path of the AGV (Automated Guided Vehicle) to sort parcels and deliver them to the specified places. The path-planning algorithm to the discharge port is designed based on passive RFID technology, which allows identifying the discharge locations. The algorithm identifies the multiple paths of the AGV and also solves the potential intersection conflict and pitfall that may arise when the system is running. The algorithm has been successfully tested by simulation experiments.

The study [18] proposed an ant colony algorithm that searches for optimal solutions among the set of available solutions, similar to the way ants search and track. The algorithm tests the best possible transport vehicle among the many available vehicles. It can improve vehicle steering path and shorten delivery time. It is worth noting that this algorithm effectively addresses the problems that appear in the traditional vehicle scheduling method. The algorithm was tested on simulation software, and it showed excellent results in improving express delivery orders.

The study [19] suggested using dynamic programming equations for the delivery and receiving process in order to improve the efficiency of the express logistics process. The study assumed the creation of a TSP problem model, and sought to choose the shortest way to reach the goal of cost reduction. The study has not been practically implemented and has not been simulated by any software, so the algorithm must be validated in express logistics to prove the validity and feasibility of the algorithm.

Smart warehousing: The study [20] presented a system that automates warehouses based on IOT, artificial intelligence, sensor networks, and cloud computing. RFID technology identifies the type of goods received and barcodes are used for the variety of products. It is worth noting that the information of incoming and outgoing goods is automatically recorded in the computer connected to the network and cloud computing. The robots work with the technology of raging ants to draw the shortest path to reach the specified product in the warehouse. Moreover, the robot is equipped with cameras that process the image and use the sensors so that they do not collide with each other.

The study [21] proposed a system that works specifically as a low-volume high-mix scenario based on the Internet of Things and RFID technologies to monitor the warehouse. The proposed system receives customer requests and checks raw materials if they are available. It issues orders to the system to start production, unless it issues purchase orders automatically in the quantities necessary to produce the order. The proposed system works to track the status of orders and know the production statuses. Moreover, the proposed system is equipped with fuzzy logic technology to suggest the most appropriate method for selecting orders in order to enhance production efficiency.

The paper [22] describes the concept of intelligent warehouses that use artificial intelligence and optimization algorithms that include inventory planning based on prediction algorithms that use company data from 20 years ago. In addition, the system works to receive products and localize them in the warehouse, where it works to localize similar products in close places based on SQL procedures. The system issues the products according to the expiration date, as the products with the closest expiration date are the ones that are sold first. The system results showed a 40% improvement in the order picking process, and the number of items with an expiration date reached a minimum.

An intelligent logistics system based on the Internet of things was discussed [23] to monitor drug preparation laboratories and monitor their transportation until they reach your point of sale. The proposed system consists of two layers: The first layer contains the Radio Frequency Identifications (RFID), which works on identifying medical products and tools. The second layer is a wireless sensor network that connects nodes in the system to transmit data between nodes. The main nodes in the system are equipped with RFID and GPS readers to locate trucks during transportation.

The study [24] discussed the most important technologies of the Internet of Things that can be associated with the automation of business processes and their use in logistics services. The most important technologies presented by the study are Radio Frequency Identification (RFID) and Wireless sensor networks. Moreover, the study presented the limitations of Business Process Execution Language (BPEL) to define business processes.

Smart Packing: It is the process of linking information about materials and machines to the Internet via a computer, to facilitate communication between them and other elements. The process of smart packaging takes place in two ways:

- The contribution of machines in exchanging information and increasing efficiency during the production and packaging process.
- Interactive packaging technology that gives the consumer the opportunity to interact with the products.

In this way, the packaging and the packaging itself can exchange information, through a direct contact service with the consumer. Smart packaging systems also help track products at all stages of logistics and distribution channels, in addition to increasing consumer participation and satisfaction, as the consumer who reads the code printed on the product can access detailed information about it and its nutritional value or whether it is counterfeit.

With current digital systems, the consumer can directly access the brand's consumer advisory group, to obtain information about the product, ensure customer satisfaction, and make marketing measurable. Additionally, once the consumer reads the code from their smartphone, it is easy to direct promotional messages to them. Going a step further, a sensor feature can be added in the package, to give the consumer the ability to know whether the package was opened or filled later during the sale, or to check whether the temperature of the package is in the required range and check the expiry date, through smartphones or tablets. This property has gained great importance, especially in the food and pharmaceutical industries.

Intelligent packaging logistics is a global network that constantly communicates with the outside world through scanners and mobile devices and can be machine-readable by radio waves, allows separate product information to be tracked and updated, and adds detailed information throughout the product lifecycle, has become a necessary and mandatory policy Especially for health and basic products. These systems also give great solutions to attract the consumer, share the brand, protect it from monitoring and improve production processes, thanks to which the information does not move only in one direction, as it creates an interactive platform between the producer and the consumer.

With the ability to give all products different codes, companies are increasingly using RFID technology and are subsequently read by fixed or portable readers. Moreover, this technology offers the possibility of freedom of immediate monitoring of data for processing, storage and preparation of analytical reports for the activities of the products. Noteworthy, intelligent packaging reduces labor costs by up to 50%, inventory costs by 30%, in-store losses by 20% and inventory times by up to 80%. Global demand for electronic smart packaging features is expected to be $895 million in 2030, down from $55 million in 2020, and that there will be more if infrastructure, software, and services are included. To have an electronic specialty to improve packaging in 2030, with about 21 billion packages sold in 2030 [25].

New technologies have improved supply chain operations in various industries and markets, increasing product identification and monitoring, and ensuring unimaginably clear capability for managers of large and small brands. In fact, new technologies are a wealth because they increase consumer experience with packaging, because new technology is forcing companies to be more transparent in clarifying information about what the packaging is and how to dispose of it, because the needs of consumers in the 21st century are moving in this direction.

Active Packaging: Active Packaging of Food technologies have transformed basic packaging processes from inactive packaging whose function is only to act as a barrier protecting packaged food from microbial, chemical, oxygen, moisture and light contamination to active packaging whose function is to act as an interactive system between the packaged product, the packaging and the surroundings.

All active food packaging technologies involve physical, chemical or biological action to modify the interactions between packaging, product, and apical space in the packaging to achieve specific desired results. Active food packaging technologies include three main groups:

- Absorbers and Scavengers.
- Emitters.
- Other Active Technologies.

Smart technologies for food packaging: Smart food packaging technologies are defined as a system characterized by their ability to perform smart functions such as detection, sensing, recording, tracing, communication and applying scientific logic to facilitate the decision-making

process to extend the shelf life, ensure safety, improve quality, provide the necessary information and alert potential problems. The ability to communicate is one of the most important functions of smart packaging because the packaging and the packed food move together during the cycle of the distribution chain, and thus communication provides an important possibility in terms of knowing the status of the packed food.

Smart packaging systems use small, inexpensive devices that are labels or labels that are attached either to primary packaging (such as sterile bags, plastic packages, trays, and glass and plastic bottles) or to secondary packaging (such as outer cartons or shipping packages in ships and reefer containers). and others) to facilitate the communication process through the transmission and distribution chain [26]. There are two types of smart packaging systems:

- Package Indicators Systems as shown in Figure 6.
- Data Carrier Systems as shown in Figure 7.

Figure 6. Examples of time and temperature indicators

Figure 7. Maturity Indicators example

The World Bank [28] [29] describes in the Logistics Performance Index (LPI) in the Kingdom of Saudi Arabia as low, with a cumulative rate of 3.16 out of 5, or 63% as shown in Figure 8. Shipping and transportation, tracking shipments in real time, and finally the time or schedule of shipments. The Kingdom's ranking in this indicator comes at 52nd place after we were 49th in 2014 and 41st in 2007, meaning that this sector is regressing backwards in the KSA as shown in Figure 8.

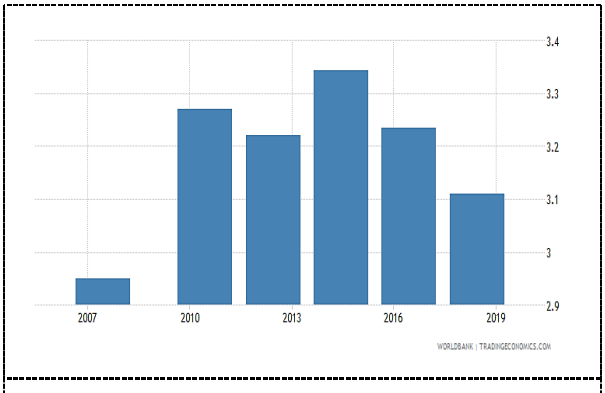

Figure 8. Saudi Arabia - Logistics Performance Index

Smart Logistics in Saudi Arabia: Crown Prince Mohammed bin Salman launched the National Transport and Logistics Strategy in July 2021 [30] to implement the goals of Vision 2030. This strategy will enhance technical capabilities in the fields of technology, communications and transportation in Saudi Arabia. It is worth noting that it will enhance the link with the global economy and enable the Kingdom to exploit its strategic location, which links between Asia and Europe, making Jeddah Islamic Port and Dammam Port a link between East and West, and this is a competitive advantage that most Gulf countries lack. In addition, it will reduce the proportion of employment in the industrial and commercial sectors to a significant level.

The study [31] discussed the impact of the application of the Internet of Things on various fields in the Kingdom of Saudi Arabia and the challenges and security threats that can be faced. Moreover, the study suggested a model for the acceptance of the Internet of Things in the Kingdom of Saudi Arabia based on theories of information systems such as (TAM and UTAUT). The results of the statistical analysis indicate that the Internet of Things is acceptable in the Kingdom of Saudi Arabia.

The paper [32] aimed to analyze the levels of logistics services in the Kingdom of Saudi Arabia, discover weaknesses and suggest solutions to improve the performance of logistics services. The study also proposed an integrated framework that uses cloud computing and Blockchains to improve the performance of logistics services and reduce

their costs. The study used the K-mean algorithm to make comparisons between the performance of logistics services in Saudi Arabia with neighboring countries.

#		Country	Mbps
1	-	United Arab Emirates	130.19
2	-	Norway	107.50
3	+1	South Korea	98.93
4	-1	Qatar	92.83
5	-	Netherlands	91.66
6	+1	Saudi Arabia	87.66
7	-1	Bulgaria	83.71

Figure 9. Speed Test Global Index Report 10/2021

Auxiliary factors for logistics services in the KSA: KSA has many ingredients that make logistics projects succeed and overcome difficulties as follows:

Internet coverage: Saudi Arabia ranks sixth in the speed test Global Index report as shown in Figure 9 [33]. It is expected that the Internet will cover 97% of Saudi lands as shown in Figure 10.

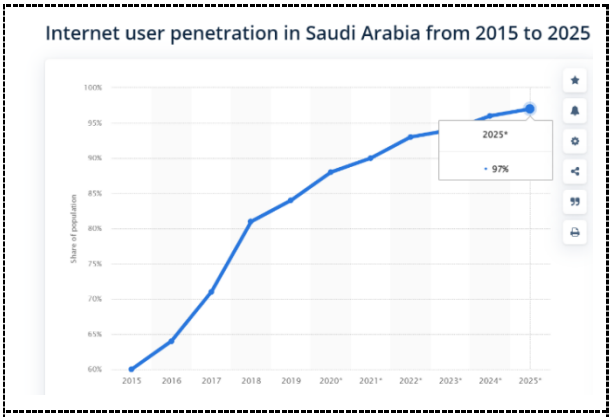

Figure 10. Internet User Penetration in Saudi Arabia from 2015 to 2025

Advance payment service: Many advanced banking and payment services are available in the Kingdom of Saudi Arabia such as credit cards and electronic wallets such as "STC pay" and "Halala". Smartphone applications such as MADA pay and Apply Pay and other services are also available that have facilitated e-commerce and are sure to facilitate the work of smart logistics services.

Reliable network of roads and services: In the past years, the Kingdom of Saudi Arabia has developed a large land, sea and air transport network. It is worth noting that the Crown Prince launched a strategy that aims to make Saudi Arabia a global route for passenger transport. The extensive road network and traffic police management are all factors that help in the success of smart logistics projects.

V. CONCLUSION AND FUTURE WORK

The Internet of Things has greatly helped in the development of logistics services. In this study, the most important technologies that contributed to the development of smart logistics services, such as the Internet of things, sensor network and cloud computing, were presented. In addition, the most important applications of smart logistics services, which are smart transportation and smart warehouse management, were presented. It is worth noting that Vision 2030 was discussed in the field of smart logistics services. They also discussed the potentials owned by the Kingdom of Saudi Arabia that contribute to the development of smart logistics services.

The data in the study shows that the Kingdom of Saudi Arabia has the ingredients that make it in the list of Arab and regional countries in the field of smart logistics services. The most important of these components are the speed of the Internet, the areas it covers, and the easy payment services provided by various banks. It is worth mentioning is the government's interest in all fields, including logistics, which was inaugurated by Prince Mohammed bin Salman and the start of work on smart logistics projects [31].

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No animals/humans were used for studies that are basis of this research.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The authors confirm that the data supporting the findings of this research are available within the article.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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An Effectiveness of AI Approaches in Human Disease Diagnosis for Increasing the Efficiency of Medical Systems- Review

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Abstract: This review discussed the artificial intelligence techniques used in the medical examination, the models used for artificial intelligence algorithms in the medical examination, how the data were classified, as we gain a deeper understanding of disease biology and how diseases affect an individual, so, we provided an overview of the research related to the use of models used for artificial intelligence algorithms in the detection of human diseases and also compared the results obtained through artificial intelligence techniques, and how effective those algorithms were in medical detection and prediction. In recent research, the areas of Breast Cancer, Diabetes Disease, DR, Lung Cancer, Diabetes mellitus, COVID-19, Heart disease, Diabetes diagnoses, Cervical Cancer and Phthalic acid. There is a need for artificial intelligence (AI) to be able to support predictions for personalised treatments. Healthcare applications and systems are being introduced along with the adoption of cloud computing in healthcare, so medicine has entered the digital age with data from new modalities and sources such as wearables and the Internet of Things.

Keywords: Diabetic Retinopathy (DR), Deep learning (DL), K-SVM-related algorithms generated (K-means and support vector machine), Deep learning-based measure (DML), Consecutive Long-Term Memory Model (CSO-CLSTM).

I. INTRODUCTION

In the age of digital technology, we will be able to tailor medical treatment to the needs of individuals and groups of patients. Healthcare professionals in the 21st century face many technological advances and large amounts of data. Combined with digital medical records [14]. Innovative technologies such as blockchain and AI [9] have emerged promising solutions to combat the global coronavirus pandemic in 2020. Blockchain can combat epidemics by enabling early detection of outbreaks, ensuring medical data is requested, and ensuring reliable medical supply as AI provides smart solutions to identify symptoms caused by the virus, treatments and how to make supportive drugs [16]. By perceiving the disease's symptoms, AI-based software diagnoses the ailment even before it occurs.

Furthermore, AI is always learning and has a better possibility of producing more accurate findings than before. Disease detection and treatment is usually a difficult and complicated procedure since several diseases have very similar symptoms [5]. Various AI algorithms assist clinicians in analysing medical imaging such as MRIs, x-rays, and CT scans and diagnosing particular diseases based only on symptoms. Another important use of AI is the Internet of Medical Things, which uses IoT Devices to collect healthcare data [3]. Both diagnosis and disease treatment are highly robust. At the same time, Artificial Intelligence (AI) models, surgical gadgets, and mixed reality apps are used CDSS particular results, such as hepatitis, lung tumour, and skin cancer diagnosis, are achieved utilising AI [1].

The Power of AI in Healthcare: Machine learning models may be trained on a significant quantity of medical data [17]. The classification of medical data is based on the viewpoint of a human medical professional. Many advancements in information and communication technology have recently occurred, altering the world [18]. Within healthcare systems, digital technologies are generating vast amounts of data [16]. To popularise AI in healthcare and develop interpretable algorithms, including AI training in medical education for many solutions that can aid in medical diagnosis and prediction, big data analytics

techniques allow extracting value from data that has four: Variety, speed and honesty [2]. In the world of machine learning, medical diagnosis is a difficult issue.

Healthcare Data into Digital Data: The healthcare industry is fundamentally shifting. Within healthcare systems, digital technologies are generating vast volumes of data [16]. Artificial intelligence (AI) permeates all aspects of social and economic life and other areas [17]. Big data analytics techniques allow extracting value from data that has four: Variety, speed and honesty [1]. Many advancements in information and communication technology have recently occurred, altering the world [18]. The classification of medical data is based on the viewpoint of a human medical professional [16].

The Importance of Human Diseases Diagnosis: Diagnosis is the process of determining the pathophysiology of a disease based on its indications and symptoms. Diagnosis is also described as determining which disease an individual has based on symptoms and indicators. The importance of illness diagnosis cannot be overstated [3]. In the world of machine learning, medical diagnosis is a difficult issue. Machine learning models may be trained on a significant quantity of medical data. The classification of medical data is based on the viewpoint of a human medical professional [2]. AI tactics have resulted in success. AI applications in health care. As a result, it received a hearty welcome [3]. AI expert systems are being debated as to whether or not they will eventually replace human doctors. However, we must not overlook that, in some circumstances, an AI expert system can aid a human doctor in making better decisions or even replace human judgment. The influence and balance of AI strategies in diagnosing the disease to reduce errors in misdiagnosis, as well as the application of the PRISMA approach, are examined.

II. RELATED WORKS AND MECHANISM

In this section, we discuss AI approaches for illness diagnosis, pertinent survey studies on the diagnostic process and our addition to the existing work. The current state of machine learning models with optimisation strategies for classifying medical data is discussed in this work. Attempt to provide an overview of recent research in the areas of Breast Cancer, Diabetes Disease, DR, Lung Cancer, Diabetes mellitus, COVID-19, Heart disease, Diabetes diagnoses, Cervical Cancer and Phthalic acid. AI has entered many fields and is emerging in healthcare, providing significant support in streams of personalised treatments and facing challenges in the era of big data, such as vital signal monitors, molecular assays, lab tests, pumps, and medicine. Nowadays medicine with rapid technological developments, modern sciences in genomics, imaging, and new sources, for example, wearable devices and the internet of things [9], medicine relies on very large medical images as in recent years, and deep CNNs have achieved remarkable success in medical image analysis [23]. All images and data recorded in electronic medical records AI strategies have been able to overcome seeing large amounts of different sources and are still undergoing improvements and training that reduce problems and help health care [9]. Disease diagnosis in healthcare plays a vital role [2], the implications of AI should be considered on a large scale, especially since it is already at a large scale, and its importance lies in allowing users to translate ideas and conceptual goals into concrete tactics that can be implemented in real-world systems [22]. In prenatal diagnosis, ultrasound examination is highly recommended as it is critical for accurate identification of fetal brain ultrasounds Difficulties in determining standard levels of fetal brain ultrasounds (FBSPs) have two types. First, it is not easy to detect features of fetal brain tissue Fetal brain Because the fetal brain tissue is not mature. The amount of classified image data is limited to prohibitive assembly costs, and a differential convolutional neural network (Differential-CNN) has been proposed to automatically select six standard fetal brain planes (FBSPs) from non-standard planes [23].

