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(A Peer Reviewed Journal)

EDITOR-IN-CHIEF :

DR. H.S. HOTA

ATAL BIHARI VAJPAYEE UNIVERSITY,

BILASPUR (C.G.)

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Message

I am delighted to know the publication of the 10th volume of the International Journal of Decision Science and Information Technology (IJDSIT) by the Department of Computer Science and Application at Atal Bihari Vajpayee University, Bilaspur in association with Modern Technology and Management Institution, Inc., USA, with Dr. H. S. Hota, Professor and Head of the Department of Computer Science and Application, serving as the Editor-in-Chief. This milestone achievement is a testament to the dedication and hard work of our esteemed faculty members and researchers.

The International Journal of Decision Science and Information Technology has been a flagship publication of our department, providing a platform for researchers and academicians to contribute their valuable research findings in the field of decision science and information technology. It serves as a conduit for the exchange of knowledge, ideas, and innovations among scholars from around the world.

I would like to express my sincere appreciation to the editorial team, reviewers, and authors for their invaluable contributions to the International Journal of Decision Science and Information Technology. Your dedication and expertise have been instrumental in maintaining the high standards of this journal. We are not only elevating the standing of our journal but also positioning it as a global brand. This achievement reflects our university's commitment to fostering international collaborations and showcasing the research capabilities of our esteemed faculty members and researchers.

I encourage all members of our academic community to continue their scholarly pursuits and contribute to the growth and advancement of knowledge in the field of decision science and information technology. Together, we can further strengthen the reputation of our university and make significant contributions to the academic world.

Once again, congratulations to the Department of Computer Science and Application on the successful publication of the 10th volume of the International Journal of Decision Science and Information Technology. I am confident that this accomplishment will inspire even greater achievements in the future.

Best wishes to all.

Prof A.D.N. Bajpai
Vice Chancellor
(Atal Bihari Vajpayee University, Bilaspur)

Editorial Notes

The International Journal of Decision Science and Information Technology (IJDSIT) is an international peer reviewed journal dedicated to the latest advancements in the field of Decision Science and Information Technology. The current issue of journal is being published by Department of Computer Science, Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India in association with Modern Technology and Management Institution Inc. under the MoU between Atal Bihari Vajpayee University and MTMI, USA every year in the month of January however the first 7 volumes of journal were published by MTMI, USA. The goal of this journal is to promote authentic and original research in many areas of achievements in Decision Science and information technology. Its broad nature allows for a wide dissemination of knowledge amongst researchers both from academe and industry, to initiate, cultivate, share, and discuss various new issues and developments in different areas of theories and practices. The journal will hopefully benefit scientists, business, industry and government leaders and managers relating particularly to Information Technology. Topics that would be covered in IJDSIT include, but not limited are: Artificial Intelligence and Expert System, Decision Science, Information Technology, Big Data, Data Analytics, Machine Learning, Internet of Things (IoT), Machine learning, Computer Networking, Information Communication and Technology (ICT), Block chain and Crypto currency, Technology, Soft Computing, Information security, Cryptography and Network security, Graph theory, Data Mining, Distributed Computing, Decision support system, Cloud Computing, Robotics and Augmented reality, Pattern Recognition, Business Intelligence, Business Analytics, Smart Governance, E-Commerce and M-Commerce, E-Learning and M-Learning, Fuzzy logic and Fuzzy mathematics, Biotechnology and Bioinformatics, Optimization techniques or any other related topics. I am happy to release the current issue of IJDSIT with six research articles. These research articles covers the broad topics of the journal like Decision support System, Business Intelligence I would like to thank Prof. A.D.N. Bajpai, Hon'ble vice chancellor, Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India and Prof. Kamal Nayan Agarwal, Vice-Chairman, MTMI, USA and Professor, School of Business, department of Information System and Supply chain Management, Howard University, Washington DC, USA along with Prof. Dinesh Sharma, School of Business and Technology, Department of Business, Management and Accounting, University of Maryland, Eastern Shore, USA to make this journal as collaborative journal of Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India and MTMI, USA. I also thank all the members of editorial board for their untiring supports to see this journal in reality. I would also like to thank all authors to publish their research articles in IJDSIT. It is worth mentioning here the important feedbacks provided by the reviewers to authors to improve the quality of their manuscripts. Finally, I hope that readers will find the research articles published in IJDSIT useful and thought provoking. This issue of journal features an exciting collection of research articles that highlight the application-oriented advancements in machine learning and deep learning techniques. In this issue, we are proud to present six research articles authored by experts from both India and abroad. The papers explore diverse domains, ranging from healthcare and education to cyber security, demonstrating the wide-reaching impact of modern computational methods.

These comprehensive articles delve into various domains, including facial recognition, driver drowsiness detection, and cancer detection, all utilizing machine learning techniques. The paper showcases the versatility of machine learning in solving real-world problems across different sectors. The authors provide insights into the challenges and opportunities in each domain and present their findings on novel methodologies and techniques.

Dr. H.S. Hota
(Editor-in-Chief)

Editorial Board

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FACIAL RECOGNITION AUTHENTICATION

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ABSTRACT

Keycard-based entry has been widely known as the default option for an entry system even though they are considered to be unsafe in today's standards. One can also forget or lose their card. Since entry sometimes takes more time than usual with the user pulling up their card and the system recognizing it, it might cause long lines in front of the keycard reader. This report explores an alternative entry system that is based on biometric authentication, to be more specific, an entry system based on facial recognition technology (FRT).

The vision of our team was to create a new entry system that can replace the AUK's old system. A system that works efficiently, only needing one to look at the camera for it to confirm their identity and grant access. As many may know, facial recognition technology works on artificial intelligence. In order to create this system, our team had to study and gain an understanding of Artificial Intelligence, construct the source code for the system and build a small dataset for testing reasons. However, even though the system has been successfully implemented on a smaller scale, problems were faced when the user was wearing glasses or a hat. Furthermore, the AI would have low accuracy where there is a difference of lighting between the pictures of the user in the dataset and the same user waiting to be authenticated in front of the camera. Despite the difficulties initially faced, the project was deemed successful. This report will go into detail of the planning, code, implementation and the results.

Keywords: Artificial Intelligence, Facial Recognition, Biometric Based Entry, Biometric Authentication, Entry System.

1. INTRODUCTION

The American University of Kuwait uses a keycard-based entry system for students, faculty and staff. However, this poses some problems. It can be time-consuming for the user to pull out their ID and wait for the system to authenticate them and grant access, that is why sometimes long lines can be seen. Users can also forget their IDs which may cause difficulties in entering the university. Furthermore, unauthorized people can enter the university since it's very easy to copy a keycard. (Key Card Access Systems | Key Fob Entry Systems | Open path, n.d.) This is where the facial-based entry system comes into play, all the problems maintained above would be solved, in addition to making it easier and safer for users to enter the campus. Users would only need to look at a dedicated camera, wait for it to authenticate their identity and then be granted entry. Guards would still be there in case there are guests or a rare case of mismatch.

2. LITERATURE REVIEW

There are a lot of methods and ways to approach Facial Recognition Technology that have been built across the previous decades. In this report, we will be using the latest method which incorporates deep learning.

(A Review of Face Recognition Technology, 2020). It creates a "template" of a target's facial image and data. It tries to match that "template" on the target's face on a photograph or a video. That is why it's important for that "template" to be trained on multiple situations or photographs in order to increase accuracy (Facial Recognition Technology - prosecutors' center for excellence, n.d.).

Another approach of facial recognition is to categorize faces by gathering facial contours, determining their standard form, and subsequently classifying additional profiles based on their variations from this standard. This categorization method is multi-faceted, producing a set of distinct values that can be contrasted with other data sets in a repository.

3. RESEARCH METHODOLOGY

Unsurprisingly and with good reason, collecting facial data of everybody who enters the university on a daily basis might constitute suspicions of a privacy breach. However, if it's strictly forbidden to sell or publicize that data outside the university, and if it is also implemented that this data is to be used only for the sole purpose of seamless entry to the campus. Then there should be no ethical problem. As for the legality, as of March 2023, there is no law in Kuwait outright banning facial recognition to be used in private businesses and services.

At first, we used to have an old software that couldn't recognize users wearing makeup which cannot be helped since it would be a hassle for the user to remove it. Now, we are using a new software that could recognize the user regardless of make up since it's based on the facial structure. That way it would fix this oversight. It was immensely important to change the system since that would remove the main reason this system is being implemented. Which is making entry easier and more seamless. Requiring the user to remove their makeup or don the same makeup as the pictures that were taken by the IT is unrealistic and unintuitive. (Ueda & Koyama, 2010)

After successfully implementing the software, we needed a dataset to test the software with. Since this project needs to be tested on a smaller-scale first. We decided to use a smaller dataset. The dataset consists of the team's facial data, the professor and some famous people, so we can be able to determine if the software works reliably and to our satisfaction.