Artificial intelligence diagnostic criteria were connected to heart, and nerve disease, most malignancies and renal disease, diabetes, cholera, and dental disorders, among other clinical areas, studied [3] within the domain names of diabetes diagnostic and prediction tactics based on statistics mining and their categorisation based on the underlying models employed. Based on a literature analysis of information mining-based approaches for diabetes detection, categorisation, and prediction, a complete taxonomy of regularly used diabetes diagnostic and prediction processes has been developed. In addition, numerous methods were examined based on characteristics like algorithm/model, data entry format (data entry), plug-and-play capabilities, and so on. This research concludes that to detect, categorise, and forecast illness appropriately, we should pre-process the data and use hybrid approaches, which employ numerous models in tandem rather than a single model, based on this evaluation and evaluation. We want to integrate dimensionality reduction, denoising, feature selection, and feature extraction methodologies with classification and prediction algorithms for pre-processing for the greatest overall performance and results. The AI approaches used in the detection of human diseases are,

CNN for Diabetic Retinopathy Diagnosis: Diabetic retinopathy used in [5] by Applying the Kaggle dataset of retina pictures to teach an ensemble of 5 deep Convolution Neural Network (CNN) models (Resnet50, Inceptionv3, Xception, Dense121, Dense169) to encode the rich functions and enhance the type for a special stage of DR, Figure 1 shows how it works.

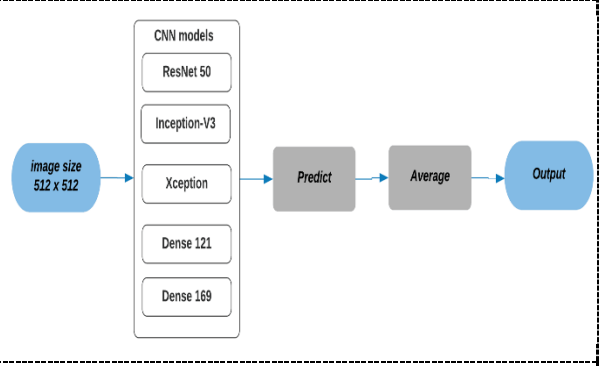

Figure 1. Five Deep Convolutional Neural Network (CNN) Models

While DR has 5 stages or classes, specifically normal, mild, moderate, severe and PDR (Proliferative Diabetic Retinopathy), this paper's main idea is to detect all stages of DR spatially, the mild stage by dividing the image and comparing it with the images in the database. Figure 2 shows how it works by dividing the image and rotating it. Also, how to control it early and differentiate between the mild and the normal stages. The accuracy of this model was 93%.

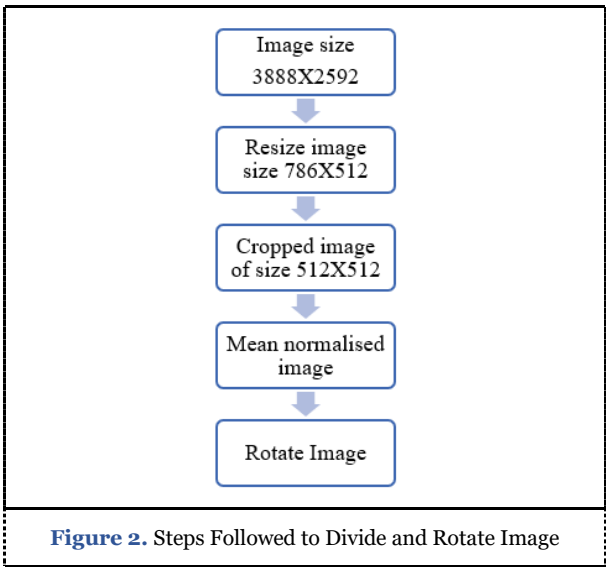

Figure 2. Steps Followed to Divide and Rotate Image

SVM for Diabetes Diagnosis: To control diabetes, numerous facts mining and machine learning strategies have been used for the prognosis. Barakat et al. [7] suggested using SVMs to diagnose diabetes. They use an extra explanation module, which converts the "black box" model of SVM right into a file, A clean illustration of the SVM diagnosis (classification) resolution. The accuracy of this model was 94%. Shi et al. [12], their study suggested effective intelligence in predicting DEHP toxicity. The framework was designed by integrating a Harris hawks' optimisation (HHO) profile using a support vector machine (SVM) called SGLHHO-SVM. The main proposed methodology is that the developed SGLHHO integrates a collection mechanism, two core operators extracted from the salp swarm algorithm and a grey wolf optimiser to enhance and restore the searchability of the original HHO [12]. SVM can separate samples related to the highest classification accuracy by hyperplane when w and b can be obtained. Regarding kernel technologies, SVM can also solve nonlinear classification. The nonlinear function can be modelled as follows:

$$g(x) = sgn(\sum_{i=1}^{n} a_i y_i K(x^i, x) + b) \qquad (1)$$

Where: $K(x, x^i)$ is the kernel function and $K(x, x^i) = exp(-\gamma\, kx - xik2)$.

3D CNN for Diagnosis: Lung Cancer is primarily based on deep CNN. The machine analyses and provides CT scans immediately, accurately representing calibrated possibility rating suspicion. Machines include a Computer-Aided detection unit (CADe) to detect and cut suspicious lung nodules also a computer-assisted diagnostic unit (CADx) that performs each the extent of the nodules. Evaluation and category of malignancies on the patient degree through evaluation of suspicious lesions of CADe. Both CADe and CADx modules obtain comparable or higher performance. One of the first-rate CADe and CADx structures posted on LUNA16 and Kaggle Data Science Bowl standards [6]. This model provided a complete probabilistic lung diagnostic machine, and the accuracy of this model was 94% [6].

CSO-CLSTM for Heart Disease and Diabetes Diagnosis: Heart disease and diabetes diagnosis CSO-LSTM model's [11] performance was verified using healthcare data. The CSO-LSTM model achieved a maximum accuracy of 96.16 % per cent and 97.26 % per cent on, respectively, during the experiment. This proves that the model offered is effective. Performance can be enhanced in the future by adopting feature selection techniques that lessen the curse of dimensionality and computing complexity. Table 1 shows a heart disease & diabetic illness dataset, comparing the average performance of current and suggested CSO-CLSTM methods [24].

Table 1. Performance Analysis Comparison

	CSO-CLSTM	SVM	KNN	NB-A	FNCA	J48
Illness	Heart disease					
Sensitivity	98.6	83.1	92.1	87.9	95.5	94.2

Specificity	96.9	82.4	87.7	84.8	92.8	91.0
Accuracy	97.2	76.7	89.0	79.8	93.3	92.4
Illness	Diabetic disease					
Sensitivity	96.3	83.2	92.0	87.3	NA	94.4
Specificity	94.3	81.6	87.0	84.4	NA	91.0
Accuracy	96.1	77.3	88.8	79.1	NA	92.0

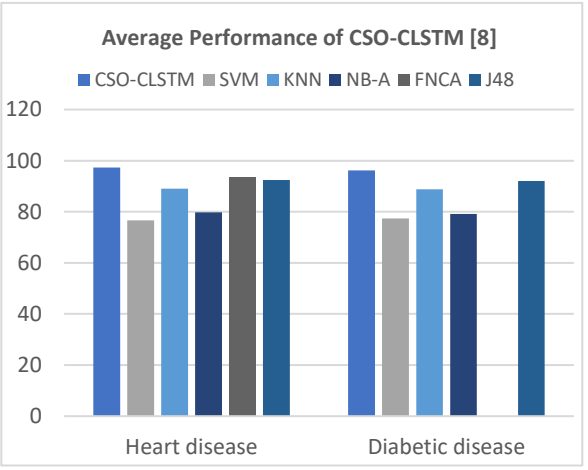

Figure 3. Analysis of the Average Classifier Performances on the Diabetes & Heart Disease Dataset

The average classifier performances on the Diabetes & heart disease dataset gave the following results [24]. Furthermore, hybrid meta-heuristic algorithms can overcome the drawbacks of the CSO method, such as its slow search precision and high likelihood of entering local optima [2]. The condition is diagnosed using the suggested Crow Search Optimization approach based on the CSO-CLSTM. A CSO is used to track both the 'weights' and 'bias' characteristics of the CLSTM version to obtain a greater category of clinical facts [2]. In addition, to avoid outliers, these research panels used the (iForest) isolation strategy. The CSO program enables significant research into the diagnostic implications of CLSTM release. Healthcare facts are used to confirm the overall performance of the CSO-LSTM version. During the trial, the CSO-LSTM version had the greatest accuracy ratings in identifying heart disease and diabetes, with 96.16 percent and 97.26 percent, respectively [2].

AI Speech Processing Framework, CNN for COVID-19 Diagnosis: Diagnosis of COVID-19 used AI speech processing framework and CNN, based totally on the cough sound only, wherein numerous sounds of itching have been gathered from infected people, and via way of means of comparison, the analysis is made, in particular with the ones infected asymptomatic. The accuracy of this model was 98,5% who have COVID-19 and 100% for asymptomatic. Three ResNet50s in a parallel plane make up the CNN architecture. Figure 4 shows a ResNet50 Parallel series model with 77,2048 4-d tensor output layers.

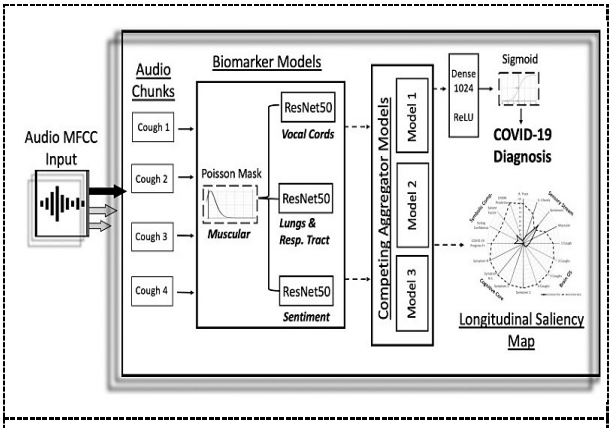

Figure 4. COVID-19 Discriminator Architecture Overview

Pre-screening for diagnosis with a salinity map for vital indicators When pre-processing, it starts with a recording of one or more coughs, then goes through a two-step pre-processing procedure that includes recording and input into a CNN-based form. Each cough recording is separated into 6-second audio clips for output, which are then padded as appropriate, processed with an MFCC program, and passed on afterwards. The result of these processes becomes the input to CNN. Then there's a dense bilayer with Sigmoid activation, followed by 1024 deep-linked (dense) neural network layers with ReLU activation. The complete architecture is trained using the COVID-19 cough dataset for binary classification. Numerous types of A topic salience maps are created by aggregating the output of a portion of a CNN structure using competing schemas. This paper's conclusions and presentation are primarily based on the outputs of the first audio group [8].

Neural Networks Detecting Possible Falls in Elderly Individuals: Several research have been conducted to detect possible falls in elderly individuals using various types of sensors and algorithms [10]. The proposed system can be classified into a wearable-based system, a camera-based system, and an ambience device; the concept involves categorising a fall with very low-resolution heat sensors and then alerting the care workers [10]. We also compare the performance of three recurrent neural networks for fall detection: long short-term memory (LSTM), gated recurrent unit (GRU), and Bi-LSTM [10]. Compared to LSTM and GRU, the Bi-LSTM algorithm produces excellent results because the use of their data is influenced by prior and new information. The user's privacy was not jeopardised due to the information received through this system, which is another benefit of this alternative [10].

The AVE Algorithm for Invasive Cervical Cancer Diagnosis: The AVE algorithm effectively detect confirmed cancers (i.e., a direct precursor to invasive cervical cancer). It is based on the deep science of automatic visual assessment. In a study, Pal et al. [12] presented a new and innovative method for detecting cervical cancers using DML that does not include any effort to mark cervical boundaries. This paper presented a pioneering initiative to study the effectiveness of a deep metric learning algorithm for classifying cervical images. The result of the experiment showed that deep metric learning with combined loss reduction performs better than the previously proposed AVE method in the waiting test set. In addition, the current frame reduces the annotation work at the ROI image level. The training loss is designed to minimise the positive distance and maximise the negative distance. Mathematically, the contrastive loss (Lcontrastive) is defined as:

$$L_{contrastive} = [d_p - m_{pos}]_+ + [m_{neg} - d_n]_+ \quad (2)$$

Where m_{pos} means the positive distance's upper limit, m_{neg} denotes the negative distance's lower limit, d_p denotes positive distance, d_n denotes negative distance, and [x]+ = max (0, x). While DML with n-pair embedding loss DML with n-pair embedding loss [12].

Ultrasound Detection for Prenatal Diagnosis: A differential convolutional neural network (CNN) has been developed. For the correct measurement of the head and the diagnosis of brain lesions, accurate determination of the sound waves of the fetal brain is critical. A differential convolutional neural network (Differential-CNN) has been developed to automatically recognise six standard fetal brain planes (FBSPs) from non-standard planes. Additional differential feature maps are generated from the initial CNN feature maps using differential operators in the differential CNN framework. The differential convolution maps will provide high-definition performance.

A data set of 30,000 2D ultrasound images from 155 fetuses between 16 and 34 weeks of age was generated to evaluate the performance of these algorithms. The accuracy was found to be 92.93% in trials. It also showed that CNN differentiation could be used to facilitate the deployment of automated detection [1]. Classifying and Analysis Data with Experimental Results: Here is a summary of the results of the mentioned studies. Table 2 includes the most important algorithms mentioned in each study and the accuracy result for each algorithm.

Table 2. Classification Analysis of Data with Experimental Results

Ref	Research problem	Algorithm/ Tools/ Model/ Classifier	Dataset	Accuracy
[3]	Breast Cancer	Fuzzy Logic /Omega algorithm	Images	76%
		K-SVM	Wisconsin Diagnostic Breast Cancer (WDBC) data set	97.38
		Backpropagation neural network.	backpropagation	99%
[3]	Diabetes Disease	SVM	*Blood Samples*	93%
		ECG, CNN, LSTM,	Heart rate variability	95%
[5]	DR	(CNN) models (Resnet50, Inceptionv3, Xception, Dense121, Dense169)	Kaggle	93%
[6]	Lung Cancer	CNN	Kaggle	94%
[7]	*diabetes mellitus*	SVM	*Blood Samples*	94%
[8]	COVID19	CNN	Cough sound only	98.5%
[11]	Heart disease	CSO-LSTM	Healthcare data. During the experimentation	96.16 %
	Diabetes diagnoses			97.26 %
[12]	Cervical Cancer	KNN	Cervical Cancer Data	90%
		DML	Images	
[13]	Phthalic acid	SVM	Blood samples	95%

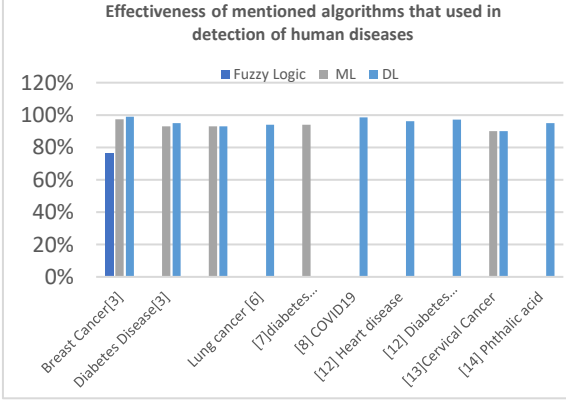

Figure 5. Comparison of Effectiveness

Figure 5 shows the effectiveness of mentioned algorithms that are used in the detection of human diseases.

III. WEAKNESSES AND STRENGTHS IN THE MENTIONED STUDIES

The classification of findings after the experiment for artificial intelligence techniques applied in the medical care field is shown in this review. The use of metric learning techniques [12] may lead to more advanced, but it has been observed that some misclassification still exists. So, a possible reason for this is a lack of proper generalisation during training. The application of the proposed system in the real world is to act as an intelligent assistant to the physician who also evaluates the woman. The images used in the system can be acquired using various devices, such as a smartphone and digital Camera or colposcope with the ability to take pictures. Weaknesses lie in the steps to address this discrepancy, in addition to the imbalance of data and regional differences in the appearance of the cervix. Experimental results have indicated that the proposed [13] SGLHHO can perform much better than others in improving these functions.

In addition, SGLHHO was also used to search for the best parameters and sub-features of SVM; the SGLHHO-SVM has been successfully used to predict DEHP toxicity. Also, an accurate comparison was made between SGLHHO-SVM and other competitive algorithm rhythms. In addition, the results also confirmed that SGLHHO-SVM achieved higher prediction accuracy with more stable properties to work in the future. However, several aspects still need to be investigated, where it should be noted that more influencing factors and coefficients are entered. Thus parallel computing can reduce the computational burden in specific applications. SGLHHO-SVM can be used to predict more diseases to extend the application of this algorithm, such as clustering and segmentation of the cross-sectional image, as well as more data samples that can be collected to build a more effective and reliable framework.

IV. CRITERIA OF AN EFFECTIVE FRAMEWORK FOR RESPONSIBLE AI

The majority of AI development and the complexity of AI's impacts. Given the black-boxed nature of certain AI models, which may make decision-making processes and outcomes opaque, this process requires exposing and then seeking to minimise bias in algorithms and working to enhance interpretability or explainability. Privacy, dependability, and safety are other often-mentioned concerns [17]. However, these well-known difficulties, prevalent in AI ethics research, are only a small part of the social and ethical dangers and implications associated with AI. Broadly it should think about AI's ramifications. It should allow users to translate conceptual ideas and objectives into concrete tactics that may be executed in real-world systems. Flexibility It should be flexible enough to work with a wide range of AI systems. Lifespan and regularly. Guided It should be simple to use and comprehend, with enough documentation.

Importance of Artificial Intelligence and Big Data in Healthcare: Big data and blockchain have left their imprint on the sector. Huge volumes of data are created in the healthcare business. Health records, diagnostic testing, and the Internet of Wearables devices are all examples [19]. As a result, the information is gathered, merged, and double-checked.

Intelligence and related health are gaining relevance from several sources. The usage of data, on the other hand, is a difficult procedure [5]. Technology Cloud computing allows users to access information stored anywhere at any time. It may be utilised by people or businesses to improve productivity and performance while lowering costs and complexity. There are several issues connected with keeping data on the cloud, the most significant of which is ensuring the privacy of customers' data against unwanted access and harmful assaults. Additionally, the owners' data available at any moment is a concern [19].

Blockchain and AI in Healthcare Systems: Blockchain is based on the principle of decentralisation. Its database is dispersed among a network of participants rather than housed in a single location [20]. This decentralised idea provides excellent security for the stored database so that there is no single point of failure, and for importance, the blockchain is accessible to all network members. The notion of how the blockchain works are depicted because this is possible through a technique known as consensus. In principle, everyone has access to the public blockchain, and anybody may join and make transactions on any blockchain [9].

ML and DL are two significant technologies applied to solve challenges in recent research [20]. The goal of machine learning, in general, is to grasp the structure of data and match it to models that people can articulate and use [21]. ML allows computers to train on data inputs and use statistical analysis methods to generate output values within a certain range. Anyone may join, make transactions, and participate in the consensus process on a public blockchain since it is accessible to the public. Figure 6 depicts the blockchain concept and a visual representation of how blockchain works.

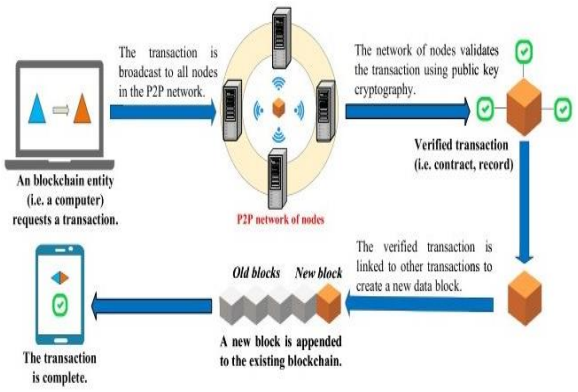

Figure 6. Concept of Blockchain

In general, blockchains may be classified as public (permissionless) or private (permissioned) [21]. On the other hand, private blockchains are closed networks managed by a single entity. To provide authorisation to a participant, a validation method must be employed. A blockchain comprises three main components: data blocks, distributed ledgers (databases), and consensus methods. Blockchain's ability to keep the chronological sequence of data records, such as COVID-19, is a distinguishing advantage. These data items are kept on the chain in chronological order indefinitely. Each data record (medical data) on the blockchain can be saved as a transaction.

A block is made up of several transactions, while a blockchain is made up of multiple blocks connected [25]. The previous block's hash is stored in each block's header field. The smart contract and its execution provide the same results reflected and recorded on the blockchain. The Internet of Things (IoT) and blockchain can collaborate [26]. Using blockchain and AI platforms to avoid COVID-19 is also a challenge.

V. CONCLUSION

Many artificial intelligence algorithms were utilised in the medical detection of various human illnesses, categorisation data, and experimental findings in this review, demonstrating that the best accuracy was achieved. Backpropagation Neural Network for Breast Cancer with 99 percent, Diabetes Disease with a 95% accuracy rate by ECG, CNN, LSTM, DR with 93% with CNN models, Lung Cancer with 94% using CNN, diabetes mellitus with 94% accuracy using SVM, by using CNN for COVID19 the model achieved 98.5%, heart disease 96.16%, and diabetes diagnoses 97.26%. For Cervical Cancer, both are utilising CSO-LSTM, and both are using KNN and DML. Phthalic acid has a final accuracy of 95% when using SVM. Also, the strengths and weaknesses in the mentioned studies summarised the effectiveness of those algorithms in medical detection and prediction it was discussed.

While recent technological advances in the areas of big data, analytics, and artificial intelligence (AI) have opened up new avenues of competition, where data is used strategically and treated as an ever-changing asset capable of unleashing, our future work is Building a model for detection and prediction of the brain and neurodegenerative diseases.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Not applicable.

HUMAN AND ANIMAL RIGHTS

No animals/humans were used for studies that are the basis of this research.

CONSENT FOR PUBLICATION

Not applicable.

AVAILABILITY OF DATA AND MATERIALS

The authors confirm that the data supporting the findings of this research are available within the article.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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Classification of Bugs using Machine Learning Algorithms

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Abstract: DevOps is a method used to automate the process between the development team and the IT team through which they can develop, test, and release their software. Bugs during this stage slow the entire release cycle. To overcome this, Machine Learning and Deep Learning Algorithms are used to analyze and arrive at the possible cause of the bug. This reduces the dependency on the developers and, in turn, speeds up the release cycle. The bug dataset is fed to various classification algorithms like CNN, Random Forest, Decision Tree, SVM, and Naïve Bayes for bug classification. Based on the experimental results, it can be observed that Convolutional Neural Networks, a deep learning technique, outperformed all the other approaches used. Furthermore, it was observed that Naïve Bayes, a probabilistic classifier generally preferred for text classification, performed poorly with the bug dataset used in this paper. Ensemble methods like a Decision tree and Random Forest performed better on this dataset.

Keywords: DevOps; Machine Learning; Deep Learning; CNN; bugs

1 Introduction

The DevOps paradigm has gained much popularity in the Information Technology world today since it enables teams to quickly deliver stable, reliable products. It ensures swift release cycles, thereby improving the maintenance and upgrade timelines. DevOps combines agile with automation and continuous delivery, promoting efficiency between development and operations teams and providing faster innovations and superior deliverables to customers and businesses. Bug Tracking Systems (BTS) play an important role here as it emphasizes better quality faster, thus rendering better service and customer satisfaction. The BTS systems allow for efficient communication and collaboration between the reporters of the bugs and the respective feature developers by posting comments and attachments, giving more information on the errors, and promoting speedy resolution. In addition, these systems have features that provide detailed information about team members' efforts to analyze and solve a bug reported, statistics on the number of bugs reported, and many more items to debug.

However, even with the combination of the above two aspects, that of DevOps and BTS, there are still gaps in smooth product delivery. The main cause is that the bug counts for large enterprise projects are generally high, and sorting and contacting the respective developers for a fix is still manual. This increases the resolution time for each bug raised. Since there is human intervention in the bug assignment and bug

fixes process, there are high chances of errors, which further delay the bug resolution, affecting the entire release cycle. This is an area wherein Machine Learning, and Deep Learning algorithms can be used to classify the bugs reported and suggest a fix to the tester, thus removing the manual overhead. This paper has used a system developed for bug classification with Atlassian JIRA [1] as the BTS and the bug data generated from the DevOps tool named Chef [2]. This paper suggests a two-layered approach, wherein the algorithms first detect the nature of the bug in the first layer and then, based on its nature, identify the plausible cause in the second layer. Various supervised learning algorithms were experimented with for classifying data, and their performance was observed and analyzed. It was observed that the Convolutional Neural Networks (CNN) outperformed others. This paper is segmented into five parts. Introduction falls under Section 1, followed by Related Work in Section 2. This section focuses on the study done by others in this area. The working of the proposed system is elaborated in Section 3. Section 4 describes the results obtained. The paper concludes with a possible future direction this research can take, as highlighted in Section 5.

2 Related Work

Natural Language Processing, which encompasses text classification, finds extensive application in domains like spam detection, sentiment analysis, etc. Textual data has an immense level of information within it, but extracting relevant data from it is tedious and time-consuming owing to its unstructured nature. CNN focuses on obtaining patterns from the input textual data, passing them through various filters, to extract feature maps. These are then passed through multiple hidden layers for further feature extraction, and the final output is obtained from the output layer of the neural network. Research has been done using the reports generated from bug-tracking systems to classify the bugs into various categories. The research undertaken by Diksha Behl, Sahil Handa, and Anuja Arora proposes using TF-IDF along with the Naïve Bayes approach [3] to classify bugs into security and non-security categories. A vocabulary of bugs was created from all the bug reports, and each report was converted into a vector, indicating the occurrence of certain words in the report. Based on the weighted values of each complete word vector, the report was classified as a security or non-security bug.

The researchers of [4] have worked on a bug reports classification system. This system uses N-gram Inverse Document Frequency to derive phrases from the bug report to categorize the bug report as a valid bug. These features were inputted into Logistic regression and Random Forest classification models. This approach was compared with a topic modeling approach used for similar bug classification. The N-gram IDF approach was found to be more accurate in both models. Tao Zhang and Byungjeong Lee, in their paper [5], have described a method to detect identical bug reports based on bugs reported on Bugzilla. They made use of bug rules and text-based similarities to identify duplicates. Taxonomy classification and hierarchical clustering algorithms were used to classify the bug into the appropriate category. The paper by Neelofar *et al.* [6] provides a method to classify bugs and compares feature extraction methods of TF-IDF and Chi-Square algorithms. This research concluded that the Chi-square algorithm performed better than TF-IDF in prediction accuracy. The idea behind the classification was that correct classification of bugs can help the bug triage team to assign the reported bug to the right developer. The approach proposed by Lin Tan and co-authors in their research paper [7] seeks to analyze the bug reported and create a patch based on its root cause. R2Fix classifies the bug, obtains the parameters used in the source code based on the report from the classifier, and uses these patterns to generate a patch. This paper seeks to improve the bug classification aspect of the previous studies and aims to classify the bugs to arrive at the root cause of the issue. This is achieved through two layers of classification. The subcategory thus arrived at makes it easier for the developer to provide a solution.

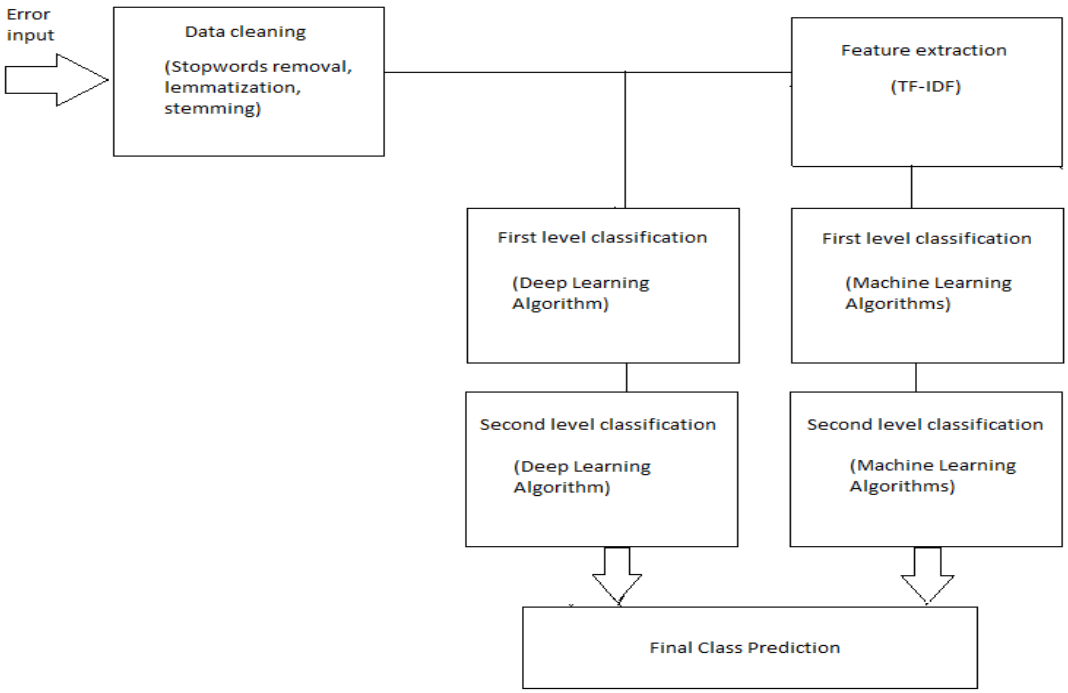

Figure 1: Architectural diagram of the proposed system

3 Proposed System

The pictorial representation of the model used in the paper is shown in Fig. 1. Data obtained from Atlassian JIRA, a bug-tracking system, has to undergo pre-processing, after which it will be subjected to various Machine Learning and Deep Learning Algorithms to learn from the existing bugs and classify the new bugs based on its learning. A two-layered classification is done wherein the first layer classification predicts the bug's nature based on this class. A particular sub-class is predicted to give a plausible fix to the tester. The errors collected during the operational time are stored and later used to re-learn the algorithm after the storage reaches a certain threshold.

3.1 Dataset

A Bug tracking system called Atlassian JIRA was used to collect the bug list. The first error level was essentially the output provided by the Chef Orchestration tool. The errors, in CSV format, were used as input to the algorithms. The dataset consisted of 948 samples.

The dataset was categorized into 5 classes, namely:

1. *Appserver Scripting Tool (270 samples)*
   This category deals with app server Scripting Tool related errors.
2. *Middleware (70 samples)*
   This category deals with errors related to Middleware installation, patching, and upgrades.
3. *Machine (315 samples)*
   This category deals with errors arising due to machine configurations, permissions, resource limitation
4. *The compilation (117 samples)*
   This category deals with issues in code quality, like variable declaration issues and syntactical issues.
5. *Application (176 samples)*

This category deals with issues specific to the application deployment and upgrades.

The sub-classification for each of the categories mentioned above is as follows:

- AST
  i) Startup/shutdown – Errors related to service reboot
  ii) Domain – Errors related to the improper domain configuration
  iii) Machine/Properties issues – Errors related to wrong attribute references in property files passed to the AST scripts
  iv) Connection/SSL issue – Errors caused by connection issues to application servers due to improper server configurations
- Middleware
  i) OPatch – Issues obtained during patching of Middleware
  ii) RCU - Issues in creating DB schemas
  iii) Machine - Issues specific to the virtual machine, its configurations, and permissions
  iv) DB issues – Issues related to the database connection, like incorrect credentials, lack of relevant schemas, etc.
- Machine
  i) Missing file – Issues due to lack of required file
  ii) Missing Parent Directories – Issues arising due to the lack of a parent directory to create contents within it
  iii) Rerun/System exit – Issues arising due to manual interrupts
  iv) Permission issue – Issues related to incorrect permissions
  v) Package issue – Issues arising due to unavailable packages in the yum repo
  vi) Connection – Issues due to network and connection
  vii) Timeout - Issues due to lack of resources or command timeout
- Compilation
  i) Missing Declaration – Issues arising because of missing variable declaration
  ii) Missing Attribute – Issues due to lack of variable assignment
  iii) Syntax Errors – Chef-specific syntax errors

Note: Application errors are not sub-classified as they are specific to the applications and not the orchestration process.

Following are a few examples of commonly encountered errors [8] [9]:

1. **Sample error 1:**
   Error Starting server AdminServer: nodemanager.NMException: Exception while starting server 'AdminServer'

2. **Sample error 2:**
   Parent directory /user1/postgresql/9.x/bin does not exist.
   Error executing action create on resource 'template[/user1/postgresql/9.x/bin/postgresql.conf]'
   Chef::Exceptions::EnclosingDirectoryDoesNotExist

3.2 Pre-processing

Text data needs to be pre-processed as it helps in improving accuracy. The textual data was converted to lowercase to ensure case insensitivity. The words in the NLTK stop words corpus (English) were removed along with the other non-alphabetic characters, like numbers and punctuation marks, since they do not contribute to the predictions. Stemming, a process of deriving the word's root form, was also applied.

3.3 Machine Learning Algorithms

3.3.1 Feature Engineering

Feature Engineering is the method of selecting suitable features for the algorithm. This paper has used a method called "Term Frequency-Inverse Document Frequency," known as TF-IDF.

TF-IDF is a numeric measure to judge the significance of a word in the collection. The significance of the word jumps up when the occurrence of a word in the collection offsets the occurrence of the word in the document increases.

$$\text{TF-IDF}(x) = \text{TF}(x) * \text{IDF}(x) \quad (1)$$

Where

TF(x) = (Count of term x present in document) / (Total count of terms in the document).

IDF(x) = $\log_e$ (Total count of documents/Count of documents with term x:- ln(x)).

3.3.2 Classification

This paper compares the performance of a few classification algorithms such as Support Vector Machine, Decision Tree, Naïve Bayes, Random Forest, and Convolutional Neural Networks (CNN). A tree-based model for decision-making is employed in Decision Trees [10]. They yield resource costs, utility, and chance event outcomes as results. The tree is split into edges based on condition/internal node attributes. The last branch, thus obtained when the further split is not possible, is the decision/leaf. The categorized class labels will be the child nodes.

$$\text{Entropy}(M) = -\sum p(M) * \log p(M) \quad (2)$$

$$\text{Gain}(L,M) = \text{Entropy}(L) - \text{Entropy}(L,M) \quad (3)$$

Random Forest [11] uses labeled training data, creates multiple decision trees, and merges them into one, thereby improving prediction accuracy. It is similar to bagging classifiers and decision trees in terms of the hyperparameters used. A subgroup of features determines the node splitting, contributing to the classification. Using separate thresholds for each feature can modify the tree structure and contribute better to the accuracy of the predictions than choosing a common threshold for all features.

Support Vector Machines (SVM)[12] are discriminative classifiers that categorize new samples based on the hyperplane generated during the training phase. In two-dimensional space, the hyperplane is a line dividing the 2D space into two parts corresponding to the classes in the data. A very different perspective to the ensemble model is provided when bagged with other machine learning algorithms.

Another algorithm used for text-based classification is the Naïve Bayes algorithm based on conditional probability [13]. The core part of the algorithm comes from Bayes theorem, which states

$$P(N|O) = (P(O|N) * P(N))/P(O) \quad (4)$$

3.4 Deep Learning Algorithms

The algorithm used under Deep Learning methodology is Convolutional Neural Network, also known as CNN[14]. It is a class of deep, feed-forward artificial neural networks (the connections between the nodes in various layers do not form a cycle). For making minimal pre-processing, it makes use of a variety of multi-layered perceptrons. The animal visual cortex was the source of inspiration for this algorithm. Two important operations in CNN, which can be considered feature extractors, are convolution and pooling. Convolution can be considered as applying a filter over a fixed-size window. Pooling merges the vectors resulting from various convolution windows into a single-dimensional vector. After several max pooling layers and convolutional layers, fully connected layers provide high-level reasoning in the network. Neurons in a fully connected layer are activated via affine transformation, with matrix multiplication and a bias offset.

4 Experimental Results

The approach used in this paper successfully performed a two-stage classification of bugs reported from the execution of Chef cookbooks. Comparing various machine learning techniques and deep learning algorithms found that the deep learning CNN algorithm gives the highest accuracy score. Since the second classification layer depends on the first layer, having a high-accuracy model in the first layer is the most important aspect. Fig. 2 compares various classifiers in the first stage of classification. The graph in Fig. 2 shows that CNN achieves the highest accuracy score of 97.73 percent compared to the other algorithms, whose accuracy score is less than 90 percent for the same data. The naïve Bayes algorithm yielded an accuracy of 85 percent. The decision tree algorithm classified 76 percent accurately compared to the 86 percent of Random Forest. The performance of SVM surpassed that of the other machine learning algorithms with an accuracy of 87 percent.

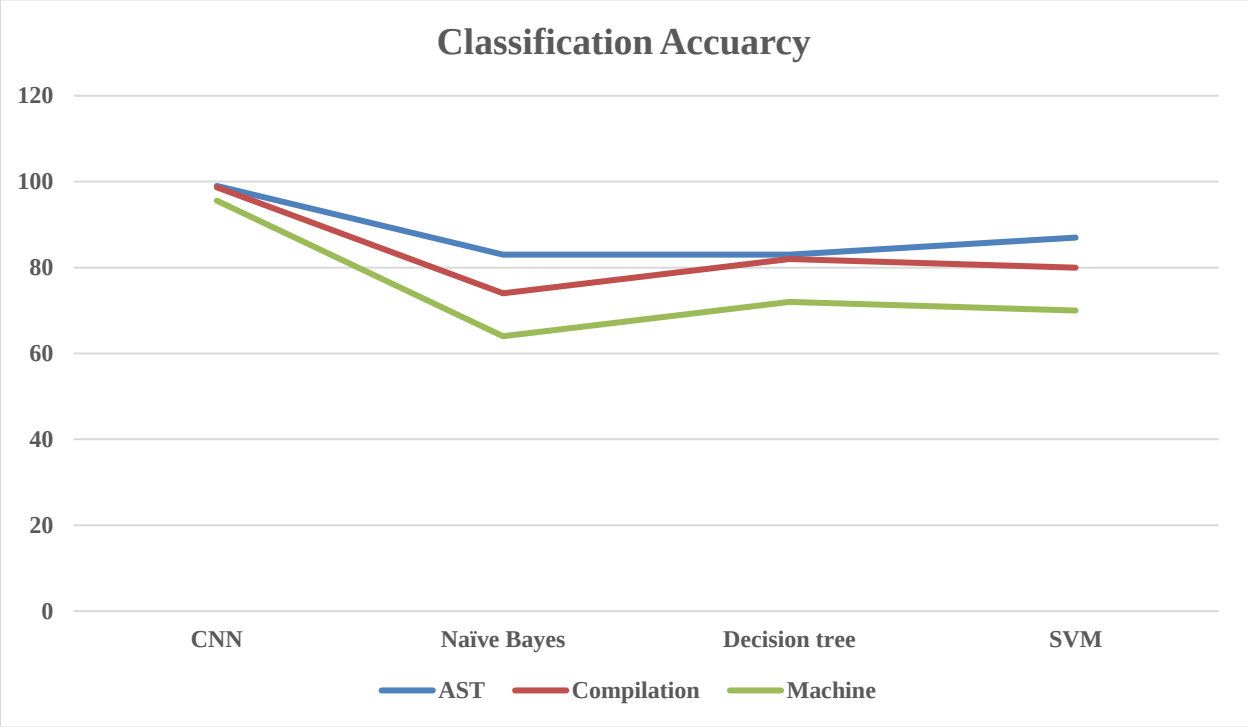

Figure 2: Accuracy, in percentage, for First Level Classification

Even though Naive Bayes is considered a standard approach for text data classification, but it is less accurate when compared with deep learning algorithms. Although convolutional neural networks are traditionally used for image data, it was also found to perform very well on text-based data. From the comparison of accuracy on test data, it was observed that CNNs perform the best on both the first level classification and each sub-classification in the second stage. The results for the same are shown in Tab 1.