After making the dataset and finishing the software, the actual implementation with a camera is left. To do this, we need a camera, a computer that will run the software and to connect the dataset to the computer locally. When there is a match between the camera and the dataset, the computer will send a signal to the gate signaling it to open. As stated already, since this is a smaller-scale implementation, actually implementing the computer to open the gate is not needed; merely making sure the system has a high accuracy in detecting faces and matching it is most important in this test.

In order to create a facial recognition system, we are going to use Python, a programming language as it has a numerous number of libraries which are designed for machine learning and computer vision. The main libraries we are going to use are OpenCV and NumPy.

- OpenCv is the main library for computer vision which allows us to work with images and videos and manipulate them (Brahmbhatt, 2013, p.4).
- NumPy, allows us to store images as NumPy arrays to make calculations on them and train them (Harris et al., 2020).

A facial recognition system requires two parts, face detection and training. For face detection, we are going to use CascadeClassifier which uses Haar Feature-based Cascade Classifiers to detect faces (Madan, 2021)

The second part is training the images with the labels using OpenCv built in recognizer.

Based on Software Engineering guidelines, these diagrams that are listed below had to be created in order to streamline the process and make it easier for our team to approach the project (Sommerville, 2015).

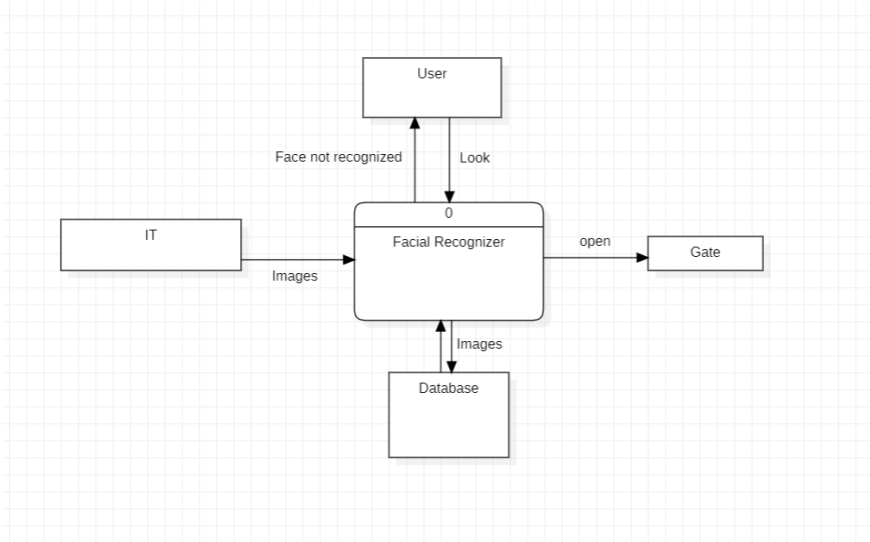

Figure 1: Context Diagram

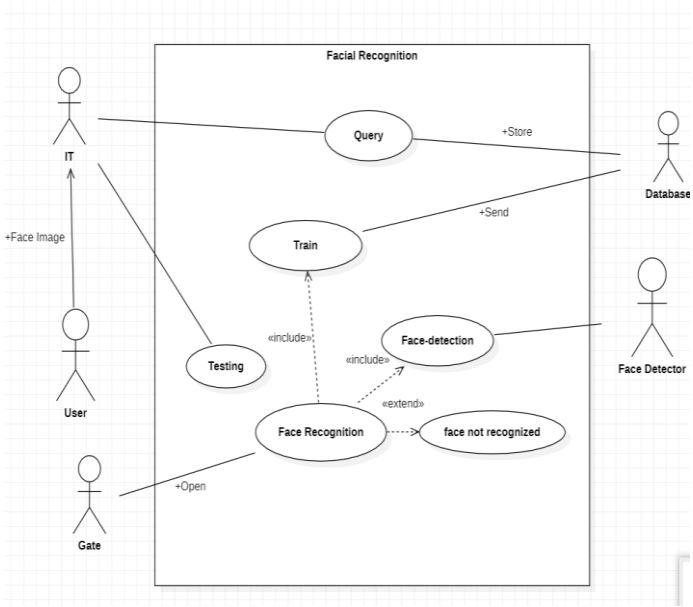

Figure 2: Use case model

As shown in Figure 1 and Figure 2, users will go to the IT department in order to take images for their faces. Then, the IT will store these images in the database. Now the face recognition system will train with the images in the database. The IT department will then test the system with the user and check if it works well. Finally, in real time, a user will come and look at the camera and the face will be scanned by the system. If the face is recognized, the gate will open. Otherwise, the gate will not open.

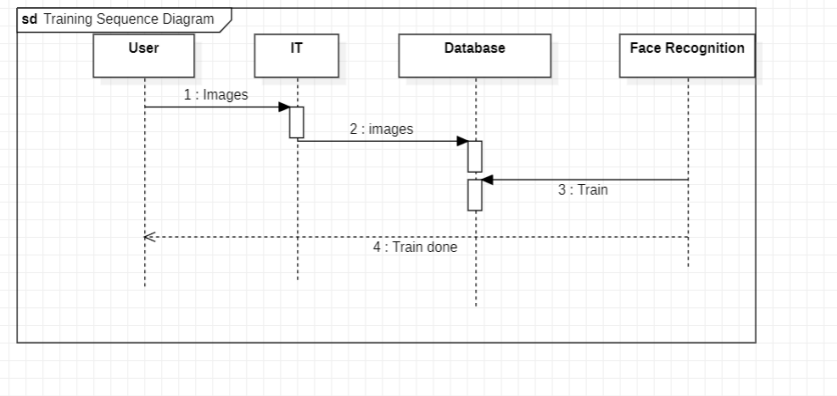

Figure 3: Training Sequence Diagram

In Figure 3, the user will send their pictures to the IT, so the pictures can be saved in the database and then the software can be trained and recognize the people in the pictures. Figure 4 will illustrate the process of how the user is granted access to the university.

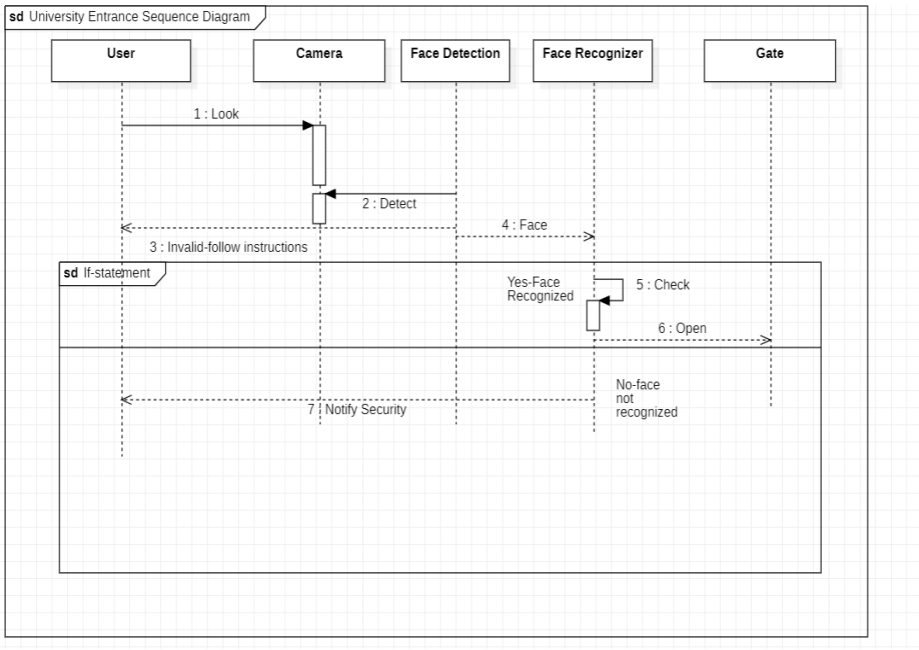

Figure 4: University Entrance Sequence Diagram

In Figure 3 the process of training the system on the pictures that were taken of the user by the IT. In Figure 4, it will illustrate how the system will interact with information the database has. Here you can see that the users will look at the camera so it can scan their face. The system will then compare the scan with the dataset. If the face is invalid the security staff shall ask them to follow the instruction which may include removing their glasses, mask or look at the camera clearly. If the face is valid then it will look up the database to recognize the user. Then, the system will check if the face is recognized or not. If the face is recognized then the gate will open. However, if the face is not recognized the system shall notify the security staff to check with the visitor and take their information before entering the campus.