Table 1: Accuracy percentages from second level of classification

Algorithm	AST	Compilation	Machine	Middleware
CNN	99	98.67	95.57	98.83
Naïve Bayes	83	74	64	61
Decision tree	83	82	72	70
SVM	87	80	70	75
Random Forest	88	88	80	76

The tabular data given in Tab. 1 shows that CNN, a deep learning algorithm, has achieved high accuracy rates, above 95 percent, for the second stage of classification. The other machine learning techniques have lesser accuracy scores in comparison with CNN. The accuracy achieved by Naïve Bayes is in the range of 61 to 83 percent in the second stage of the classification; the Decision tree achieves in the range of 70 to 83 percent; the Support Vector Machine in the range of 70 to 87 percent, and Random Forest in the range of 76 to 88 percent.

5 Conclusion and Future Scope

This paper evaluates the performance of various machine learning and deep learning approaches for Bug Classification of DevOps bugs using JIRA data. As opposed to the traditional method, in which a developer has to triage the bugs manually, this approach enables them to invest lesser time in debugging the issue and arriving at the root cause. Based on the experimental results, it can be observed that Convolutional Neural Networks, a deep learning technique, outperformed all the other approaches used. Furthermore, it was observed that Naïve Bayes, a probabilistic classifier generally preferred for text classification, performed poorly with the bug dataset used in this paper. Ensemble methods like a Decision tree and Random Forest performed better on this dataset. This model can be extended to suggest plausible solutions for the bugs, which can significantly reduce the maintenance windows. This approach can also be extended to support and resolve customer issues. Since the approach accepts inputs in textual format, this can also be extended for any text classification problem.

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Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

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Technological Gaps on online English Language Teaching: E-Learning Insufficiency

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Abstract: Technology, in the year 2020, has attained its utmost use by becoming the solution for people across the world in all sectors. Despite the use of applications like Zoom, Google Meet, Kahoot, and Google Classroom, teaching language online has proved challenging without a live teacher. This paper aims to throw light on the technological gap and its pace that has not matched the necessity of the period. The analysis of an example from English Language Teaching will not show what technology lacks in this field but also serve as a guide for the developers of future artificially intelligent software and applications. As teaching and computing are two different fields, it is the researchers' duty to bridge the gap by meticulously explaining the limitations in the currently existing applications and the necessary features in the yet-to-be-developed ones.

Keywords: Insufficient Technology; ELT; applications; bridge; online teaching; Artificial Intelligence

1 Introduction

Can a machine ever replace a teacher?

From the times when information, knowledge and wisdom were taught by mere word-of-mouth, we have moved to gain those via books. However, throughout, there had and has always been a teacher- a person. Despite astounding inventions and changes across the world during every era, the field of education has not witnessed many revolutionary transformations. Science has always surprised us with unimaginable things; hence, one cannot set boundaries for the transitions expected in the future. The farthest some students have imagined is to insert the knowledge one wishes to gain using a chip or some easy and advanced method as per the brain capacity available in each person, without taking any effort from the students' side. This way, students could save the time required to gain theoretical and practical knowledge, explore the world and create or invent things. This thought might have been crazy and hilarious many years ago, but now we all know that it is highly plausible. After all, technology is all about reducing human workload. That is what it did when it came to audio-visual media, which has started to replace books. Be that as it may, that progress does not suffice in a field that is the root of future scientists, doctors and leaders. Or, maybe, the technology has advanced enough but has not been directed towards education [1-16].

1.2 Research Structure

In a recent issue of the journal Learning, Media and Technology, the Covid-19 'pandemic politics, pedagogies and practices characteristic of education in 2020' has been discussed and reflected upon elaborately, calling for further research on applying technology for education and media [17]. Education is a vast field to consider for exemplifying any thought or idea. Hence, this paper takes English Language teaching to point out the drawbacks of current online teaching facilities. It recommends the necessary aspects to focus on while building the future mode of education. These aspects will not be futuristic-as they are not ideas-but points to be given importance to, in the case of education. An example of an application that guides error-free writing has been provided and analysed from various perspectives [19]. Moreover, a survey was conducted to elucidate this research statement. Although teaching Science, Mathematics, or other subjects is possible using the currently available applications without much strain, teaching language has been a challenge for teachers around the globe.

1.3 Why Now?

Although technology's application in education is not a novel development, it was not fully used until recent times. While people hesitated to shift from classroom to online education methods, an epidemic (Covid-19) has forced people and organisations to learn to adapt to online means. In 2020, when online education was the only possibility, people gradually learned and used it effectively. While students searched for sites and applications that would guide them with their homework, teachers searched for ways to make their teaching interesting and effective, as the students' attention span online is highly limited. Whilst people of other fields found it easier to work online, teaching online became a burden to many teachers because of the limitations in every application. Teachers try to make every class creative using quiz applications and others. Necessity is the mother of invention. This necessity for online education did not occur as an immediate need until everyone was forced to stay home for a year. With this sudden peak in demand, a rise in online education methods has also been expected. But unfortunately, technology has not been quick enough to match the pace of rising needs. This paper plans to serve as a call for the application, software developers, and others to act upon the need of the time. Moreover, computing and education are two different fields. Sufficient measures must be taken for the technology to be directed towards education. Research papers listing the necessities could easily serve as a guide for focussing on the expected solutions.

2 Available Applications

One cannot deny the existence of numerous applications that have made online education a good alternative during the pandemic. But considering the progress of science and the current information age, this transition towards digital classrooms should have been the best and not something people look forward to letting go of once the pandemic ends. This should have been a permanent and phenomenal solution. Some popular online teaching applications are Google Meet, Zoom, Google Classroom, Google forms, Google documents, Microsoft teams, Kahoot, Flip grid, YouTube, etc. Of these, some aid in live classes, some for homework and assignment submission, some for creating quizzes and some for creating interesting PowerPoints. But none of these has the option to auto-correct assignments except the Google Form, which auto-corrects the multiple-choice questions. While talking about self-education in the article Future of Technology in Education, Ekaterina Novoseltseva, a tech blogger, says that technology in this information age is advancing so much that the role of a teacher has shifted more towards being just a "guide on the side", while the students whole-heartedly learn what exactly they want to learn on their own [12]. If the current period is already shifting towards unsupervised learning, we should already be equipped with software and applications that promote such a movement. But it is still in the developing stage. Besides, BBC Learning English, Hello English, and Speak Fluent English are some online applications available to teach English as a Second Language. But they could be useful only to a beginner or intermediate-level person. An advanced learner of English who would like to get their essays or reviews corrected would need a live teacher to correct them. Auto-correct for long passages with importance given to all the aspects of assessment has not been possible so far.

2.1 Drawbacks in Most Applications

From the analysis of the popular applications used for teaching online, it is evident that most of those satisfy basic needs and could be a temporary solution. With this positive push from the epidemic towards the technological world, it should be going higher and not getting down the ladder back to old-school methods. With some help from science, we could easily take this up to the next level. Zachary Pardos, an assistant professor at the University of California, Berkeley, says that auto grading could be enabled for problems or essays while preparing an online course. However, additional personalisation needs to be done from the technological side to devise adaptive learning. For an adaptive teaching system, the essential components are those which could regularly assess what a student knows, their knowledge in that particular discipline, suggestable tips, and customisable order of lessons. If human teachers were to assess and change all these as per each student regularly, they would soon be exhausted due to the colossal task [6].

3 Survey on Online Education

A survey was conducted using a Google Form questionnaire to know teachers' online teaching experience, and the following is the link to the questionnaire "https://forms.gle/FkYrX5GdZKywFhYT7." Below is a graphical representation (Fig. 1 and Fig. 2) of the answers to two of the questions asked in the survey.

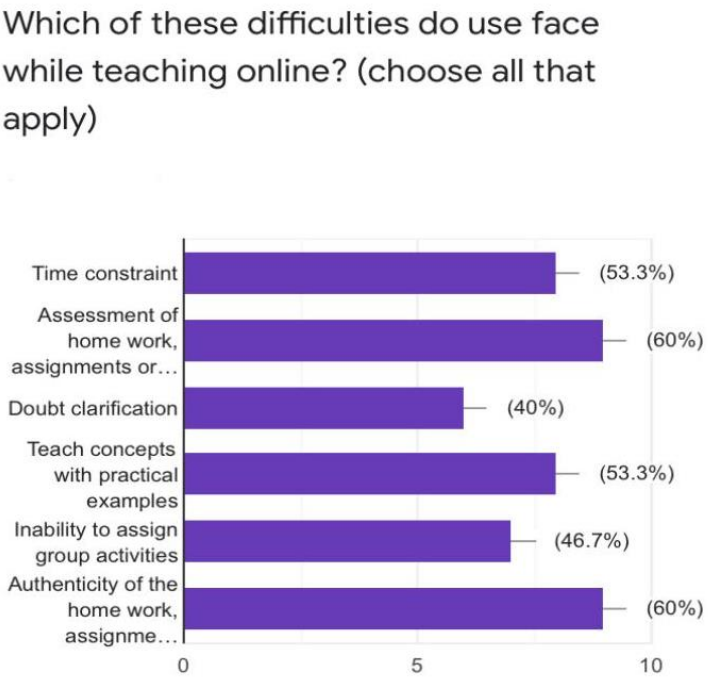

Figure 1: Teaching difficulties

From the graphs (Refer to Figs. 1 and 2), it is clear that most of the time, the drawback has been the assessment, authenticity of homework, practical classes and time constraint. We can see that 60% of the teachers found assessing homework and assignments to be highly stressful and difficult online. Checking the authenticity of homework and assignment also turns out to be hard for 60% of educators. It is not because there are not enough plagiarism-checking applications or sites but because those options are not in-built into the Google Classroom or other applications which teachers use. Likewise, 53% said that they hardly found time to conduct interesting activities or practical classes.

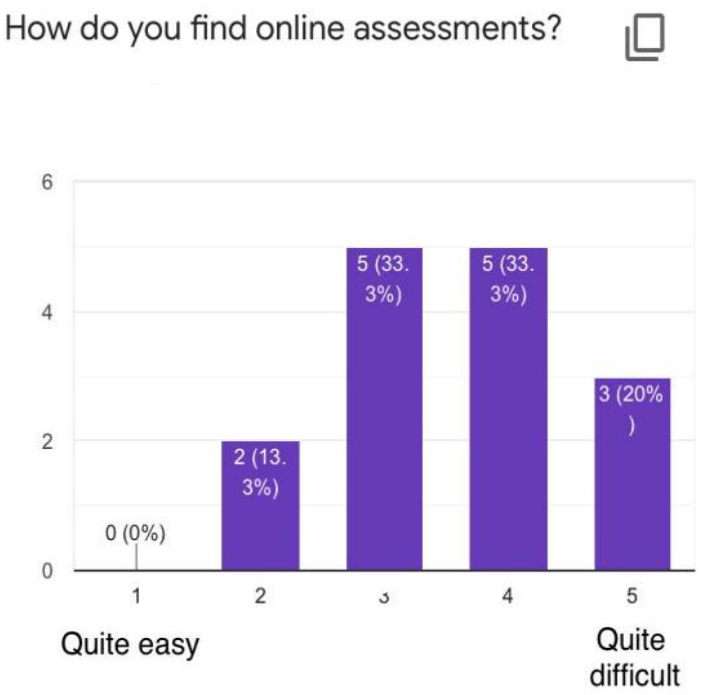

Figure 2: Online Assessments

The reason could be that they spend more time preparing the online material for teaching than before. Nor were they able to find time to provide additional guidance to the students who were slow in understanding concepts or completing assignments. The teachers nor the students have advanced notepads where they can make every minute correction using a pen on the screen. Whatever science invents should also be easily available for the users. They have made corrections in the students' work by inserting text boxes to mention the corrections, and it is a tedious procedure compared to usual notebook and paper corrections. All these are about education in the presence of a live teacher, where you have to guide yourself with the help of instructions, videos, assignments, etc. In the absence of a teacher, neither doubt clarification nor assessment happens without the supervision of a teacher.

We are looking forward to an artificially intelligent online bot that could play the role of a teacher or aid the teacher as much as possible to reduce the workload.

3.1 The Farthest use of Current Applications

To prove the lack of vital online assessment, the subject of ELT has been chosen. Of all the available applications, Proofreader has the option and sophistication to correct an essay or a paragraph, as shown in fig. 3

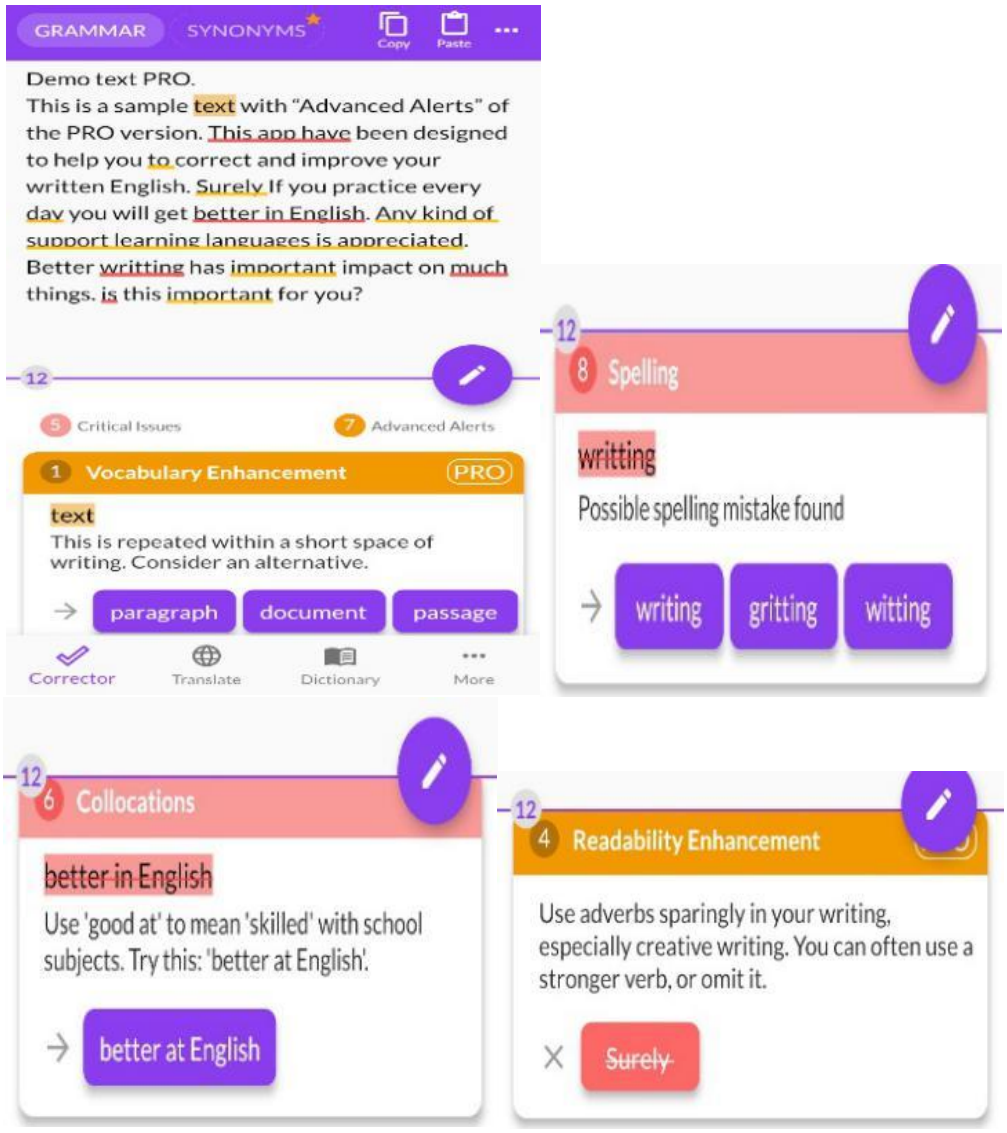

Figure 3: Online Proofreading

This image shows the demo text, which the Proofreader application has corrected. It also means that this text demo contains all the possible ways this app can correct. The only corrections it has focused on are vocabulary enhancement, grammar, readability enhancement, collocations, spelling, capitalisation and punctuation. These contribute just around 40% of language assessment. In language assessment, we must focus on multiple aspects such as context, clarity, relevance, coherence, brevity, student understanding, and background. A teacher would generally understand a student's current knowledge, the pace of learning, skills they require immediately, etc., and then plan the next lesson or classes accordingly. For this customisation to happen, more efforts must be put into devising online courses. Artificial intelligence is required for a bot to understand a student to this level before providing lessons.

4 Recommendations for Technology Developers

Some of the details which should be focused on while assessing or clarifying a doubt are:

i) **Content**: So far, no application has been designed to check the relevance of the content in an essay to the given topic. One could easily write perfectly framed grammar sentences and ace the course without understanding that content has a crucial role in any essay.

ii) **Coherence**: Unless the auto-correcting bot is advanced enough to understand the cultural references, slang words, regional aspects the student means and others, it will not be able to assess the coherence or continuity or relevance between the sentences of paragraphs.

iii) **Clarity**: One could easily beat around the bush and still be right in his/her (students') grammar. A paragraph could be filled with nonsensical but perfect sentences. One could not have delivered their point and still have completed the task. The bot will not be able to point out those as mistakes.

iv) **Background**: There are numerous applications for teaching English as a second language. But all of them include just British and American English. A person who uses grammatically correct Indian English will still be marked wrong as it does not fall under the British or American English set as the standard English in those applications. As English is a language that continues to grow, similar to American English, Indian English, Australian English, African English and others should also be taken into account while creating an application. To incorporate those, in-depth research on English needs to be done, which is quite tedious and long. Science should grow irrespective of linguistic dominations or politics. An English language learner who grows up in an Indian environment cannot be expected to have a British or American accent or slang. It is a pretty vast issue that needs to be addressed by the linguists of the current times. A device or application that aims to understand all these factors should be AI-based.

v) **Student's understanding**: Considering all the abovementioned aspects, a teacher could assess a student's level of understanding and devise his/her next lesson plans accordingly with a method that would grab the student's attention. A machine should possess high-level Artificial Intelligence to understand a student to this extent and customise its lessons. It is not an extremely futuristic thought. There are many AI-facilitated applications and devices these days. But whether they are sufficiently or to the full extent applied in education is a question mark. Learning a language does not concern writing skills alone. Reading, listening, and speaking skills are also equally important. Nevertheless, the currently available unsupervised online learning mode cannot check pronunciation, intonation, pace or fluency.

5 Views on Future Technology

According to [5], the available technological advancements have the potential to exceed mere teaching. With the assistance of Artificial Intelligence, online courses could also observe how students learn. Simultaneously, they could survey the type of tasks and thinking that hold the students' attention and the sort of problems they find tedious and dull. Following that, their learning process can be altered accordingly to fit every student's learning style. Most importantly, this could be done more accurately than any other usual face-to-face method. The examples and possibilities for the future of technology in education in an article [12]. As per the suggestion, bringing social media into education could allow learners and educators to post their thoughts, ideas, and comments in an interactive learning environment, where students could follow influencers and learn from their posts. Another idea is to create better digital simulations and models that could aid teachers teach ideas and concepts normally not demonstratable in a classroom. Epistemic games are yet another concept, where "commercial game-like simulations put students in roles like a city planner, journalist, or engineer and ask them to solve real-world problems". Innovative thinking requires more than knowledge of the right answers in a test. To become a creative professional, one should possess "real-world skills, high standards, professional values, a particular way of thinking about problems and

justifying solutions". There are a lot of other suggestions in the article that future developers could look into and gain ideas.

6 Conclusion

The problem is probably not that the technology is not advanced enough but that it has not been used adequately for assisting pedagogy. The expected advancements in technology for online education are not necessary for the future but for the current period. It is a fact that teachers and students struggled to get into the habit of using online means for education. Some still find it tedious and look forward to returning to face-to-face classes. The reason behind this is teachers' and students' lack of effective training in using technology. This has been one of the main reasons educational institutions, teachers, and many organisations stall using ICT in their daily lesson plans. But now that they all have been introduced to it, they should feel encouraged to continue this way. Regrettably, the added workloads and difficulties made them feel right about avoiding technology so far. Janssen stresses the need for teachers to be involved in planning the technology to address their instructional needs. Failing, they would stop encompassing digital technologies as soon as things return to normal (2020). This research is a reminder for the application developers to focus on the essential aspects recommended by teachers and researchers in the field of pedagogy as well. "University educators perhaps need to temper enthusiasms for what might be achieved through technology-enabled learning and develop better understandings of the realities of students' encounters with digital technology." The answer to the question of whether a machine could ever replace a teacher is not a matter of 'could' or 'could not'. The machine WILL replace a regular teacher in due time. But it is the researchers' and developers' duty to ensure that nothing has been compromised and that the replacement is for the best.

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Hybrid Controllers and Distillation Column: An Advancements Review

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Abstract: Controller is the heart of the distillation column, widely used in most industries such as petrochemical, pharmaceutical, and oil and gas. An intelligent and precise autonomous hybrid intelligent controller can achieve higher efficiency and high-grade pure output with the low-cost operation. The behaviour of the plant is often non-linear and interactive. Hence suitable models and perfect controller designs are very critical. A study has been carried out for several models and controllers. Extensive analysis has been carried out with different controllers and models for their efficacy, performance and the purity of the byproduct. A comparative study has been done with different controllers and models concerning their performance, and various challenges posed in numerous works of literature have been reviewed.

Keywords: Hybrid Controller; Distillation Column; artificial intelligence; low-cost operation; higher efficiency

1 Introduction

The Distillation Column is the most common and less expensive device for separation in most chemical, petrochemical, pharmaceutical, and oil and gas industries. The construction cost of the equipment is very economical and affordable, but the operation cost is very expensive to achieve the desired efficiency output. The controller task is critical and difficult due to the system's behaviours, such as non-linear and interactive. The chemical industries are the primary users of this distillation process, and studies of controlling methods are examined here. The variables used in the system will be dynamic characters, and the system's thermodynamics may also need improvement. Due to uncertainties and measurement delays, control system design is more difficult and complex. The distillation column's fundamental binary model is described in Fig. 1. The number of trays, condenser, and reboiler is all included. The process fluid or the mixture that wishes to be detached is passed to the feed tray, where the ingredients are separated. Each component's boiling point must be considered when sorting the ingredients into their respective categories. The column is separated into two parts, Rectifying section and the stripping section. The Rectifying section consists of gas components, and the stripping section of liquid components. The objective of the distillation column. A huge amount of heat is transmitted between trays to separate the ingredients from the composite and thus urges the designing of a precise controller for efficient and high-quality results with the economic process. Various controllers have been used in the distillation column to maintain the good quality of the composition of liquid and gas products. In this paper, we have discussed various models used and different control strategies in the distillation column.

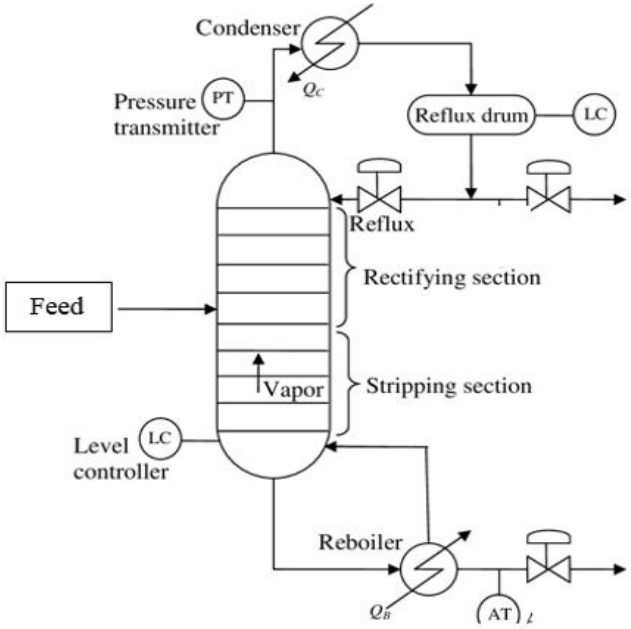

Figure 1: Distillation Column

2 Literature Survey

Due to the complexity of the process, the controlling strategies and distillation columns in industries need to provide more high-efficiency results. All these complexities must be considered while designing the control system. The survey's main objective is to propose a framework for an automated control system to perform efficiently and precisely. Researchers are focusing on intelligent controllers instead of conventional controllers because of their accurate results with less cost. Some researchers designed hybrid controllers using intelligent and conventional controllers for the best performance.

3 Conventional Controller

In earlier days, most industries used distillation columns with conventional controllers like PI/PID. But the results were different than expected. Then multi-loop control system with a sequential design was used in further developments [2]. After this development's success, people researched automated tuning parameters, and soon the automated tuning of PID controller parameters was invented [3].

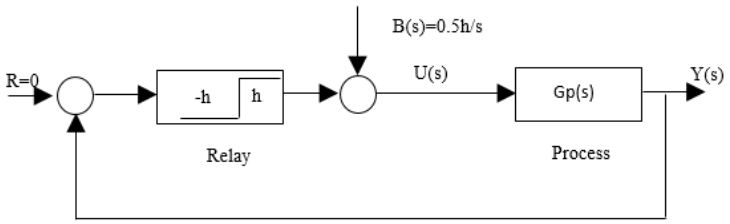

Figure 2: Biased relay model

Jia Shiu [4] highlighted the significant formula for designing multivariable decoupling control and a serially multi-loop proportional integrated/proportional integrated derivative controller. Fig.2 shows that model of biased relay and tuning formula is developed [4, 5] for tuning all the loops using the single loop method. This model is more suitable if the atmosphere is multivariable and the process dynamics vary ad sets. The meekest controller plan and its effective circle disappointment conduct limit are the most identifiable benefits of the many-circle SISO system. A more-circle framework is partitioned into identical single circles for planning reasons. Hsiao-Ping Huang [6] festered the structure of more-circle controllers

into the plan for controllers of identical and autonomous circles. An effective open-loop process was designed for every single loop. Using these designed effective open-loop process data, controller configuration is done legitimately and self-rulingly, free of the controller elements of different loops. The model-oriented method was to design a proportional integrated and proportional integrated derivative controller.

Simple parametric models are used to calculate the tuning method. This method is straightforward and compelling for planning multi-loop Proportional integral derivative controllers, essentially many input and output processes with low measurements. Process having higher measurements, the plan should be more regular because of normal displaying mistakes in the computation. The connection between I/O factors continued as the fundamental trouble was looked at in the more loop control algorithm plan for more process parameters. Truong invented [7] a new method for the autonomous design of multi-loop PI/PID controllers. A new concept of an effective open-loop transfer function has been developed to convert a multi-loop controller into multiples of a single independent loop with identical parameters [8, 9]. The effective open loop transfer function is further considered a low-order equation in the model reduction technique [7]. With the outcome of an effective open loop transfer function model, each controller with the individual loop is independently formed by engaging the IMC-based proportional integral derivative tuning method for SISO systems.

The outcomes found that the effective open loop transfer function and the reduced effective open loop transfer function proportionally approximate the active coupling between loops with the real effective open loop transfer function. In the plant model, this method always provides an astounding execution with a quick and well-proportioned time reaction and holds powerful stability. The frequent input and single output tuning method currently used in factories is a delayed process and is not acceptable for a multivariable control system. A software program has been developed to assist people in designing the multi-loop PID controller parameter. Then the parameters were calculated using a dynamic model of the many-parameter system and a controlled non-linear optimization system. This technique was accepted by most industries and found successful. Additionally, if the interaction rate is higher, many inputs and outputs based on model work have successfully tuned many conventional controllers. Huge gain and dead time sturdiness margins promise that the loop will remain unchanging and flawlessly checked even for non-linear systems [10].

4 Model-Based Controller

Inferential control is one of the most famous approaches for controlling online process control. A predictive controller model is effective only if there is a self-motivated process model, but a dynamic process model in PIC is not required. This model will use the restrained variables as a response variable. A new inferential system, PIC [5], was developed. This PIC is to actualize input parameters with a feed frontward impact. The point-by-point dynamic recreation results are given in the table. 1, demonstrated that the foreseen PIC with cascade course control works strikingly better than other control systems. Adaptive controllers are used for systems that are neither arranged in a straight line nor stationary because the requirement is to adjust the deviation in the balance of the parameter attributes. To achieve the result, using adaptive controllers allowed for making the necessary adjustments. By attempting the procedure, the controller must change the model, which is plant-based. Vu Trieu Minh [11] found three phases with his model by doing the simulation: fundamental non-linear structure, linear structure, and linear structure with decreased order. For the model orientation, MRAC is useful to control the linear model, which will be picked as the orientation model in decreasing order. Figuring the straight versatile controller from the physical laws engaged with the procedure. There was no reference to the genuine framework distinguishing pieces of evidence that established the trial creation factors, explicitly planned structures, boundary estimation, or framework approval.

Table 1: Pic with cascade work performance

Interval	1	2	3
IC			
B	6.940	6.880	6.820
D	7.150	7.110	7.090
Total	14.090	13.990	13.910
PIC (α = 11 mins)			
B	6.620	6.600	6.560
D	6.540	6.430	6.420
Total	13.160	13.030	12.980
Idyllic composition control			
B	5.150	0	0
D	7.770	0	0
Total	12.920	0	0

5 Intelligent controller

However, PMC is a strong method for the control of the multivariable design. A few variables confine the possible utilization of MPC. The use of MPC in many parameter designs will aid in providing expected postponements in extensive non-linear arrangements. All of these constraints are overcome by employing fuzzy model predictive control. R.Sivakumar presented FMPC [12] in 2010. The fuzzy model is used for non-linear MIMO distillation columns. The required strategy is to use it in low-uniqueness, multivariable, and uncertain control procedures. An adaptive system, which is a comprehensive system, is required to accomplish this. Designing an MPC controller is troublesome because of its nature of non-linear characteristics. IC is a dominant tool to assess the system characteristics [13] to find the result of the system. The neural network model is working to anticipate future outputs for most of the controller models. This model is basic while having an excellent limit for assessing the dynamic system. In 2018, Simon Diaz et al. found [1] the best controller for batch and continuous processes. The best controller for a batch process is PID-IMC with filter gave the best result in the laboratory model because of the best disturbance rejection. For continuous process, it found that artificial neural network NARMA-L2 performance was impressive considering the control performance, robustness of control action and difficulty of implementation and design. They also compared with IMC, Gain Scheduling, Expert, Fuzzy (Mamdani and Sugeno) and Neural-Network. Differential-algebraic equations (DAEs) have been used in the non-equilibrium liquid–vapour. The DAE system is shown to be of index one. Internal entropy production for the irreversible flash drum is presented as a Lyapunov function candidate to extend the stability analysis [14]. In 2019, Egdala Sarath et al. developed a lab-scale binary column and used a PI controller with an extended predictive-based tuning method [15]. The controller parameters are formulated from the summation of instantaneous controller changes and the rise time of EPC's closed-loop unit step response. The application of this novel design has been demonstrated through benchmark and experimental models of the distillation process. A new model has been developed by Rasmussen [17], which is called the cyclic method of the distillation column. From that limit, the cycle was developed by Pranav [16], which has given excellent results [18-20].

6 Conclusion

Over the evaluation of controller designing for distillation column from conventional to model based to intelligent controller. A review of various control plans utilized for the distillation column is finished. A review is examined broadly. It has been discovered that hybrid controllers, like intelligent controllers combined with model-based control, provide excellent output. The future work is to implement the Genetic Algorithm with the conventional controller and analyze the data and performance.

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Mathematical Modelling of Benard-Marangoni Ferroconvection's Linear Stability in the Presence of Vertical Throughflow

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Abstract: Hypothetically, the stability study of throughflow influence on Bénard-Marangoni ferroconvection is examined. The top of the fluid layer is assumed to be free. The surface tension effect that depends on temperature is supposed to be non-deformable and subject to general thermal boundary conditions. The bottom of the fluid layer is assumed to be rigid with a fixed temperature. An analytical solution to the issue is achieved by using the Regular perturbation approach. The findings show that the stability characteristics are independent of the throughflow direction. The ferroconvection is further delayed by Peclet number Q. Convection is accelerated by raising the magnetic number Rm and the Prandtl number Pr. It is observed that the Bénard-Marangoni ferroconvection is unaffected by M3, which represents the non-linearity of fluid magnetization.

Keywords: Bénard-Marangoni Ferroconvection; Throughflow; Regular Perturbation Method.

1 Introduction

Synthetic magnetic fluids or ferrofluids are the colloidal suspensions of single domain nanoparticles (diameter is 3-10nm) of magnetite in non-conductive liquids such as water, heptane, kerosene etc. Because of their magnetic and liquid properties, these fluids came out as dependable materials for solving complex engineering problems. The authors [1], [2], [3] and many others provided an overview of this interesting topic with applications authoritatively. The study of convective instability in the ferrofluid layer was initiated by [4], and it was widely continued over the years (see references [5] to [11]).

Suppose the upper layer of the ferrofluid is open to the atmosphere. In that case, the instability is due to the combined effect of surface tension and buoyancy forces, known as Bénard-Marangoni ferroconvection. The convective instability due to these effects attracted the researchers. To begin with, the nonlinear and linear stability of buoyancy and surface tension effects in the ferrofluid layer is studied by [12]. The combination of Rosensweig and Marangoni instabilities by taking two semi-infinite immiscible and incompressible viscous fluids of infinite lateral level is studied by Weiplepp and Brand [13]. The authors [14] have explained the cause of initial temperature gradients on Marangoni ferroconvection to understand the control of ferroconvection. The instability of Bénard-Marangoni ferroconvection in the presence of an applied magnetic field due to various effects like MFD viscosity, internal heat generation and temperature-

dependent viscosity was demonstrated by the authors [15], [16] and [17]. The Benard-Marangoni ferroconvection in a rotating ferrofluid layer with MFD viscosity was theoretically explained by [18].

The effect of throughflow on convection also draws considerable attention in the literature. The author was the first person who studies the instability in a porous intermediate by considering the case in which the convective effects rule the basic state temperature field on the throughflow. Later studied linear stability for small throughflow with both conducting boundaries, which are rigid and insulating. These authors showed that the convection is stabilized in the presence of throughflow. Authors [19] investigated the power of throughflow on convective instability in a porous medium by assuming that the boundaries are conducting and either permeable or impermeable. These works offered a physical explanation for the above situation and showed that destabilization occurs. The exact analysis of the throughflow effect on Marangoni convection was demonstrated. Authors [19] have theoretically explained the effect of throughflow on ferroconvection in a porous medium and explained double diffusive oscillatory convection with non-uniform heating effects in the porous medium. A similar study with variable viscosity and throughflow for ferromagnetic fluids was studied.

All the investigations above are limited, and no attempts have been made to understand the throughflow effect on control of Benard-Marangoni ferroconvection despite its significance in ferrofluid technology. Hence the present study examines the throughflow effect on Benard-Marangoni ferroconvection in the presence vertically applied magnetic field, and its nomenclatures are shown in Table 1.

Table 1: Nomenclature

$\vec{q}$	Velocity vector	ρ_0	Reference density at T_0
p	Pressure	k_t	Thermal conductivity
$\vec{H}$	Magnetic field intensity	χ	Magnetic susceptibility
$\vec{M}$	Magnetization	K	Pyromagnetic co-efficient
$\vec{B}$	Magnetic induction	ϕ	Magnetic potential
μ	Dynamic viscosity	∇^2	Laplacian
α_t	Co-efficient of thermal expansion	W	The amplitude of the vertical component of velocity
α	wave number	Θ	Amplitude of temperature
Ma	Marangoni number	Φ	The amplitude of the magnetic potential
T_b	Basic temperature	M_3	Non-linearity of magnetization parameter
T	Temperature	$\bar{T}$	Average temperature
∇_1^2	Horizontal Laplacian operator	Q	throughflow
M_1	Magnetic number	Pr	Prandtl number
R_t	Thermal Rayleigh number	R_m	Magnetic Rayleigh number

2 Formulation

We consider an inactive ferrofluid layer initially with an invariable throughflow of magnitude w_0 and gravity ($\vec{g} = -g\hat{k}$) associated in the direction with a vertically applied magnetic field H_0 as presented in the physical configuration. The bottom layer of fluid is taken as rigid, whereas the free upper surface is flat and non-deformable, where the surface tension effect is considered as $\sigma = \sigma_0 - \sigma_T(T - T_0)$ whereσ_0 is unperturbed value and $-\sigma_T$ rate of change of surface tension with temperature. The coordinates (x, y, z) are placed at the bottom layer with *z*–axis vertical as shown in figure 1.