4. TESTING

"Testing is the process of executing a program with the purpose of finding errors" (Singh, 2019 p.1)

For the first testing phase, we used a data set called "*Celebrity Face Image Dataset"* which has photographs of famous western celebrities. Each celebrity has a set of 100 to 200 photographs, which is considered a low range for this kind of Facial Recognition Method. Using this dataset, the facial recognizer trained on it. To test the accuracy of the system, we raised different photographs of each of the celebrities in front of our facial recognizer software. Figure 5 is an example of our software recognizing American Actor Brian Smith.

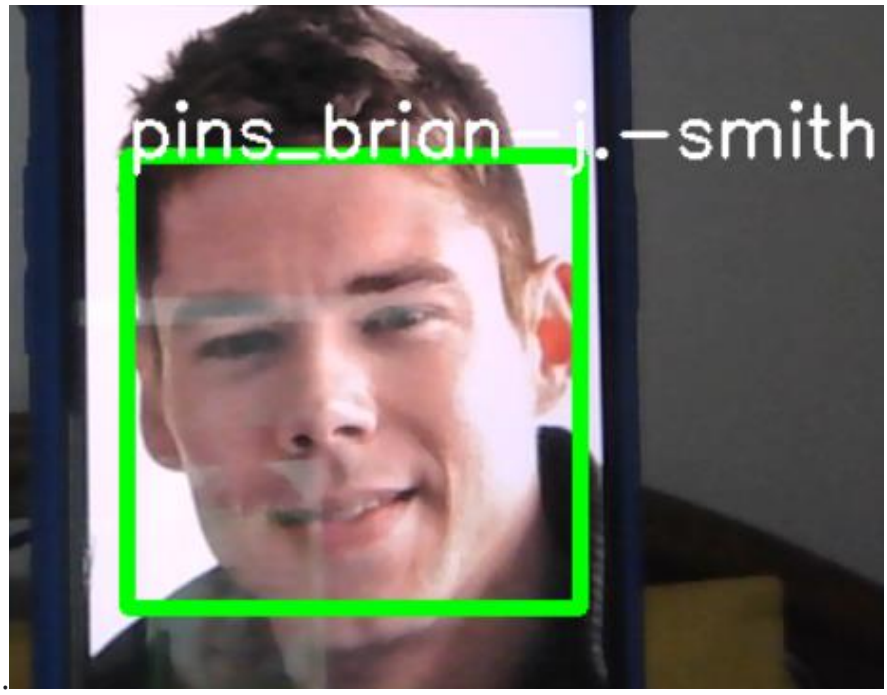

Figure 5: The Facial Recognizer Detecting Smith's Face

For the second and final phase, the team has decided to mount a camera in one of the classrooms. Since the dataset consists of the team members, we have decided to test the Facial Recognizer by having the members enter the room one by one, and seeing if the software detects our faces. At first, we had limited success. Fortunately, when different photographs of each of the team members were added with different lighting conditions and angles, the accuracy of the recognizer was greatly increased. We expect that with a better dataset, equipment and lighting for the entrance, the accuracy can be increased even further to a reliable level.

5. CONCLUSION

To conclude, implementing this biometric-based entry system on a campus scale would greatly benefit the university, the overall security would improve along with the efficiency of the authentication in entering the university. It would solve many problems which include losing the keycard and the copying of the keycards. With this system, unauthorized people entering the university through the gate would be almost impossible.

This system might be hard to set up at first, since it requires all of the current students and faculty to go to the IT department in order to record and take pictures of their faces, but once that is done, the process of entering the university would be incredibly safe and immensely comfortable for the user.

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A DRIVER DROWSINESS DETECTION USING MACHINE LEARNING AND OPENCV

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ABSTRACT
The rate at which cars, buses, and other motor vehicle-related accidents have increased in the past few years is becoming mind-bulging and fearful and the majority of these mishaps are drowsy drivers related. This has resulted in the loss of lives, goods, properties, etc. The essence of this analysis is to study and review the previous works on drowsy driving-related accidents, their causes, and measures taken. The gaps in these studies were noted in order to propose and design a new or robust system. This was achieved using various techniques such as image acquisition, computer vision, face detection, feature extraction, training, and classification. The techniques were designed using a universal modelling diagram and mathematical modelling approach based on the requirements for the object-oriented analysis design methodology adopted for the study. The designs were implemented as a prototype system using Python and tested with real-time driving behavior.
Keywords: Computer Vision, Data Science, Machine Learning, Python, OpenCV, Drowsiness detection, EAR.

1. INTRODUCTION
Road accidents are the nation's number one killer and are becoming more common as the number of vehicles on the road rises daily. We all know that the driver is in charge of the traffic system and the safety of the road. In addition to the other passengers in the car, the driver is also accountable for himself. Many people frequently disregard drowsiness when it comes to their own safety. However, if this trait is not taken into account and acted upon, it may result in an accident and be the cause of death, which might be problematic for both the driver and the passengers. In our daily lives, drowsiness is one of the main causes of actual car accidents. To increase the safety of road traffic, it is imperative to address the challenging issue of driver drowsiness. According to the National Highway Traffic Safety Administration, over 100,000 police-reported crashes involving drowsy driving result in close to 800 fatalities and 50,000 injuries per year. The actual amount, however, might be substantially higher because it can be challenging to tell whether a motorist was drowsy at the time of a collision. There are many scientists and researchers who have given frameworks to detect the drowsiness of the driver all over the world. This paper proposed to detect the drowsiness of the driver using machine learning and OpenCV.
The organization of the paper is as follows section 1 describes the related work of the paper. In section 2, we have discussed the background and related terminology. Section 3, address the proposed framework. Section 4, discussed drowsiness detection. In section 5 we have concluded the paper.

2. RELATED WORK
Gwak et al. (Gwak, Hirao, and Shino 2020) have attempted to distinguish alert and slightly drowsy states with machine learning algorithms based on hybrid measurements of driving ability, behavioral

traits, and physiological markers, with the goal of early identification of driver drowsiness. In this study, when using hybrid measurements and eliminating physiological indicators, 78.7% accuracy was obtained when identifying alert vs. mildly drowsy states.

Sanchez et al. () have successfully developed a program for facial recognition for only the nose and eyes area with 92% accuracy. The authors have achieved this with Dlib and OpenCV using SVM.

Zaki et al. (2020) have proposed a framework for fatigue while performing repetitive tasks on a production line is the fundamental cause of many mishaps. To address this issue, a study was done to build a fatigue-detecting algorithm. Authors have used machine learning techniques such as Euclidian distance to identify the fatigue. However, they have not mentioned the accuracy.

Altameem et al. (2021) have used machine learning approaches to implement real-time image segmentation and sleepiness in this work. An emotion recognition system based on Support Vector Machines (SVM) has been constructed using facial expressions in the proposed work.

Drunkenness or tiredness is a major cause of car accidents, with serious consequences for road safety. More fatalities could be avoided if weary drivers were alerted in advance. Several drowsiness detection technologies can be used to monitor for indicators of inattention while driving and alert the driver.

You et al. (2019) provide a real-time driving drowsiness detection system that takes into account the driver's individual variations. To detect the face region, a deep cascaded convolutional neural network was built, which addresses the problem of poor accuracy caused by artificial feature extraction. The frontal driver facial landmarks in a frame are discovered using the Dlib toolbox. A new parameter called the Eyes Aspect Ratio is created based on the eyes landmarks to measure the tiredness of the driver in the current frame. The authors have achieved 94.80 % accuracy in this research work.

Mohanty et al. (2020) constructed and developed a model for drowsiness or fatigue detection system using the OpenCV library and the KNN technique of Machine Learning and Shape predictor face landmarks in this suggested study. The devised technique was effectively tested, and dramatic changes in the EAR were also observed while opening and closing the eyes. The authors have shown different types of drowsiness alerts as a result.

The summary table for similar works may be seen in Table 1 based on the literature review.

Table 1: Summary of the literature survey.

AUTHORS	**TECHNIQUES USED**	**RESULT**
J. Gwak et al. (2020)	Machine Learning algorithms	78.28% accuracy
R. M Sanchez et al.)	SVM using Dlib and OpenCV	92% accuracy
A. Zaki et al. (2020)	Euclidian distance using machine learning.	Accuracy is not addressed
A. Altameem et al.(2021)	Support Vector Machines (SVM)	Accuracy is not addressed
F.You et al. (2019)	Dlib toolbox	94.80% accuracy
Archita Mohanty et al.(2020)	KNN and OpenCV	Identified different Alerts

3. PROPOSED FRAMEWORK

The process of the drowsiness detection system involves following steps. The steps are shown in the Figure 1.