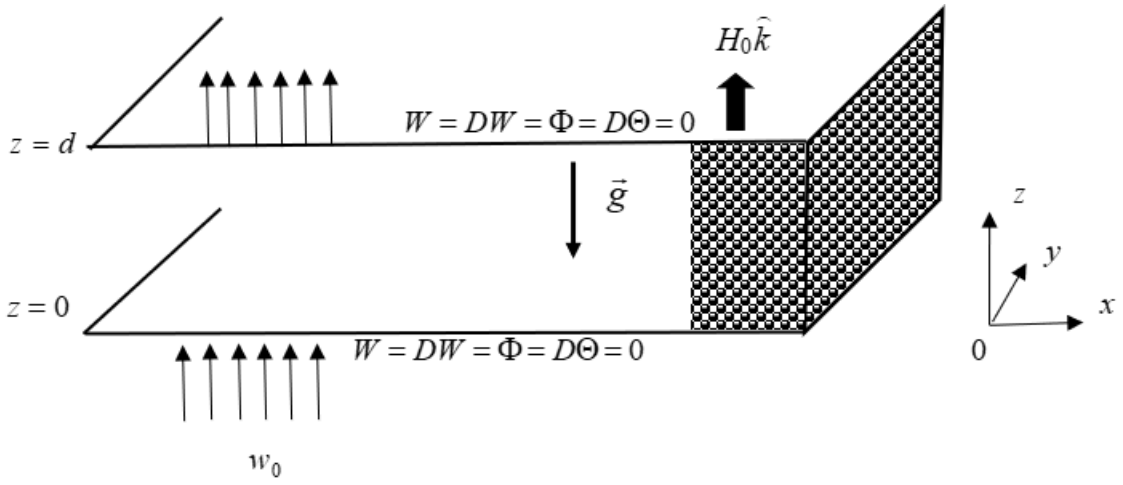

Figure 1: Physical Configuration

The principal equations of the Boussinesq approximation are

$$\nabla \cdot \vec{q} = 0 \tag{1}$$

$$\rho_0 \left[\frac{\partial \vec{q}}{\partial t} + (\vec{q} \cdot \nabla)\vec{q}\right] = -\nabla p + \mu \nabla^2 \vec{q} + \rho_0[1 - \alpha_t(T - T_0)]\vec{g} + \nabla \cdot (\vec{B}\vec{H}) \tag{2}$$

$$A\frac{\partial T}{\partial t} + (\vec{q} \cdot \nabla)T = k_t \nabla^2 T \tag{3}$$

$$\nabla \cdot \vec{B} = 0, \nabla \times \vec{H} = 0 or \vec{H} = \nabla\phi \tag{4a, b}$$

$$\vec{B} = \mu_0(\vec{M} + \vec{H}) \tag{5}$$

$$\vec{M} = [M_0 + \chi(H - H_0) - K(T - \bar{T})]\left(\frac{\vec{H}}{H}\right) \tag{6}$$

We assume that the fundamental state is inactive, and its solution is:

$$\overrightarrow{q_b}(z) = w_0\hat{k}$$

$$p_b(z) = p_0 - \rho_0 gz - \frac{\rho_0\alpha_t g\Delta T(w_0 z - \kappa e^{w_0 z/\kappa})}{w_0(1-e^{w_0 d/\kappa})} - \frac{\mu_0 K\Delta T e^{w_0 z/\kappa}(2-e^{w_0 z/\kappa})}{2(1+\chi)(1-e^{w_0 d/\kappa})^2}\left[M_0 + \frac{K\Delta T}{(1+\chi)}\right]$$

$$T_b(z) = T_0 - \Delta T\left[\frac{1-e^{w_0 z/k}}{1-e^{w_0 d/k}}\right]$$

$$\overrightarrow{H_b}(z) = \left[H_0 - \frac{K\Delta T}{1+\chi}\left(\frac{1-e^{\frac{w_0 z}{k}}}{1-e^{\frac{w_0 d}{k}}}\right)\right]\hat{k}$$

$$\overrightarrow{M_b}(z) = \left[M_0 - \frac{K\Delta T}{1+\chi}\left(\frac{1-e^{\frac{w_0 z}{k}}}{1-e^{\frac{w_0 d}{k}}}\right)\right]\hat{k} \tag{7}$$

Where, $\hat{k}$ is a unit vector along z - axis, and b denotes the fundamental state. Due to throughflow, temperature distribution at the fundamental state is nonlinear and has an intense effect on stability. But in the absence, the distribution at the basic state is linear and expressed as

$$T_b(z) = T_0 - \frac{\Delta T}{d}z$$

To examine the stability, we give small perturbations, as shown,

$$[\vec{q}, p, T, \vec{H}, \vec{M}] = [\omega_0\hat{k} + \vec{q}', p_b(z) + p', T_b(z) + T', \vec{H}_b(z) + \vec{H}', \vec{M}_b(z) + \vec{M}'] \tag{8}$$

where, $\vec{q}', p', T', \vec{H}, \vec{M}'$ are small perturbation quantities.

Substituting (8) into (2), linearizing and operating curl twice to eliminate pressure term, a component of z in the subsequent equation is

$$\left[\rho_0\frac{\partial}{\partial t} - \mu\nabla^2\right]\nabla^2 w = \rho_0\alpha_t g\nabla_1^2 T + \frac{K\Delta T w_0 e^{w_0 z/\kappa}}{\kappa(1+\chi)(1-e^{w_0 d/\kappa})}\left[\mu_0(1+\chi)\frac{\partial}{\partial z}\nabla_1^2\phi - \mu_0 K\nabla_1^2 T\right] \tag{9}$$

Substituting equation (8) in equation (3) and linearizing, we get

$$A\left(\frac{\partial T}{\partial t}+w_0\frac{\partial T}{\partial z}\right)=k_t\nabla^2 T-\frac{{w_0}^2\Delta T}{\kappa(1-e^{w_0 d/\kappa})}e^{w_0 z/\kappa} \quad (10)$$

Equation (6), after substituting (8), may be written as

$$\left(1+\frac{M_0}{H_0}\right)\nabla_1^2\phi+(1+\chi)\frac{\partial^2\phi}{\partial z^2}-K\frac{\partial T}{\partial z}=0 \quad (11)$$

We assume that the stability exchange principle holds good, and hence we considered normal mode expansion as

$$\{w,T,\phi\}=\{W(z),\Theta(z),\Phi(z)\}e^{i(lx+my)} \quad (12)$$

Where, l,m represents wave numbers in x and y direction.

We substitute equation (12) into equations (9) to (11), non-dimensionalizing by choosing

$$(x*,y*,z*)=\left(\frac{x}{d},\frac{y}{d},\frac{z}{d}\right),W*=\frac{d}{\nu}W,\Theta*=\frac{\kappa}{\beta\nu d}\Theta,\Phi*=\frac{(1+\chi)\kappa}{K\beta\nu d^2}\Phi \quad (13)$$

we obtain

$$(D^2-a^2)^2W-MD(D^2-a^2)W=-R_m a^2 f(z)(D\Phi-\Theta)+R_t a^2\Theta \quad (14)$$

$$(D^2-a^2)\Theta-QD\Theta=f(z)W \quad (15)$$

$$(D^2-a^2M_3)\Phi-D\Theta=0 \quad (16)$$

where, $M=Q/Pr$ and $f(z)$ is given by,

$$f(z)=-\frac{Qe^{Qz}}{e^Q-1} \quad (17)$$

The following are the boundary conditions chosen to analyze the stability:

$$W=DW=\Phi=D\Theta=0 \qquad z=0$$

$$W=D^2W+Maa^2\Theta=D\Phi=D\Theta=0 \qquad z=1 \quad (18a,b)$$

3 Solution to the Problem

The Regular perturbation technique is applied to extract the decisive eigenvalues with perturbation parameter a (wave number). As a result, we expand W,Θ and Φ in powers of a^2 as

$$\{W(z),\Theta(z),\Phi(z)\}=\{W_0,\Theta_0,\Phi_0\}+a^2\{W_1,\Theta_1,\Phi_1\}+-------- \quad (19)$$

Substituting (19) into (14) to (16) and using the conditions (18a, b), gathering the coefficients of terms of order zero, we get

$$D^4W_0-MD^3W_0=0 \quad (20a)$$

$$D^2\Theta_0-QD\Theta_0-f(z)W_0=0 \quad (20b)$$

$$D^2\Phi_0-D\Theta_0=0 \quad (20c)$$

Solving the above equations, we obtain the solution to equations of order zero as

$$W_0=0,\Theta_0=1 and \Phi_0=0 \quad (21)$$

Similarly, equations of order one are,

$$D^4W_1-MD^3W_1=R_t[1+M_1f(z)] \quad (22a)$$

$$D^2\Theta_1-QD\Theta_1=1+f(z)W_1 \quad (22b)$$

$$D^2\Phi_1-D\Theta_1=0 \quad (22c)$$

Solving equation (22a), we get

$$W_1=c_1+c_2z+c_3z^2+c_4e^{Mz}-\frac{z^3R_t}{6M}+\frac{RM_1e^{Qz}}{(1-e^Q)(Q^3-MQ)} \quad (23)$$

where, $M=Q/Pr$ and $c_i's$ are constants of integration and are given by

$$c_1 = \frac{1}{\gamma_2}\left[-\frac{R_t}{3M} + \frac{Ma}{2}\right] - \gamma_3 - \gamma_1,$$

$$c_2 = \frac{-M}{\gamma_2}\left[-\frac{R_t}{3M} + \frac{Ma}{2}\right] - M\gamma_3 - Q\gamma_1,$$

$$c_3 = \frac{R_t}{2M}\left[1 + \frac{M^2e^M}{3\gamma_2}\right] - \frac{Ma}{2}\left[1 + \frac{M^2e^M}{2\gamma_2}\right] - \frac{1}{2}[Q^2e^Q\gamma_1 + M^2e^M\gamma_3] \text{ and}$$

$$c_4 = \frac{1}{\gamma_2}\left[-\frac{R_t}{3M} + \frac{Ma}{2}\right] + \gamma_3$$

where, $\gamma_1 = \frac{RM_1}{(1-e^Q)(Q^3-MQ^2)}$

$$\gamma_2 = 1 - M - \frac{M^2e^M}{2} + e^M \quad \text{and}$$

$$\gamma_3 = \frac{\gamma_1}{\gamma_2}\left[1 + Q + \frac{Q^2e^Q}{2} - e^Q\right]$$

Integrating (22b) with respect to z, taking limits from 0 to 1, and using fundamental temperature conditions, we get

$$\int_0^1 f(z)W_1 dz = -1 \tag{24}$$

Substituting for W_1 from (23) and $f(z)$ from (17) into (24), carrying out the integration under the limiting conditions as $\to 0$, leads to the expression.

$$R_{tc} = \frac{20(48-Ma_c)}{3(1+M_1)} \tag{25}$$

Further, as $Ma_c = 0$ Eq. (25) reduces to the form

$$R_{tc} = \frac{320}{1+M_1} \tag{26}$$

This coincides with the expression of R_{tc} by [28]. For $M_1 = 0$ equation (26) gives $R_{tc} = 320$, which is the precise value for ordinary viscous fluids.

Further, if $R_{tc} = 0$ in equation (26), we obtained $Ma_c = 48$, the exact value of the critical Marangoni number for ordinary viscous fluids [20].

4 Experimental Results

The approach used in this paper successfully performed a two-stage classification of bugs reported from the execution of Chef cookbooks. Comparing various machine learning techniques and deep learning algorithms found that the deep learning CNN algorithm gives the highest accuracy score. Since the second classification layer depends on the first layer, having a high-accuracy model in the first layer is the most important aspect. Fig. 2 compares various classifiers in the first stage of classification. The graph in Fig. 2 shows that CNN achieves the highest accuracy score of 97.73 percent compared to the other algorithms, whose accuracy score is less than 90 percent for the same data. The naïve Bayes algorithm yielded an accuracy of 85 percent. The decision tree algorithm classified 76 percent accurately compared to the 86 percent of Random Forest. The performance of SVM surpassed that of the other machine learning algorithms with an accuracy of 87 percent.

The critical eigenvalues R_{tc} and Ma_c for various values of $Rm, Pr,$ and $|Q|$ are computed analytically. It is found that the stability characters of the system are free of M_3. Significant features of these parameters are shown graphically in Figs. 2-8.

In the existence of throughflow, magnetic field, magnetization and temperature at basic state will diverge from linear to nonlinear along a vertical direction, which has considerable influence on the stability (see Fig. 2). To review the impact of throughflow on ferroconvection, the dimensionless fundamental state distributions $\tilde{T}_b(z)$,$\tilde{H}_b(z)$ and $\tilde{M}_b(z)$ for diverse values of $|Q|$ are plotted graphically in Fig 2. From the figure, it is evident that increasing throughflow direction results in hefty deviations in these scatterings which in turn augment the instability in the ferrofluid layer.

In Figures 3 and 4, we have studied the convective instability only due to buoyancy forces. Fig. 3 and 4 represent the deviation of R_{tc} versus $|Q|$ for diverse values of Rm (see Fig.3) and Prandtl number Pr (see Fig. 4) in the absence of surface tension effects. From fig. 3 it is clear that as Rm increases R_{tc} decreases as expected and makes the system more unstable. This is because additive support of destabilizing magnetic force enhances the onset of ferroconvection. An analogous state prevails in the absence of thermal buoyancy forces (i.e.$R_t = 0$), and this case corresponds to Marangoni ferroconvection (see Fig. 5). Further, the direction of throughflow does not change the system stability system and as $|Q|$ increases both R_{tc} and Ma_c also increase. Fig.4 presents the deviation of R_{tc} versus $|Q|$ for various values of Pr. The results show that in the absence of surface tension force, increasing in Prandtl number Pr does not significantly affect the onset of ferroconvection. Fig. 6, shows that as Pr increases, and Ma decreases. Hence, its effect is to hasten the ferroconvection.

Figure 7 shows convective instability with both buoyancy and surface tension forces. A plot R_{tc} versus Ma_c is shown in Fig.7 for different M_1 with $|Q| = 5$ and $Pr = 10$. From the graphical representation, it is clear that there is a strong coupling between R_{tc} and Ma_c. When the surface tension forces are strong, the buoyancy force becomes negligible and vice-versa. Also, we observe that as M_1 increases, the destabilizing magnetic force also increases and hence hastens the ferroconvection. Further, the curves for different M_1 converge to $Ma_c = 48$ when $R_{tc} = 0$ demonstrating that it doesn't affect Marangoni ferroconvection. Theoretically, the results support this behaviour (refer (26)). Fig. 8 shows that as $|Q|$ increases both Ma_c and R_{tc} also increases. From the figure, we observe that increasing $|Q|$ Stabilizes the system. Thus, it is observed that adjusting vertical throughflow can control the onset of ferroconvection.