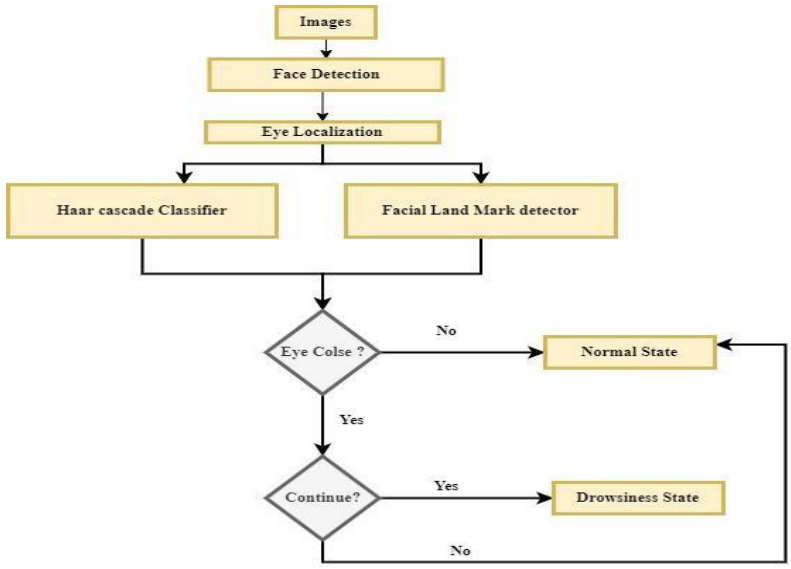

Figure 1: Steps involve in drowsiness detection

3.1 Face detection

Haar feature-based cascade classifiers are used for face detection. This is a successful object detection method presented by Paul Viola and Michael Jones in their paper "Rapid Object Detection Using a Boosted Cascade of Simple Features" in 2001. It is a machine learning approach in which a cascade function is taught using a large number of positive and negative images. It is then used to other photos to detect things (Chandra, Kumar, and Sureshbabu 2018). Face detection using Haar cascading is machine learning approach training is provided for cascading functions form various positive and negative images.

To train the classifier, the method requires a large number of positive images (images of faces) and negative images (images without faces). Then we must extract characteristics from it. Haar features such as those displayed in the image below are employed for this. They are identical to our convolutional kernel. Each feature is a single value calculated by subtracting the sum of the pixels under the white rectangle from the sum of the pixels under the black rectangle. Figure 2 shown the examples of the haar cascading.

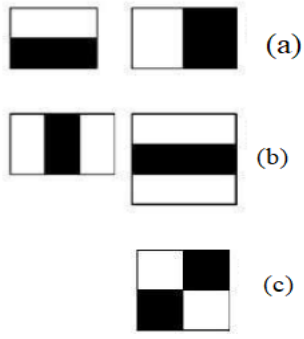

Figure 2: Examples of haar cascading (a) Edge features (b) Line Features (c) Four-rectangle features.

Figure 3 shows that five haar like features.

Figure 3: Five haar features

3.2 Eye Localization

In the system we have used facial landmark prediction for eye detection Facial landmarks are used to localize and represent salient regions of the face, such as: Eyes, Eyebrows, Nose, Mouth, and Jawline etc.

Facial landmarks have been used successfully in face alignment, head pose estimation, face swapping, blink detection, and many more applications. In the context of facial landmarks, we want to use shape prediction methods to discover essential facial structures on the face. Localize the face in the image and detect the key facial structures on the face ROI are the two steps to detect the facial landmarks.

Localize the face in the image: As mentioned in the first step of our approach, Haar feature-based cascade classifiers are used to localize the face image**.**

Detect the key facial structures on the face ROI: There are various facial landmark detectors, but all methods attempt to localize and classify the following facial regions: Mouth, left eyebrow, right eyebrow, nose, left eye, and right eye. The dlib library's facial landmark detector is an implementation of the One Millisecond Face Alignment with an Ensemble of Regression Trees (Kazemi and Sullivan 2014).

This step incudes:

I. On an image, a training set of labelled face landmarks. These images are labelled by manually, with particular (x, y)-coordinates of regions surrounding each facial structure specified.

II. Priors, or more precisely, the likelihood of distance between pairs of input pixels.

The 68 (x, y)-coordinates that correspond to facial structures on the face are estimated using the pre-trained facial landmark detector found inside the dlib library. The indexes of the 68 coordinates may be depicted on the image as shown in the Fig.4. The following facial landmark index can identify and access both the eye region; [36, 42] for the right eye and [42, 48] for the left eye.These annotations are from the 68-point iBUG 300-W dataset, which was used to train the dlib face landmark predictor. It's worth noting that there are various types of face landmark detectors, such as the 194-point model that can be trained on the HELEN dataset. The same dlib framework can be used to train a shape predictor on the input training data regardless of which dataset is used (Huang et al. 2021).

3.3 Eye state recognition

The optical flow, sparse tracking, and frame-to-frame intensity differencing and adaptive thresholding can all be used to estimate the eye area. Finally, whether or not the eyes are covered by eyelids is decided. Some other method is to infer the state of the eye opening from a single image, such as by correlation matching with open and closed eye templates, a heuristic horizontal or vertical image intensity projection across the eye region, a parametric model fitting to detect the eyelids, or active shape models.

One significant disadvantage of earlier techniques is that they frequently implicitly place excessively stringent criteria on the setup, such as a relative face-camera posture (head orientation), picture resolution, illumination, motion dynamics, and so on. Despite their real-time efficiency, heuristic approaches that use raw image intensity are

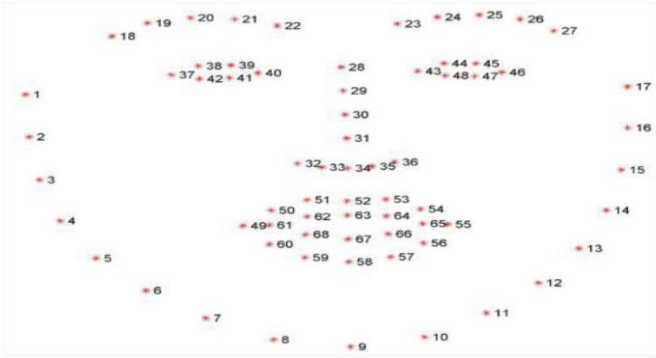

Figure 4: Generating a visual representation of the 68 facial landmark coordinates (Huang et al. 2021)

likely to be quite sensitive. Finally, using a per-frame sequence of the eye-opening estimations, an SVM classifier trained on instances of blinking and non-blinking patterns finds the eye blinks.

3.4 Eye Aspect Ratio Calculation

Blink detection is useful in a variety of situations, including face movement analysis and signal processing (Dewi et al. 2022). The eye landmarks are recognized for each video frame. The eye aspect ratio (EAR) is computed as the ratio of the eye's height to width. EAR can be computed as shown in equation (1).

$$EAR = \frac{||P_1 - P_2|| + ||P_3 - P_5||}{2||P_1 - P_4||} \quad (1)$$

Where $P_1 \ldots . P_6$ are the location of the 2D landmark as shown in Figure 5. When an eye is open, the EAR is essentially constant and approaches zero when it is closed. It is partially insensitive to person and head pose. The aspect ratio of the open eye varies little between individuals and is completely invariant to uniform image scaling and in-plane facial rotation. Because both eyes blink at the same time, the EAR of both eyes is averaged as shown in equation (2).

$$avg\ EAR = \frac{1}{2}(EAR_{left} + EAR_{right}) \quad (2)$$

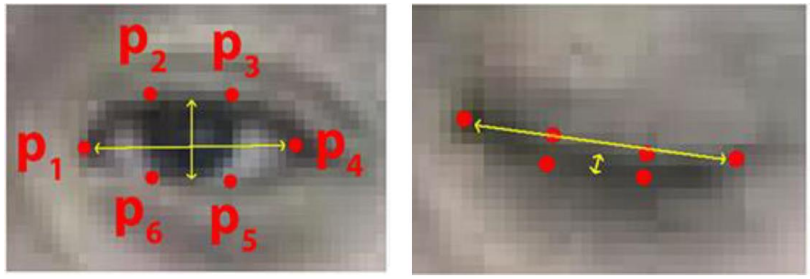

Figure 5: Open and closed eyes with landmarks p(i) automatically detected.

Eq. (1) plots the eye aspect ratio EAR for multiple frames of a video stream as shown in Figure 6.

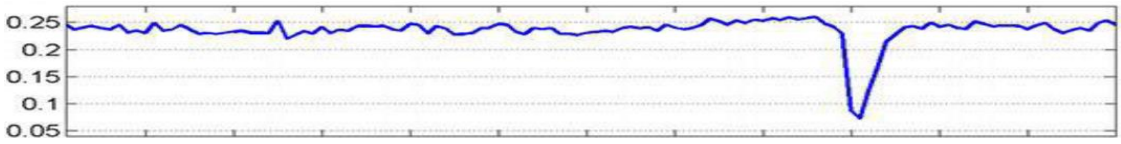

Figure 6: EAR for sight blink

4 DROWSINESS DETECTION SYSTEM

In this step, includes Eye state determination and drowsiness detection.

4.1 Eye state determination

Finally, the eye state is determined using the EAR computed in the preceding phase. If the distance is 0 or is near zero, the eye state is categorized as "closed" otherwise the eye state is recognized as "open".

4.2 Drowsiness detection

The algorithm's final step is to determine the person's status based on a pre-set drowsiness condition. A person's typical blink duration is 100-400 milliseconds (i.e.0.1-0.4 of a second). As a result, if a person is drowsy, his eye closure must be longer than this period. We established a time limit of 5 seconds. Drowsiness is detected if the eyelids are closed for five seconds or more, and a warning pop is triggered.

Implementation of drowsiness detection with Python and OpenCV was done which includes the following steps: Successful runtime capturing of video with the camera. The captured video was divided into frames and each frame was analyzed. Successful detection of the face followed by detection of an eye. If the closure of the eye for successive frames were detected, then it is classified as a drowsy condition else it is regarded as a normal blink, and the loop of capturing an image and analyzing the state of the driver is carried out again and again. In this implementation, during the drowsy state, the eye is not surrounded by a circle or it is not detected, and the corresponding message is shown.

The results/screenshots of different drowsiness states as shown in Figure 7 and Figure 8.

Figure 7: When a driver closes the eye to sleep **Figure 8**: Yawn alert when mouth opens

5. CONCLUSION

Many researchers have worked on drowsiness detection over the last few decades with great results. However, research is continuously being conducted in this subject to improve the system's reliability. This application presents several difficulties. For example, if a motorist is wearing spectacles, a camera or sensor will only view a portion of his or her face. Our model is intended to detect drowsiness in the eye and provides an alert signal or warning in the form of an audio alarm. However, the driver's response after being warned may not be sufficient to prevent the accident, implying that if the motorist is sluggish to reply to the warning signal, an accident may occur. Hence to avoid this we can design and fit a motor-driven system and synchronize it with the warning signal so that the vehicle will slow down after getting the warning signal automatically.

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CANCER DETECTION USING RNN AND LSTM BASED MACHINE LEARNING TECHNIQUES

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ABSTRACT

Cancer is a complex medical condition characterized by the uncontrolled growth and proliferation of cells in the body, which can potentially spread to other parts of the body and cause serious health complications. Unfortunately, there is no known cure for cancer, and in most cases, the diagnosed patient succumbs to the disease. Early detection of cancer is critical for successful treatment and improved patient outcomes. In this paper, we leverage a large dataset of patient reports from various healthcare institutions and apply natural language processing techniques to extract relevant information related to cancer diagnosis. We employ machine learning models based on RNN and LSTM on this data and evaluate their performance using various metrics such as accuracy, precision, recall, and F1-score. Our findings demonstrate the potential of machine learning in improving cancer diagnosis and providing valuable insights for developing effective cancer detection systems. Overall, our research contributes to the growing body of knowledge on the application of machine learning in the medical field, particularly in cancer diagnosis.

Keywords: Cancer Detection, Deep Learning, Long-short term memory (LSTM), Recurrent Neural Network (RNN).

1. INTRODUCTION

The lifestyle factors, including cigarette smoking, diet (specifically fried foods and red meat), alcohol consumption, sun exposure, exposure to environmental pollutants, ionizing radiation(Gilbert 2009), infections, stress, obesity, and physical inactivity, have been shown to significantly impact human DNA(Deoxyribonucleic acid)(Yamaguchi 2019) and cause of cancer(Anand, Kunnumakkara et al. 2008). Cancer is the condition in which group of abnormal cells are formed in the body and these cells may form a mass called tumor (but all tumor is not cancer), Cancer can grow throughout the body. There is no cure for cancer only early detection and treatment is the only way to relive its symptoms(Schwartzberg, Broder et al. 2022). Some health symptoms are signs of a cancer and for detecting the cancer in its early stages there are various diagnostic methods are available such as (Lennon, Buchanan et al. 2020) Blood Test, Urinalysis, CT-Scan, MRI(magnetic resonance imaging), etc. Deep learning has made remarkable advancements in the field of artificial intelligence, enabling intricate computational models to capture abstract representations derived from extensive datasets. Its applications span various domains, including visual processing, speech processing, and more. Deep Learning approach excel at uncovering intricate patterns within vast datasets by utilizing back-propagation algorithms. In contrast, traditional machine learning methods exhibit limitations when processing raw, unprocessed natural data(LeCun, Bengio et al. 2015). The utilization of Deep Learning models in cancer diagnosis (Schwartzberg, Broder et al. 2022) is prevalent due to their

ability to handle large volumes of data with minimal data manipulations, ultimately yielding improved results. Deep Learning models demonstrate exceptional performance in extracting intricate patterns and features from complex datasets, making them highly suitable for the task of cancer diagnosis. One of the deep learning method involves use of RNN(Recurrent Neural Network), it has shown a significant result in cancer detection(Routray, Rout et al. 2022) because of its feeding back output function which help in drawing out a useful prediction. While there have been significant advancements in cancer detection using machine learning techniques, such as RNN there is still some research gap in exploring the potential of LSTM (Long Short-Term Memory) models in this domain. Existing studies have primarily focused on traditional RNN architectures, which may not effectively capture long-term dependencies and intricate temporal patterns present in cancer data. Consequently, there is a need to investigate the application of LSTM-based machine learning techniques for cancer detection and explore how they can improve the accuracy and efficiency of the detection process.In this paper the used dataset is consists reports of Lung Cancer, Colon Cancer and Thyroid Cancer Patients, and for more precisely making the retention of patient report the proposed model in this paper involves a hybrid of RNN and LSTM neural network for finding intricate patterns within complex data and highly precise prediction of cancer.

2. PRELIMINARIES

2.1 Data Set

The dataset employed in this study is the Cancer Text Documents Classification Dataset(Falgunipatel19 2022), which comprises biomedical text full length cancer research papers collected from various medical publications along with the corresponding cancer types. The dataset encompasses three distinct classes of cancer data: Colon Cancer, Lung Cancer, and Thyroid Cancer. A total of 7569 samples were included in the dataset, with 2810 instances representing Thyroid Cancer, 2580 instances representing Colon Cancer, and 2180 instances representing Lung Cancer.

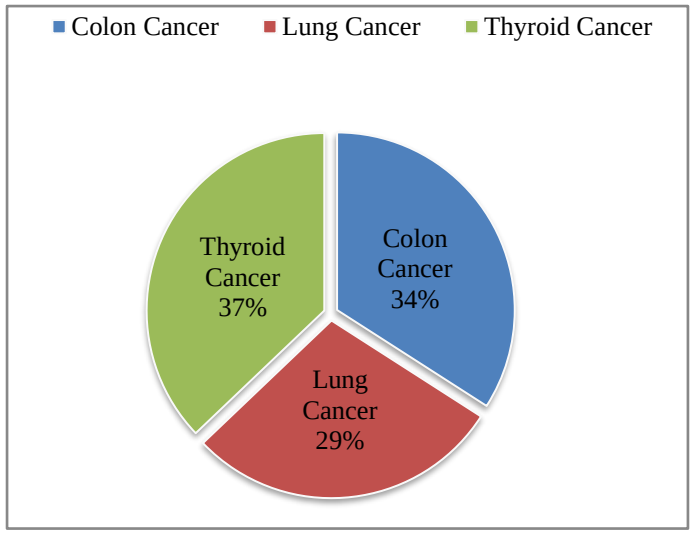


Figure 1: Cancer Text Document Classification

2.2 RNN (Recurrent Neural Network)

RNN(Sherstinsky 2018) is a type of artificial neural network that excel at processing sequential data. Unlike traditional feedforward neural networks, RNNs have the ability to maintain an internal memory, allowing them to effectively capture dependencies and patterns in sequential data. The distinguishing feature of RNNs is their recurrent connection, which enables information to be

propagated not only in a forward direction but also in a backward direction. This recurrent nature allows the network to maintain a state or memory of past inputs and use it to make predictions or decisions based on the current input.The key component of an RNN is the hidden state, which serves as the memory of the network. At each time step, the hidden state is updated based on the current input and the previous hidden state. This allows the network to capture the context and history of the input sequence. The hidden state H_t is computed by combining the current input X_t, the previous hidden state H_{t-1}, and a bias term b . The activation function $tanh$ introduces non-linearity into the computation.

$$H_t = tanh(W_{xh}X_t + W_{hh}H_{(t-1)})$$

W_{xh} represents the weight matrix connecting the input X_t to the hidden state H_t.
W_{hh} represents the weight matrix connecting the previous hidden state H_{t-1} to the current hidden state H_t.