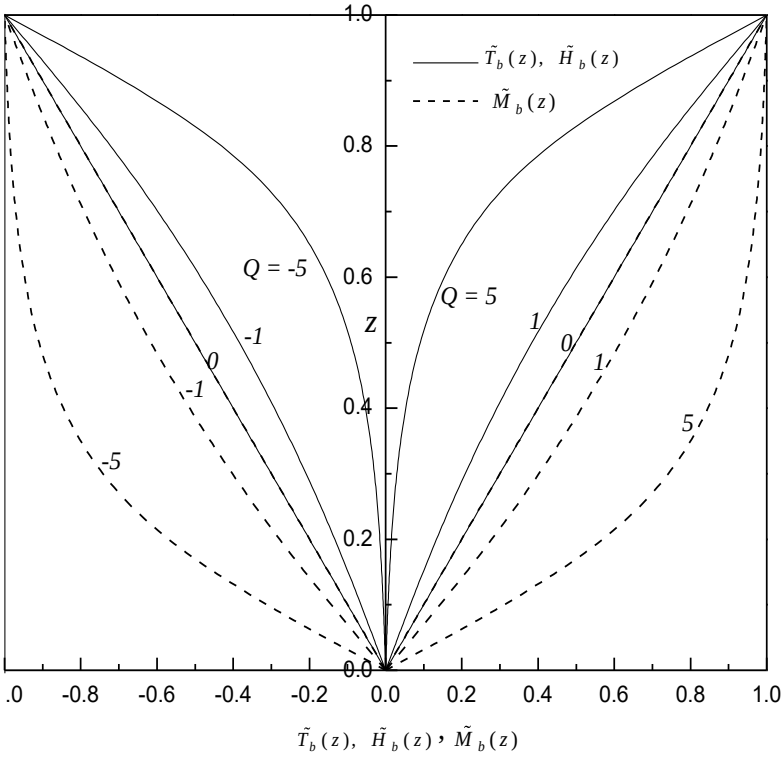

Figure 2: Distribution of basic profiles for different values of Q

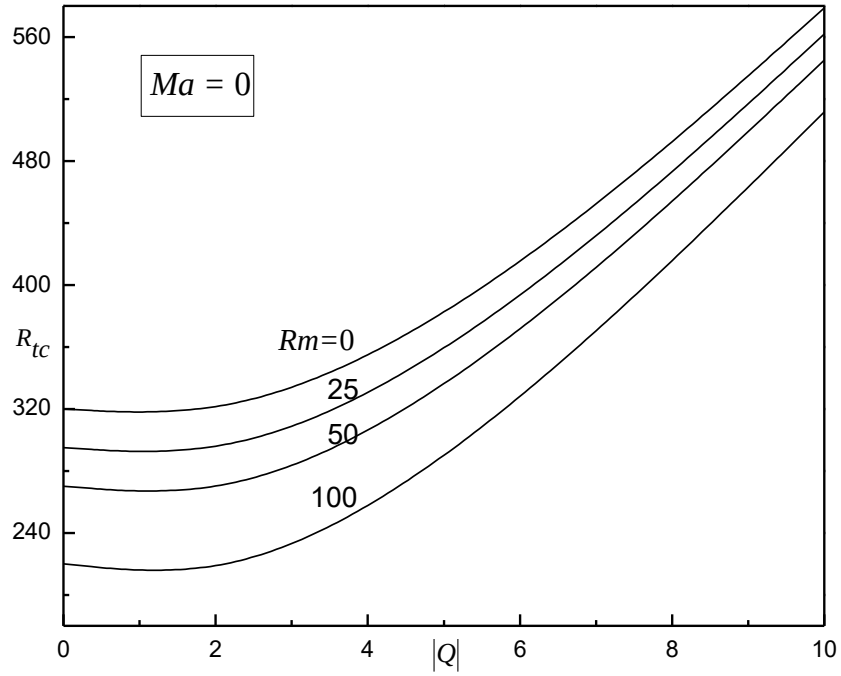

Figure 3: Variation of R_{tc} against $|Q|$ for different values of Rm

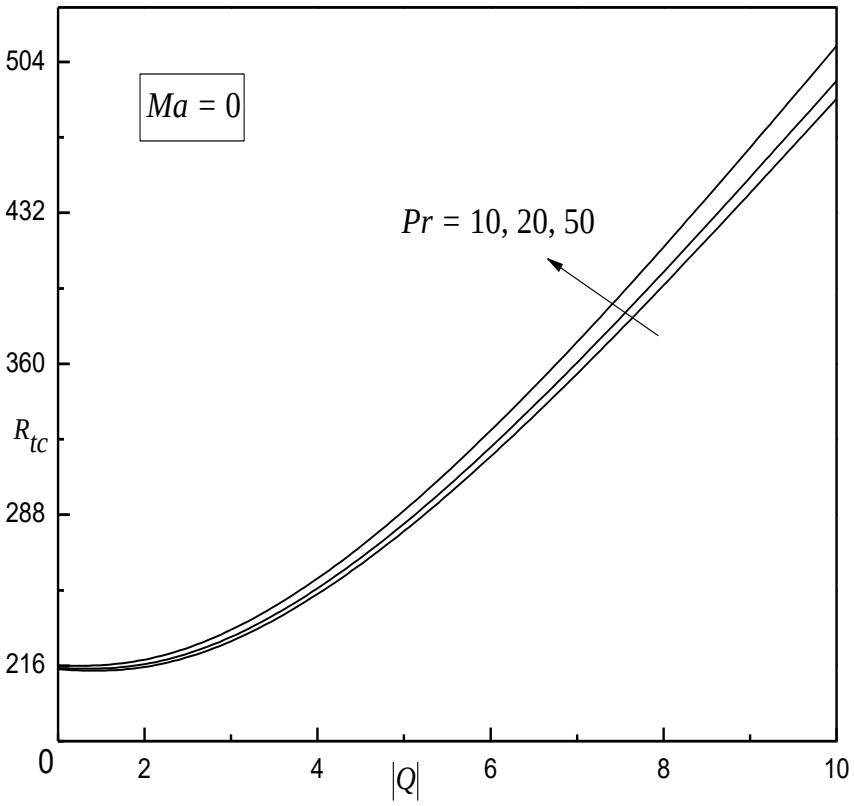

Figure 4: Variation of R_{tc} against $|Q|$ for different values of Pr

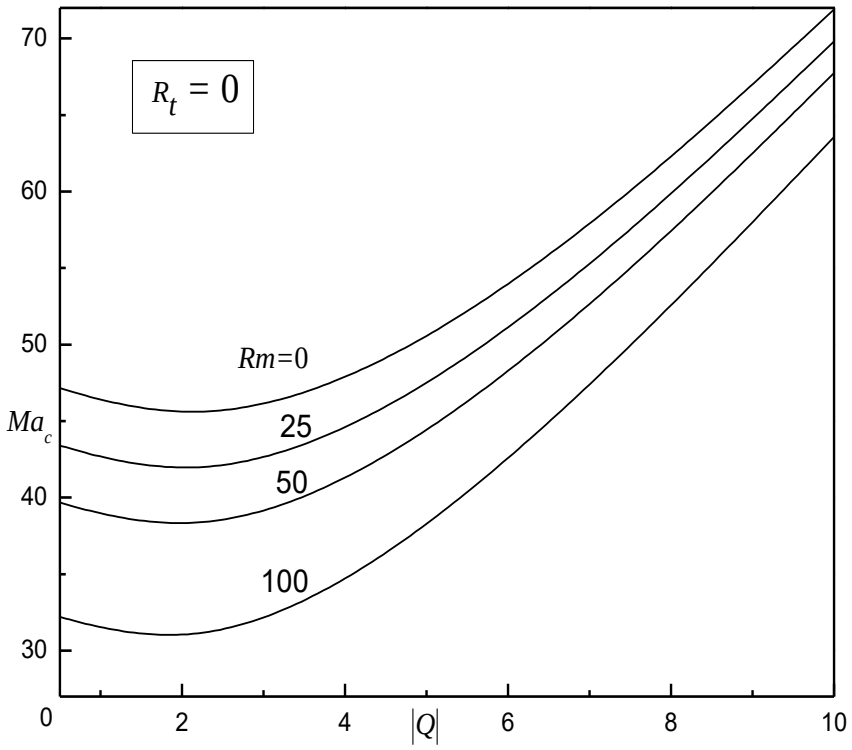

Figure 5: Variation of Ma_c against $|Q|$ for different values of Rm

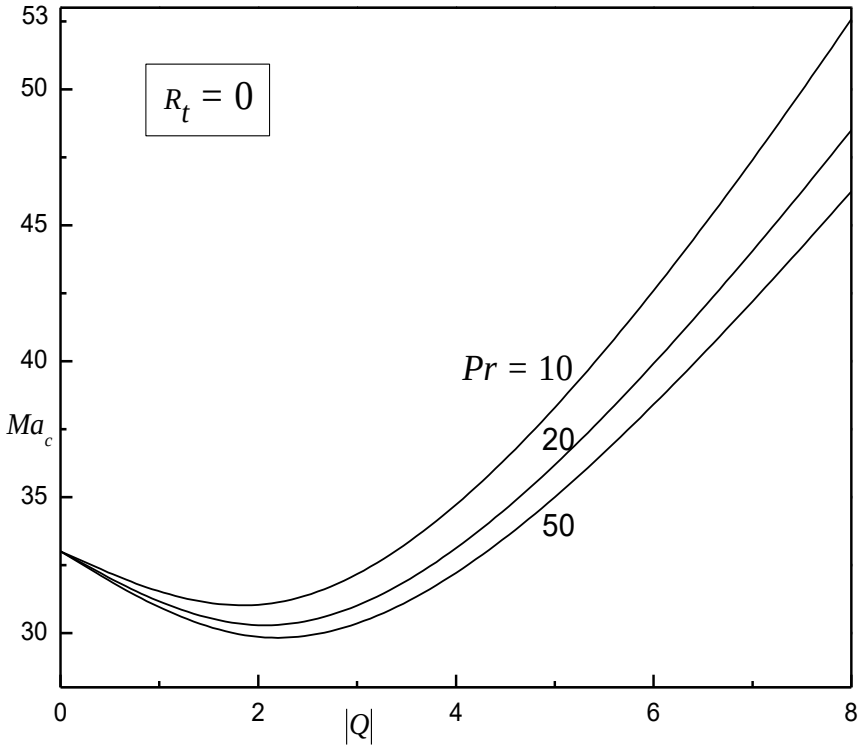

Figure 6: Variation of Ma_c against $|Q|$ for different values of Pr

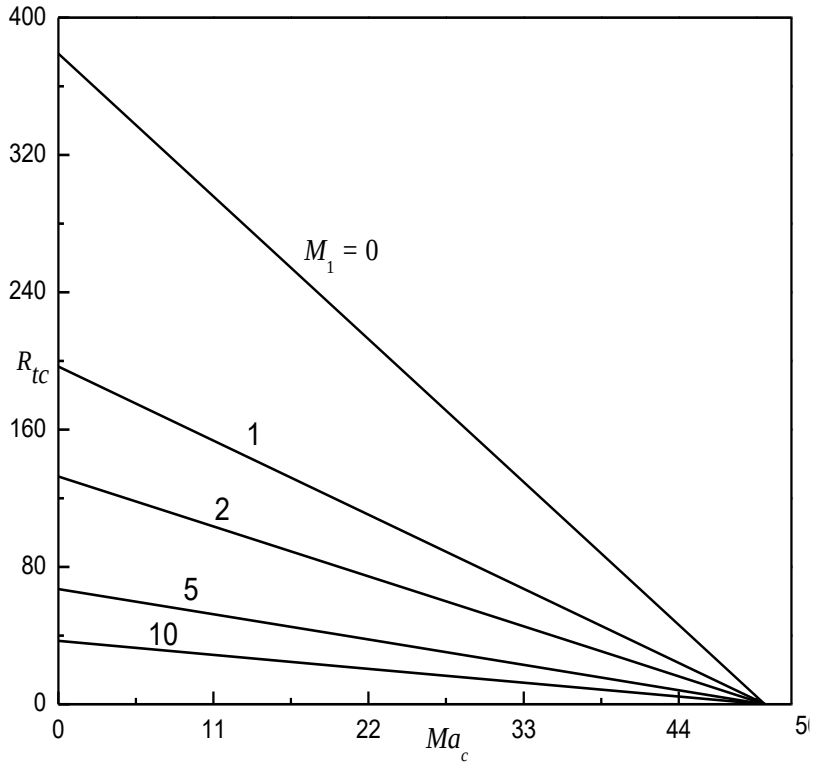

Figure 7: Variation of R_{tc} against Ma_c for different values of M_1 when $|Q| = 5, Pr = 10$.

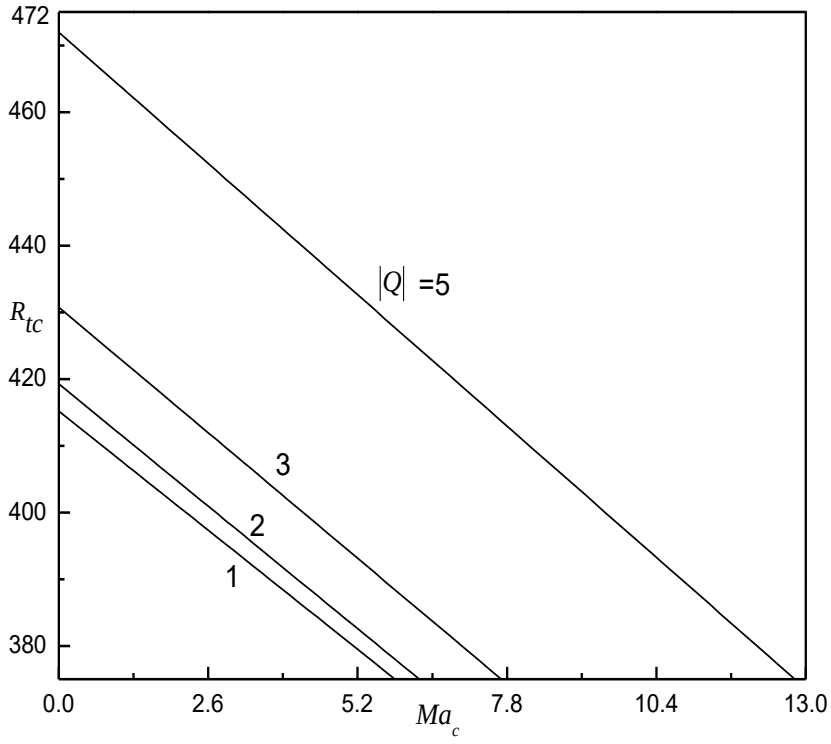

Figure 8: Variation of R_{tc} against Ma_c for different values of $|Q|$ when $Pr = 10, Rm = 100$.

5 Conclusion and Future Scope

From the above study, we can conclude,

(i) The basic state distributions $T_b(z), \overrightarrow{H_b}(z)$ and $\overrightarrow{M_b}(z)$ are nonlinear in the presence of vertical throughflow $|Q|$ and it effect the stability significantly.

(ii) The increase in the values of Rm and Pr is to speed up the ferroconvection. While, M_3 does not have any effect on the ferroconvection.

(iii) The effect of Peclet number Q, depending on throughflow, delays the inception of ferroconvection.

(iv) Magnetic and buoyancy forces strengthen one another and augment the ferroconvection.

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A Comprehensive Logo Dataset for Deep Learning-Based Classification for Content Piracy

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Abstract: Given the online infrastructure we have today, content piracy is growing and spreading quickly across various countries. These internet infrastructures' main goal is to offer a platform for delivering permitted and lawful material from the service provider to the end user. Over time, pirates have used the digital online infrastructure system to duplicate and retransmit the original content using the same infrastructure. Visual analytics of the broadcast logo is one way to determine if the content is pirated. The construction of a new scalable TV broadcast channel logo corpus spanning diverse geographies and genres, as well as the publically available datasets of TV broadcast channel logos (Indian channels), will be covered in this work. A total of 450 TV broadcast channel logos in various regional languages have been gathered for genres including (Sports, Movies, Kids and Cartoons, Entertainment etc.) Each logo is exposed to various data augmentation approaches to increase the logo corpus and boost the deep learning logo classification. This logo corpus with the cutting-edge object identification algorithm YOLO v2 is also covered in this study, along with the recognition of several logo classes. Results from experiments are documented for various inference logos with various pixel contexts.

Keywords: Data augmentation; Deep learning; Object detection; TV broadcast; Channel logo corpus; YOLO.

1 Introduction

In computer vision and pattern recognition, logo detection and classification have been the key research areas. Logo detection talks about identifying the location of the desired logo in the given input image. This is challenging as the desired logo of interest needs to be narrowed among different objects in the given input image. Logo classification talks about categorising the identified logo into a certain logo name. A wide range of applications spread across different domains where this logo detection and classification are applied [1]. Product recognition [2], vehicle logo detection and classification, social media brand image monitoring [3], copyright infringement identification, and recommendations for TV broadcast channels. The composition of logo objects will be a combination of text and graphic symbols. The logo contained in the real image can vary based on factors like size, shape, texture, transformations, rotation, contrast and occlusion. Hence the complexity of logo detection and classification in these cases will eventually increase.

Content piracy is causing a big impact on broadcasters and content providers, decreasing the value of

live programs (Like sports and entertainment). Considering the demand for this online content, there is an increase in personalised online content allowing users to choose their programs of interest. Because of huge demand, this will open the doors for pirates to act and work on content piracy and retransmit the content illegally. Figure 1 provides a high-level diagram of the flow of illegal content that pirates use. This includes setting up a hosting site where the address to stream transcoded media segments is placed, followed by a linking site that publishes and attracts users for access to content piracy. Pirates use powerful social media platforms to publish pirate links. One of the other methods to publish these pirate links could be through google ads. Using these pirate links, the re-encoded pirate content can be streamed at a cheaper price and thereby signalling a serious threat to the business related to content generation and distribution (Praveen, 2020).

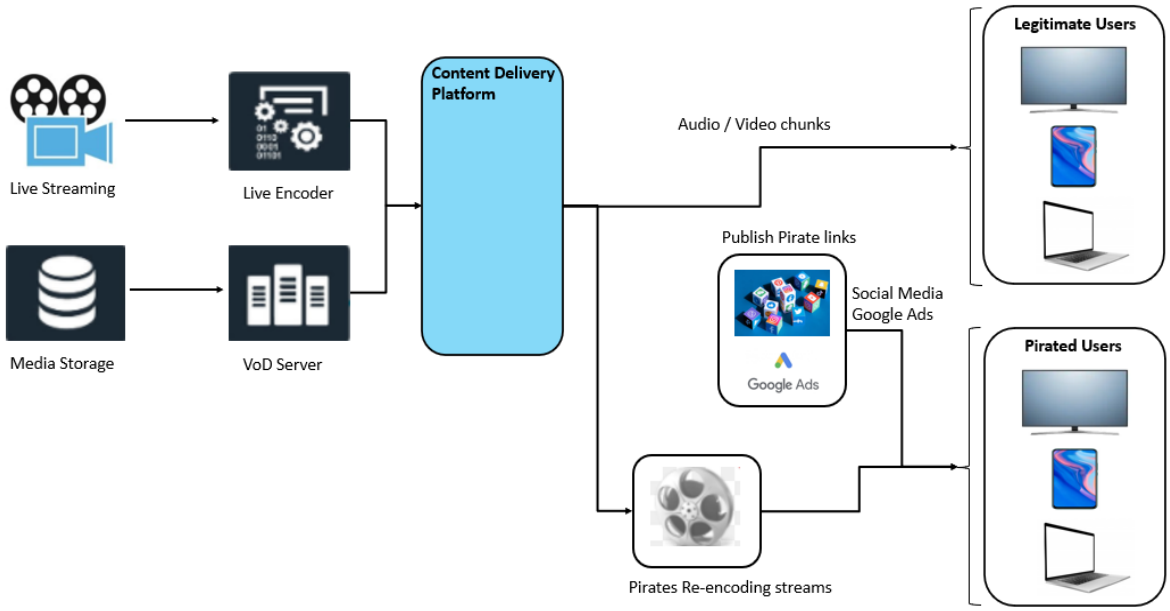

Figure 1: Flow of Pirated Content

The most important step towards curbing pirated transmission is to detect and identify that the transmitted content is pirated. This process can be categorised into the following steps, detection, collection, computation and updation. The first step is to detect the published links which point to pirated content. This is done through indexing web links and advertisements published on social media. The second step is to collect the streaming data, which needs to be analysed to check the presence of watermarking, forensic fingerprint or visual analytics of the content. The third step is to apply computations to the collected data. This could be through any of the different video analytics methods. The last step is to use the results made out of step 3 and take appropriate action. Visual analytics of the content becomes essential to compare the original content with illegal retransmitted content and identify content piracy in real-time.

The key identifier would be a broadcast logo. A broadcast logo is available in all video frames of the original content. Identification of broadcast logos can be handled independently without the need to integrate with the content delivery system and the content distribution system. Video frames need to be analysed for the placeholder of the broadcast logo and to detect the logo. These broadcast logos could have been distorted, modified, made visibly poor or hidden by the pirates in the retransmitted content. In this paper, we discuss the creation of the broadcast logo dataset comprising 450 logo classes spread across different regions in India. The creation of this large-scale dataset is expensive, challenging and time-consuming. Apart from the dataset, this research explores the state-of-the-art deep learning methods for generic object detection and uses this method for broadcasting logo detection and classification and evaluating extensive experiments.

2 Materials and Methods

2.1. Generic Object Detection

There are different generic object detection methods. The main objective of these methods is to locate the object, classify them in the given image, draw a rectangular bounding box marking the object's existence and associate the confidence score. The functioning of generic object detection methods can be broadly classified into two categories. Type 1 comprises of detection and classification pipeline, which includes extraction of region proposals followed by subjecting each region proposal to classification for different object categories. Type 2 comprises a unified approach for object detection and classification, categorising object detection as a regression or classification issue [4-16].

2.2. Region Proposal-Based Method

Figure 2 illustrates the R-CNN data flow diagram, which comprises Input Image processing, region extraction, Feature generation and classification. R-CNN uses a selective search algorithm to extract 2000 region proposals for a given image. Selective search algorithm groups similar regions based on size, shape, colour, texture etc.

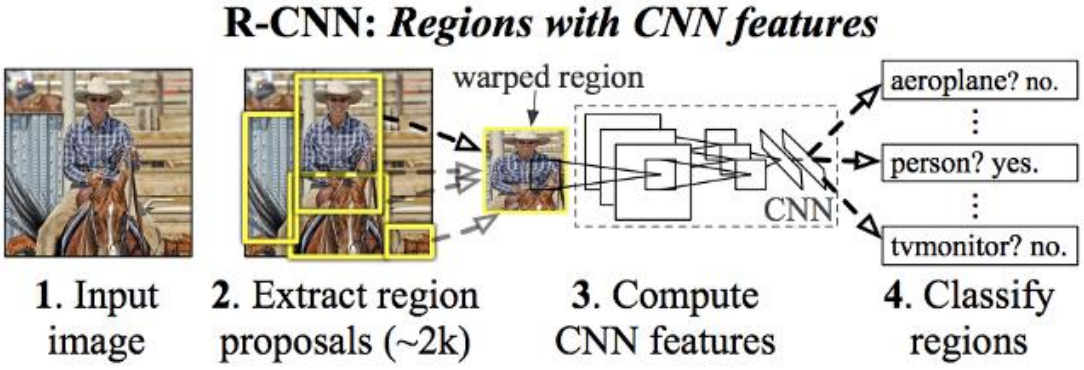

Figure 2: Data flow diagram of R-CNN [4].

2.3. Regression-Classification-Based Method

Region proposal-based methods include different steps in their pipeline, which are correlated for each step, from extracting proposals to gene generating. As a result, each step requires time to generate the results, creating a bottleneck for the real-time applications. Regression classification methods focus on generating bounding box coordinates and class probabilities based on the image pixels, thereby reducing the time required for classification. Figure 3 illustrates the data flow of SSD. The default ground truth bounding box available for each object in the input image shall be utilised in the SSD method. Each ground truth box is checked for varying aspect ratios. By doing this, shape coordinates and the confidence for all object categories available in the default box shall be predicted. During the training ground, truth boxes are compared with the default boxes, as shown in Figure 3. The matched ones shall be considered positive, while the rest are considered negative.