One challenge with basic RNNs is the issue of vanishing gradients, where the gradients become extremely small and hinder the learning process. To address this, several variants of RNNs have been developed, including Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU). These variants introduce additional mechanisms to control the flow of information within the network and mitigate the vanishing gradient problem.

2.3 LSTM (Long Short-Term Memory)

LSTM(Hochreiter and Schmidhuber 1997) is a type of recurrent neural network (RNN) architecture LSTM addresses the vanishing gradient problem that can occur in traditional RNNs, enabling them to effectively capture and model long-term dependencies in sequential data. LSTM networks consist of recurrently connected memory cells that maintain a cell state, allowing information to be stored and selectively updated over time. The network structure includes three main components: input gate i_t, a forget gate f_t, an output gate o_t, a memory cell c_t, and a hidden state h_t , given as:

$$i_t = sigmoid(W_i * [h_{t-1}, x_t] + b_i)$$
$$f_t = sigmoid(W_f * [h_{t-1}, x_t] + b_f)$$
$$o_t = sigmoid(W_o * [h_{t-1}, x_t] + b_o)$$
$$c_t = f_t * c_{t-1} + i_t * g_t$$
$$h_t = o_t * tanh(c_t)$$

These gates regulate the flow of information into and out of the memory cells, enabling the network to learn and retain relevant information while filtering out noise and irrelevant details. The input gate determines which information from the current input and previous hidden state should be stored in the memory cells. The forget gate controls the extent to which previous cell state should be retained or forgotten. The output gate determines how much of the updated cell state should be exposed as the output.

3. RESEARCH METHODOLOGY

In this paper, a cancer detection model is proposed consisting of three stages, as depicted in Fig(2). The first stage involves Data Preprocessing, which encompasses extracting relevant information from the dataset, cleaning the data, and splitting it into Training and Testing sets. The second stage is Model Selection, where the appropriate model is chosen and its hyper-parameters are fine-tuned based on the specific use-case and desired accuracy. Finally, the third
stage is Training and Evaluation, which assesses the accuracy of the model and its practical applicability.

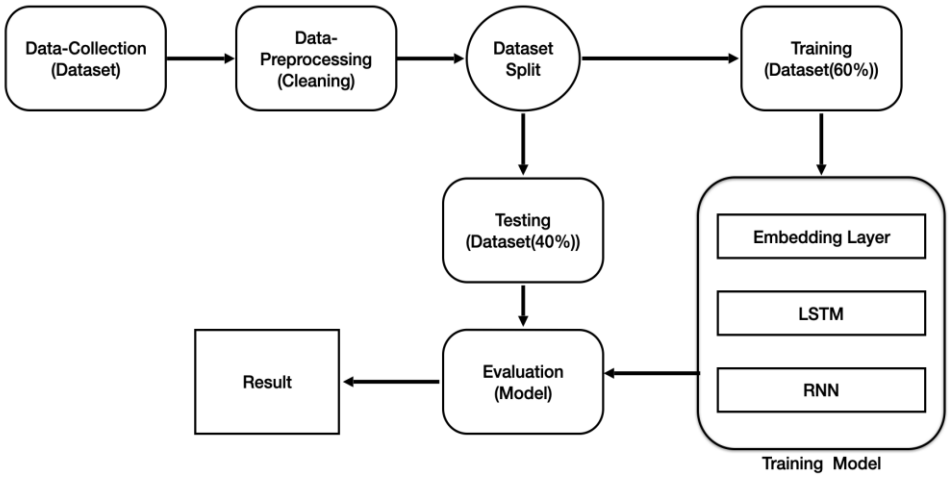


Figure 2 : Methodology

3.1 Data Pre-processing

The initial stage in the process is Data Preprocessing as shown in Fig(3). During this stage, the dataset is examined to extract relevant instances. Subsequently, the data is subjected to various preprocessing techniques such as tokenization, stop word removal, and stemming/lemmatization. Tokenization involves breaking the data into individual units or tokens. Stop word removal is performed to eliminate commonly used words that are considered insignificant and do not contribute much meaning in the given context. Stemming and lemmatization techniques are employed to reduce words to their base form. Stemming utilizes rule-based approaches by removing suffixes and prefixes, while lemmatization follows linguistic rules and employs morphological analysis to transform words into their root form. Once the preprocessing is complete, the data is divided into training and testing sets.

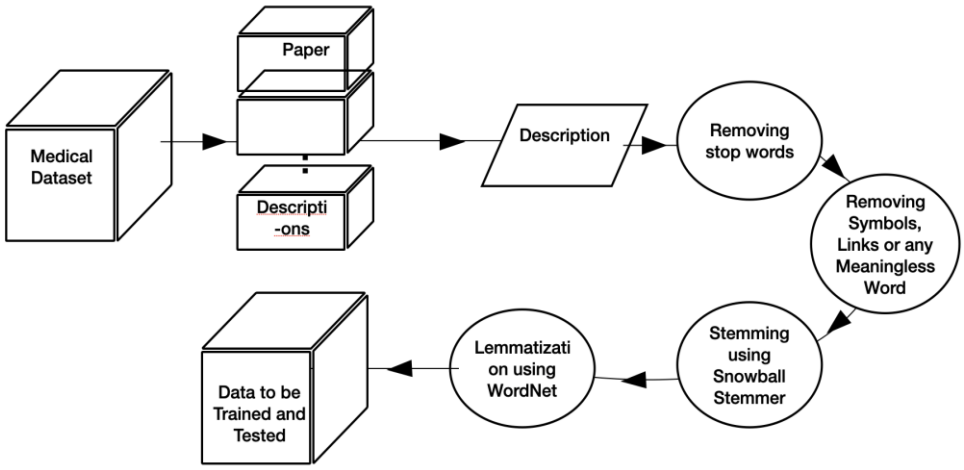


Figure 3 : Data Pre-processing

In the proposed model, 60% of the preprocessed data is used for training, while the remaining 40% is allocated for testing.

3.2 Model Selection

The second stage, which holds significant importance, pertains to model selection. This stage encompasses crucial decisions regarding the composition of model layers. Considering that the dataset consists of text-based data, the initial layer allocated is a word embedding layer. This layer serves the purpose of converting the textual data into a vector representation, as computers do not possess the inherent capability to comprehend natural language. In this particular case, the GloVe 300d Model is chosen for word embedding, as it leverages word occurrences to derive vector representations. Given the extensive nature of the data instances, it becomes imperative to employ an efficient model that exhibits high retention capacity. Thus, integrating a layer of LSTM with RNN emerges as a prudent choice for achieving this objective.

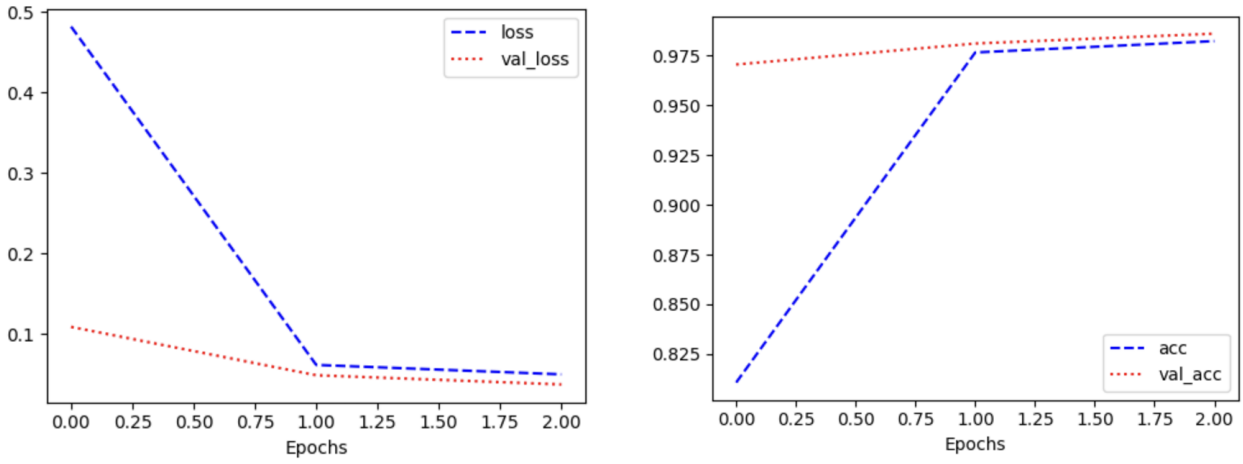
3.3 Training and Evaluation

The final stage of the process involves training and evaluating the selected model using the training data. During the training phase, the model is trained using the available training data. Once the training is completed, the model is evaluated using testing data to measure its performance and accuracy. This evaluation provides valuable insights into the practical effectiveness and capabilities of the model.

Table 1: Experimental Result	
Testing Loss	3.75%
Testing Accuracy	98.61%

4. SIMULATION AND RESULT

The simulation of the proposed model was conducted on a system equipped with an M1 processor and 16GB of RAM. Python and its packages, including Pandas, NLTK, and Scikit, were utilized for the implementation. The total training time required for the model was approximately 23 minutes. Upon completion of the training process, the model demonstrated the ability to accept patient data as input and provide comprehensive information regarding the presence of cancer and its specific type. The results obtained from the simulation of the proposed model are presented in Table 1, which showcases the quantitative measures derived from the experiments. Additionally, Figure 4 illustrates the Loss and Accuracy curves obtained from training data and validation data, respectively, plotted against the number of epochs.



5. CONCLUSION

This paper proposes an innovative architecture for the detection of cancer cells, specifically targeting Lung Cancer, Colon Cancer, and Thyroid Cancer. The effectiveness of the proposed architecture

is evaluated using the Cancer Text Documents Classification Dataset. The experimental results demonstrate the model's ability to detect cancerous cells with a satisfactory level of accuracy. While this paper presents promising results, there are several avenues for future research and improvement. One potential direction is to explore the use of alternative non-linear activation functions, such as the GRU function, which may enhance the model's performance. Additionally, incorporating parallel layers and integrating 2D data, such as CT Scan images, can potentially lead to improved accuracy and precision in cancer cell detection. Further research in these areas will contribute to the advancement of cancer detection techniques and enable more accurate diagnoses, ultimately benefiting patients and healthcare providers

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PHISHING WEBSITE CLASSIFICATION USING PROPOSED ENSEMBLE MODEL WITH PARTICLE SWARM OPTIMIZATION TECHNIQUE

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ABSTRACT

This research focused on phishing website classification using machine learning and particle swarm optimization techniques (PSO) with 10-fold cross-validation data partition techniques. Two phishing websites' distinct datasets D1 and D2 collected and used from UCI repository and both datasets contain 30 features. This research work is conducted in two phases: In first phase, we apply both the datasets with all features into baseline classifiers like Decision Tree (DT), K-Nearest Neighbors (KNN), Support Vector Machine (SVM), Gaussian Naïve Bayes (GNB), Logistic Regression (LR), Random Forest (RF) techniques and existing ensemble classifiers like Extreme Gradient Boosting (XGBoost), Adaptive Boosting (AdaBoost). This paper proposed a new ensemble model that is a combination of K-Nearest Neighbors (KNN) and Extreme Gradient Boosting (XGBoost) using the voting scheme ensemble technique. We have also compared our proposed ensemble model with baseline and existing ensemble classifiers where our proposed ensemble model achieved better performance as compared to others. In second phase, we have applied the PSO feature selection techniques on both phishing websites datasets D1 and D2. The PSO technique reduces the features from both datasets D1 and D2. We have analyzed the above-mentioned existing techniques and proposed ensemble model with reduced features of datasets where our proposed ensemble model achieved satisfactory accuracy 95.20% and 94.09% with 18 features in case of D1 and D2 datasets respectively. Our proposed ensemble model with PSO technique gives satisfactory accuracy which is approximate or little less as compared to all features of both datasets. Finally, we recommended that our proposed ensemble model with PSO techniques reduces the computational time and is recommended for phishing website classification.

Keywords: Phishing Website, Machine Learning, Classification, Ensemble Model, Particle Swarm Optimization (PSO), 10-Fold Cross-Validation.

1. INTRODUCTION

A phishing website is a fake website designed to look like a legitimate one, often used by cybercriminals to trick users into giving up sensitive information, such as passwords, credit card numbers, or personal data. Phishing websites are often distributed through emails or social media posts that contain a link to the fake website. To avoid falling victim to a phishing website, it's important to be cautious when clicking on links from unknown sources or that seem suspicious. Always check the URL of the website you are visiting to make sure it matches the legitimate one, and look for other signs of authenticity, such as the presence of security certificates or trust seals. Classification (Murphy K. P., 2022) is a type of machine learning technique that involves assigning a set of pre-defined categories or labels to input data based on the patterns or features observed in the data. The goal of classification is to build a model that can accurately predict the class or category of unseen data based on the patterns learned from a training dataset. Feature selection techniques (Chandrashekar, G. & Sahin F., 2014) are a very important role in classifying different types of attacks like malicious URLs, Intrusion attacks, Botnet attacks, Phishing attacks, etc. It refers to the

process of identifying and selecting a subset of relevant features from a larger set of available features. It aims to improve the performance of machine learning models by reducing dimensionality, eliminating redundant or irrelevant features, and enhancing interpretability. The research discussed and provides a possible solution for phishing website classification may be helpful for further study. This paper is organized into 3 sections, where "Introduction and Literature Review" section contains an introduction and includes a review of the literature about earlier research papers and studies conducted by other researchers. "Research Methodology" section comprises of Methodology that has been adopted in this paper. "Results and Discussion" includes showing all of the outcomes and implications of the research in the results and discussion. Finally, "Conclusion and Future Scope" section comprises the results.

To identify and predict phishing websites based on various techniques at different times, many studies have been conducted by various authors and researchers. The following studies are related to phishing website classification to increase the accuracy of the classification algorithm. Awasthi A. & Goel N. (2022) used base classifiers for classification, followed by ensemble classifiers, which are tested both with and without cross-validation. When compared to the previous works of literature, the outcomes of this study are remarkable. The proposed ensemble classifier achieved better classification accuracy with k-fold cross validation. Patel J. (2022) suggested a method to categorize URLs as real or phishing URLs. After extracting features based on three criteria, this constructed a dataset with a mix of authentic and phishing URLs. From a total of 10,000 URLs, were able to extract 18 features, with 5000 phishing and 5000 genuine URLs. They used DT, RF, SVM, and ANN as machine learning classifiers and compared their performance in terms of accuracy where ANN achieved the highest 84.35% of accuracy. Pathak P. & Shrivas A.K. (2022) compared performance of individual classifiers like DT, KNN, SVM, GNB, LR, and RF and existing ensemble classifiers like AdaBoost, XGBoost and Bagging classifier (based on decision tree classifier) where XGBoost ensemble classifier achieved remarkable performance of 90.77% accuracy with 10-fold cross validation technique. Odeh A. et al. (2021) have discussed several difficulties with ML-based phishing detection methods. On websites with captcha information, huge amounts of image data, and ML algorithms, inefficiency has been found. The literature extensively studies overfitting, low accuracy, and hyper tuning of ML techniques. Dharani M. et al. (2021) discussed the use of ensemble ML algorithms like RF and XGBoost and a curated feature set, phishing detection using a website's URL is expected to produce highly accurate predictions with a suitable bias-variance trade-off in a timely and secure manner. Satapathy et al. (2019) suggested Extreme Learning Machine (ELM) as a classifier to detect phishing web pages. For results assessment, ELM was compared with other machine learning methods such as NB, and ANN where ELM achieved the highest accuracy of 89.3%. Adi S. et al. (2019) discussed the advantages of feature selection technique. Feature selection process can always boost accuracy and decrease computation time of the classification algorithm, a comparison of the four feature selection approaches will be conducted in this study. They found that after feature selection techniques K-NN, SVM, ID3, DT, and NB increase the performance with less computational time. Jain A. K. & Gupta B. B. (2018) proposed an ML-based anti-phishing system based on URL features. The suggested ML techniques are SVM and NB classifiers trained using more than 33,000 phishing and legitimate URLs. Experiment results show more than 90% accuracy in detecting phishing websites using SVM classifier. Kumar and Gupta (2018) suggested an approach based on hyperlinks information to detect phishing website URLs. They have used feature selection and various ML classification algorithms such as NB, SMO, SVM, RF, LR, Adaboost, C4.5, and NN on WEKA tool to predict the phishing website URLs. Cuzzocrea A. et al. (2018) proposed a decision tree J48 algorithm for classification of phishing attacks. The suggested classifier can detect phishing attacks with a precision of 0.923 and a recall of 0.916 in the evaluation. Machado L. & Gadge J. (2017) proposed an efficient way for detection of phishing websites using C4.5 decision tree approach. For better results, the proposed approach used a variety of URL properties.