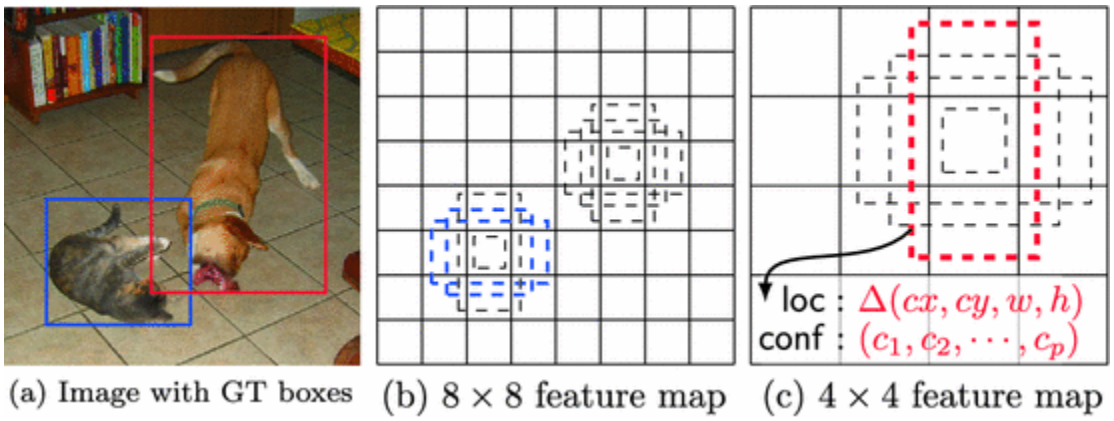

Figure 3: Single Shot Detector (SSD) method [10] includes an input image

2.4. Dataset Collection

This section will focus on dataset gathering from available sources, followed by expanding the available dataset using data augmentation techniques. Lastly, describing the different data augmentation techniques used. Publicly available TV broadcast channel logo datasets contain logos across different regions of the globe. These images are small in number and lack logo classes as well. It has been observed that the same logo class is quite repeated with variations in size and contrast.

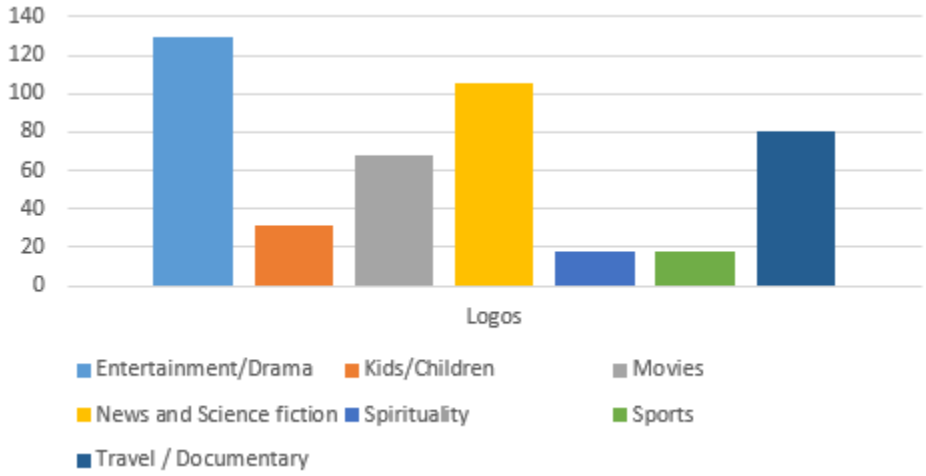

Figure 4: Images grouped as per their TV genre

In this paper, we have collected images of popular Indian TV broadcast channel logos. The logo of 450 TV broadcast channel logos has been collected using the google search engine, which is spread across different TV genres (Entertainment/Drama, Kids/Children, Movies, News and Science fiction, Spirituality, Sports, Travel/Documentary). Within each different TV genre category, care has been taken to pick the popular broadcast channel logo. Figure 4 indicates a pictorial representation of the logos captured and grouped under different TV genres, and Figure 5, updated below, captures a glimpse of TV broadcast channel logos collected.

Figure 5: Some popular Indian TV broadcast logo images retrieved from google search

Data augmentation is a technique to artificially increase the data size, thereby increasing the data diversity required for training the model without explicitly capturing new data. This technique focuses on expanding and enriching the depth of the data through transformations like cropping, titling, zooming etc. Figure 6 describes the original image being expanded/extended to more similar images with variations in the internal pixel values through various data augmentation techniques.

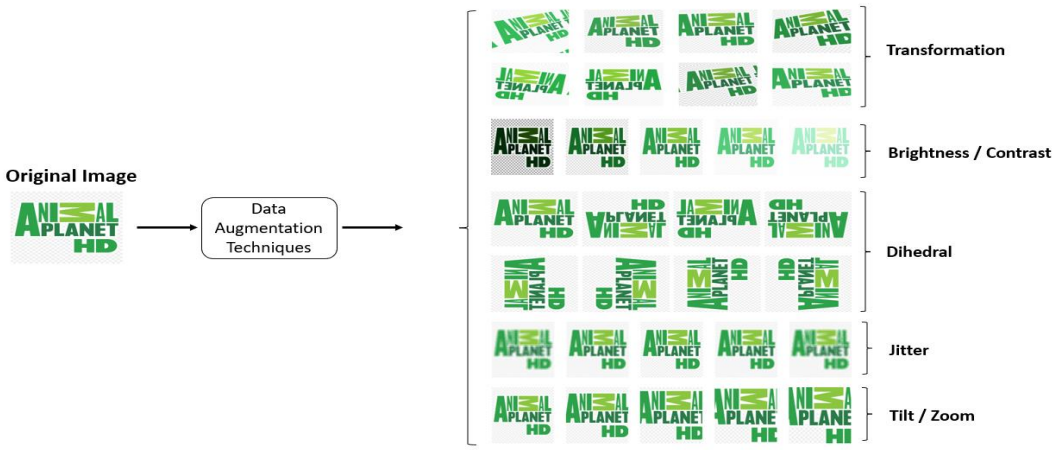

Figure 6: Some of the data augmentation techniques

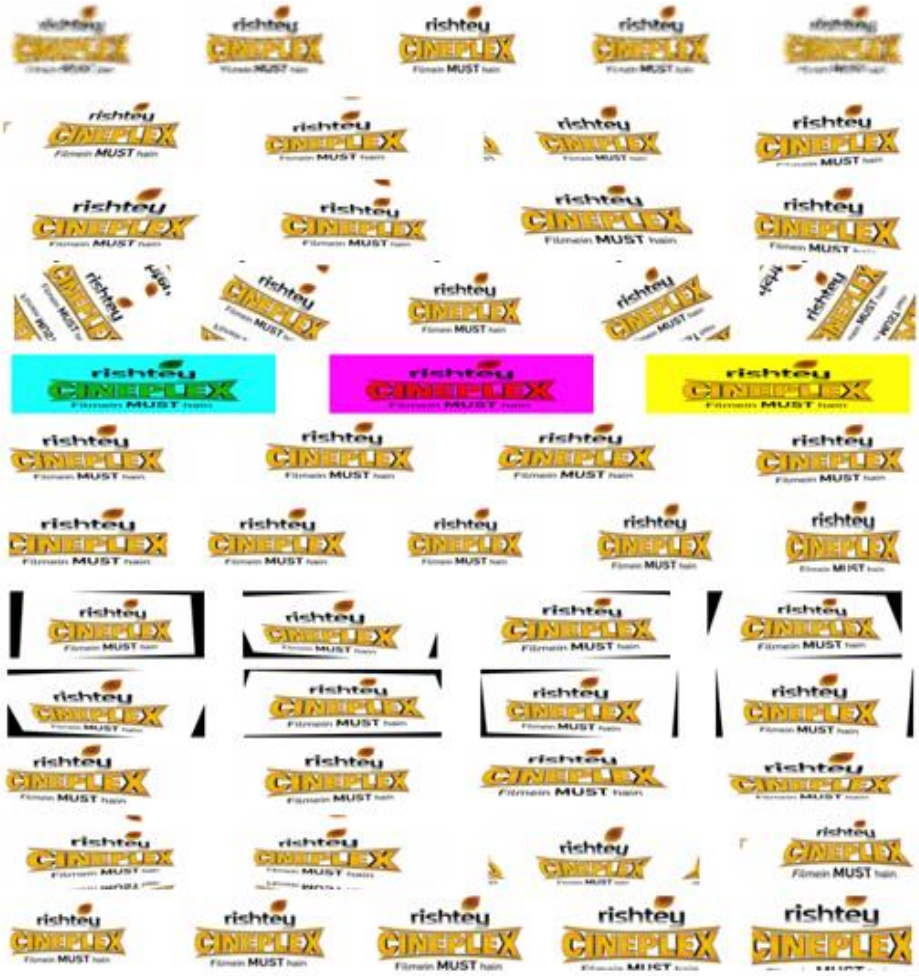

Figure 7: Transformed images after applying data augmentation techniques

Using the fastai image transformation library, the dataset collected, shown in Figure 4, has been expanded. Some of the key transformation applied includes (brightness, contrast, crop, dihedral, flip, jitter, perspective wrap, rotate, RGB randomise, skew, squish, symmetric wrap, tilt, zoom, and cut-outs). Figure 7 captures the transformed images after applying the fastai image transformation library.

3 Approach

Figure 8 illustrates the system diagram. In the training phase, the given input image is subjected to data augmentation methods to augment data of different kinds, eventually enhancing the classification model's performance and reliability. The accuracy of the classification model shall be enhanced even in cases where the logo is purposefully made with low visibility. The real data augmented images shall be the input to the block object detection based on the regression classification method. The real data augmented images are annotated, which shall be used by block object detection for training the model. In the testing phase, the system pipeline includes a key component, the regression classification method (YOLO), to extract different object classes for the given image. The objective of the block network of object detection and classification in the below diagram (figure 8) is to identify the objects running through image pixels, generate the coordinates around the identified object and predict the class probabilities.

Figure 8: System pipeline for extracting objects, classifying and bounding box

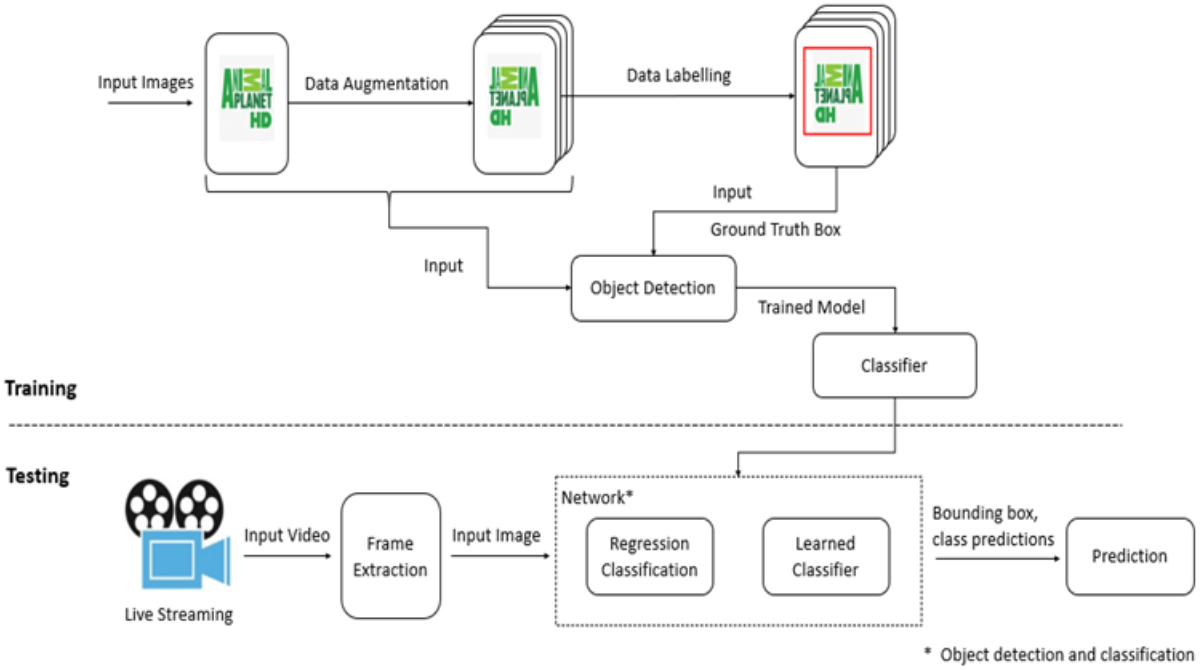

Figure 9 details the regression classification method in the context of a broadcast video image. Unlike region proposal-based object detection methods where each image is searched for the region of interest that could hold the object and then classify the identified object, regression classification method potentially targets to generate coordinates of bounding box and probability of class availability through image pixels in a single execution of the algorithm. The given input image is split into S x S grid of cells. The objects available in the image can be part of one S x S grid cell or spread across a collection of grid cells. The cell that hosts the object's centre and its corresponding grid is the grid responsible for predicting the object. Identification of objects and classifying them are done using a single CNN network. Every grid cell can predict B bounding boxes and Cp class probabilities. Bounding box prediction comprises 5 parameters (Bx, By, Bw, Bh, C). Bx, By corresponds to center of the box relative to a particular grid cell. Bw, Bh holds the width and height of the corresponding bounding box. Parameter C holds the confidence score about the availability of the object. The confidence score shall be zero if no object exists in the given cell. The

confidence score will be maximum when the intersection of the union (IoU) of the predicted box and the ground truth box are equal.

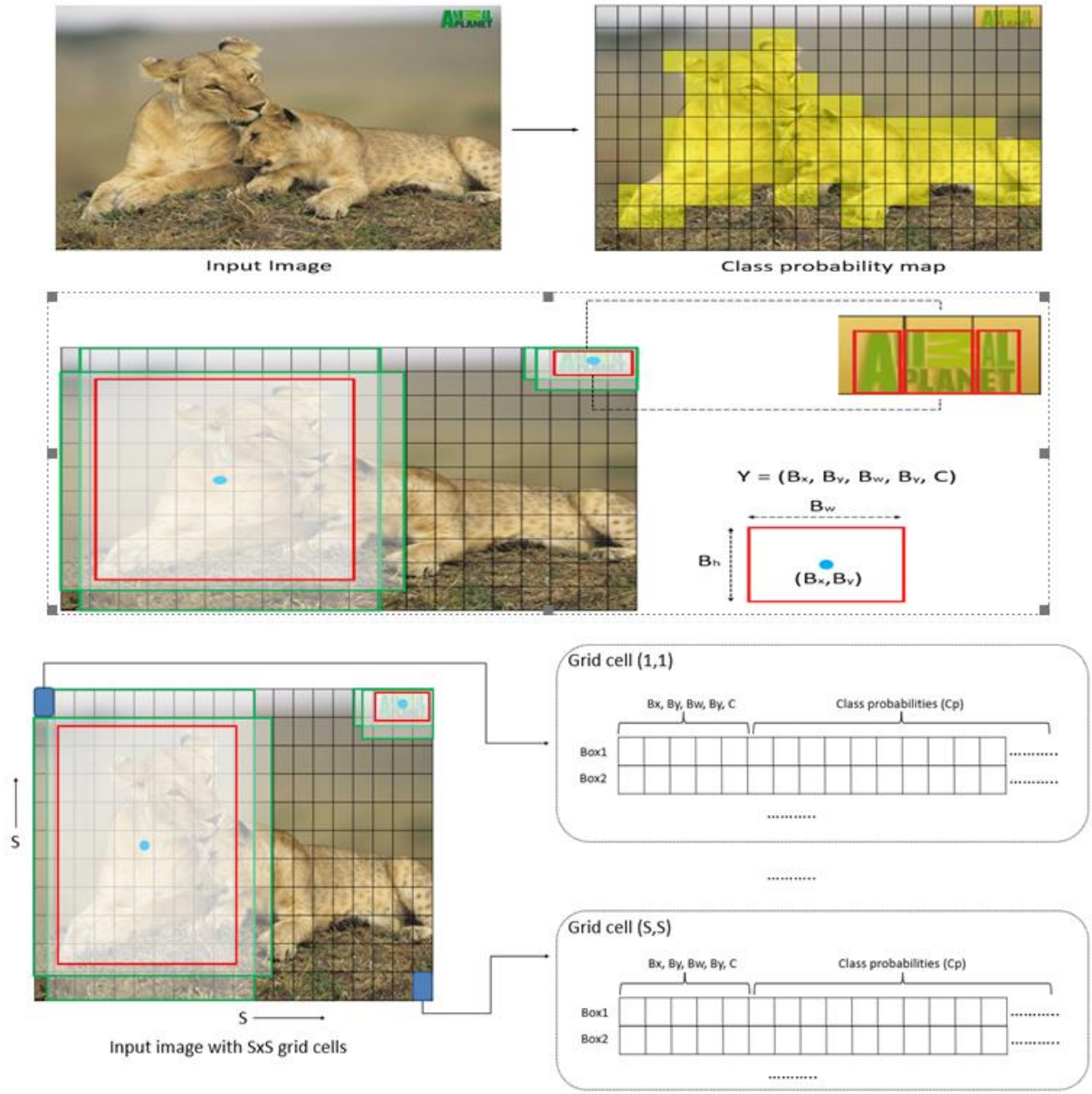

Figure 9: Object detection based on image pixel and classification

4 Results and Discussion

Each collected 450 different Broadcast TV channel logos (Figure 4) has been subjected to various data transformations, as shown in figure 6. Further, the data set is used on the system described in figure 7 for training the model. Each TV broadcast logo image is used as an input for different transformation methods to generate 125 real data augmentation images. Table 1 indicates the TV genre category, real data-augmented logos and total images after data augmentation techniques.

The complete dataset (Total images: 56250) is categorised into:

a. Training set – Consists of a total of 54000 images

b. Testing set – Consists of total of 2250 images

Table 1: Overall real data augmentation datasets

TV Genre	Logos	Augmentation Logos per TV broadcast logo	Total Images
Entertainment/Drama	130	125	16250
Kids/Children	31	125	3875
Movies	68	125	8500
News and Science Fiction	105	125	13125
Spirituality	18	125	2250
Sports	18	125	2250
Travel/Documentary	80	125	10000

Table 2 indicates the experimental results. Random images are picked from each TV genre category for verification using the trained model. For example, the TV genre category (Entertainment / Drama) consists of 130 different channel logo classes. Certain images are chosen from each different 130-channel logo class for verification. This is repeated for other TV genre categories. Precision, recall and accuracy have been calculated for each TV genre category.

The confidence score resulting from the intersection of union (IoU) of the predicted box and the ground truth above 0.5 is the targeted threshold for the below experiments.

Table 2: Channel logo experimental results

TV Genre	Logo Classes	Images used for Testing set	Precision	Recall	Accuracy
Entertainment/Drama	130	650	0.815	0.801	0.812
Kids/Children	31	155	0.823	0.794	0.803
Movies	68	340	0.807	0.781	0.801
News and Science Fiction	105	525	0.842	0.806	0.842
Spirituality	18	90	0.853	0.817	0.849
Sports	18	90	0.842	0.793	0.838
Travel/Documentary	80	400	0.832	0.806	0.831

Perhaps pirates will try to hide the logo through distortion or make them visibly poor. To artificially create this case, some data augmentation techniques such as random erasing/cut-out and jitter have been used. These artificially created images will mimic real-time behaviour about the pirated content, which has changed to the broadcast logo. The below picture in figure 10 captures some of the results taken from our trained model.

Figure 10: Results for random erasing/cut-out, jitter images

5 Conclusion

This paper focused on generating a broadcast video logo dataset, the mode to increase the data set through data augmentation techniques covering different image transformations. The idea behind the image transformation is to create artificial images that simulate a real environment where the pirates will makeover the logo while redistributing the pirated content. This paper discussed the different methods of generic object detection algorithms and system pipeline, which uses regression classification methods to identify the object and its location and classifies it. Experiments were carried out on different TV genre categories and the results obtained were promising. Systematically investigated the role of random erasing/cut-out jitter on the object recognition performance.

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