2. RESEARCH METHODOLOGY

Research methodology is a very important section in the field of research work. In this section, we have explored the dataset, different machine learning based classification techniques, and feature selection techniques to develop a robust model.

2.1 Phishing Website Data Set

This research work used two phishing website datasets collected from UCI Machine Learning Repository (**https://archive.ics.uci.edu/ml/datasets/phishing+websites**). The first dataset (D1) contains 2456 instances, and the second dataset (D2) contains 11055 instances. In this, both datasets contain 30 features along with one class with two different labels: phishing and legitimate websites. Both datasets D1 and D2 contain 1094,6157 legitimate samples and 1362,4898 phishing website samples respectively. The dataset has no missing values.

2.2 Machine Learning Classifications Algorithm

Machine learning is (Murphy K.P., 2022) a branch of artificial intelligence that enables computers to learn and improve from experience without being explicitly programmed. The machine learning based classification approaches used in this research are Decision Tree (Murphy K. P., 2022), K-Nearest Neighbors (Bishop C. M., 2006), Logistic Regression (Bishop C. M., 2006), Support Vector Machine (Bishop C. M., 2006), Gaussian Naive Bayes (Bishop C. M., 2006).

2.3 Ensemble Classifiers

An ensemble classifier is (Raschka S. & Mirjalili V., 2019) a machine learning model that combines the predictions of multiple individual classifiers to make a final prediction. It leverages the idea that aggregating the predictions from diverse models can often lead to improved accuracy and robustness. Ensemble methods such as bagging, boosting, and random forests are commonly used to create ensemble classifiers. In this research work, we have used different ensemble classifiers are as Random Forest (Bishop C. M., 2006), XGBoost (Chen T. & Guestrin C., 2016), AdaBoost (Raschka S. & Mirjalili V., 2019).

2.4 Particle Swarm Optimization (PSO)

PSO stands for Particle Swarm Optimization (Clerc M., 2010) a popular metaheuristic optimization technique inspired by the social behavior of bird flocks and fish schools. In PSO, a population of particles, each representing a potential solution to an optimization problem, moves through the search space to find the optimal solution.

3 RESULTS AND DISCUSSION

The research focused on developing an effective classification system for classifying phishing and legitimate websites. In this research work, we have used two datasets D1 and D2 as explored in section 2.1, and applied the 10-fold cross validation data partition technique. This experimental work is categorized into two sections:

In the first section, we have developed the model without feature selection for classification of phishing websites in the case of both datasets. In this research work, we have used different machine learning based classification techniques like DT, KNN, LR, SVM, GNB, RF, AdaBoost, XGBoost, and proposed ensemble model and compared their performance in terms of accuracy where our proposed ensemble model achieved highest accuracy as compared to other individual's classifiers in case of both the datasets.

In the second section, we have also used same D1 and D2 datasets with PSO feature selection technique. After applying PSO technique, the features of both D1 and D2 datasets are reduced from 30 to 18. We have applied both reduced datasets D1 and D2 with 18 features to all individuals' classifiers, existing ensemble classifies, and proposed ensemble classifier where our proposed ensemble classifier achieved satisfactory accuracy of 95.20% and 94.09% with only 18 features in

the case of D1 and D2 datasets respectively. Tables 1 show that accuracy table of proposed and existing classifiers and Figure 2 shows the comparative graph of proposed ensemble model and existing classifiers with accuracy in both cases with D1 and D2 datasets.

Table 1: Accuracy of Dataset D1 and D2 for Phishing Website Classification

Classifiers	Dataset D1		Dataset D2	
	Without Feature Selection 10-Fold_CV (Accuracy)	**With Feature Selection (PSO) with 18 Feature (Accuracy)**	**Without Feature Selection 10-Fold_CV (Accuracy)**	**With Feature Selection (PSO) with 18 Feature (Accuracy)**
Decision Tree Classifier	90.72	90.72	90.41	90.41
Gaussian naïve Bias	91.78	91.61	60.39	59.09
Support Vector Machine	94.42	94.22	92.68	91.54
Logistic Regression	94.10	93.85	92.54	92.06
Random Forest	92.31	92.30	91.59	91.60
AdaBoost	93.49	93.57	93.41	92.24
KNN	95.28	94.99	94.71	93.68
XGBOOST	94.87	94.83	93.41	92.73
Proposed Ensemble Model (KNN+XGBOOST)	**95.36**	**95.20**	**94.75**	**94.09**

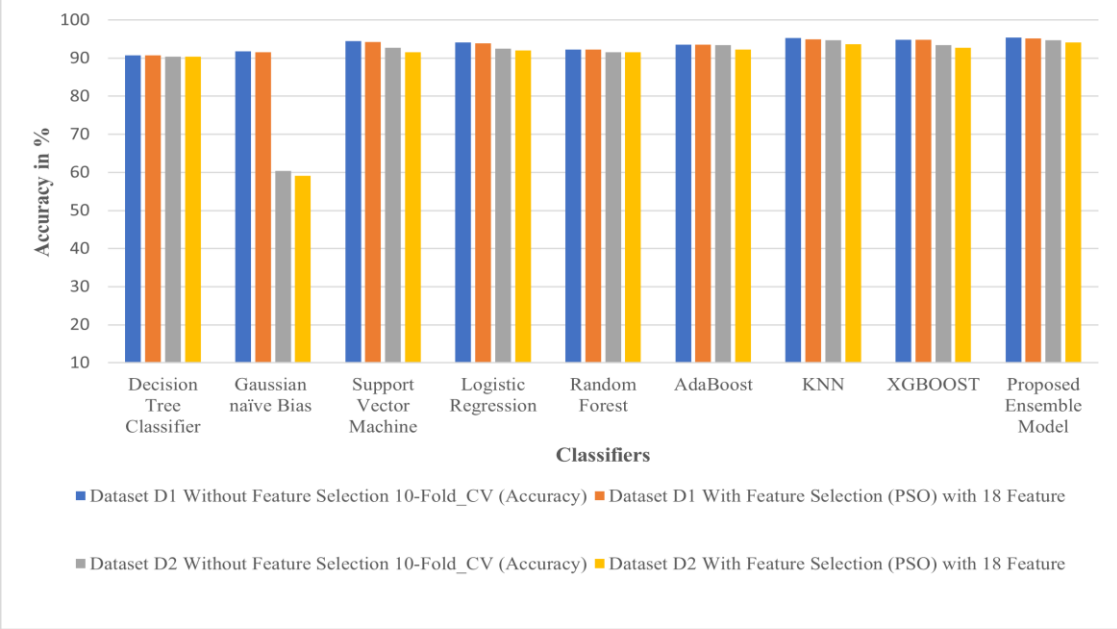

Figure 1: Comparative graph of proposed and existing classifier

4 CONCLUSION AND FUTURE SCOPE

This present research work focused on developing a robust classification system for classifying phishing and legitimate websites. This research work proposed an ensemble model using machine learning based classification techniques and compared the performance of proposed ensemble model with other existing classification techniques with all features of phishing website dataset. This research work also used PSO feature selection technique to select the relevant features

from phishing website datasets and computationally increase the performance of model. Our proposed ensemble model achieved satisfactory accuracy of 95.20% and 94.09% with 18 features in the case of D1 and D2 datasets respectively. The results obtained by this research are outstanding and we observed that they outperformed previous works of literature. So finally, our proposed ensemble model classifies phishing and legitimate websites with less computational time. In future work, we will extend our approach from an automated framework should be proposed based on feature selection and deep learning techniques.

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OPTIMIZING LEARNING OUTCOMES: A MACHINE LEARNING-BASED FRAMEWORK FOR ASSESSING STUDENT AND TEACHER PERFORMANCE

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ABSTRACT

This paper proposes a novel framework for assessing student and teacher performance using machine learning techniques. The goal of this framework is to optimize learning outcomes by providing an accurate and objective assessment of student and teacher performance. The proposed framework utilizes various data sources, including student grades, attendance records, and teacher evaluations, to train machine learning models that can predict student performance and teacher effectiveness. The models are trained on historical data to identify patterns and relationships between different variables, which can then be used to make predictions about future performance. The framework is designed to be flexible and adaptable to different educational contexts and can be used to evaluate performance at various levels, including individual student and teacher levels, as well as at the level of classrooms, schools, and districts. The results of the framework can be used to identify areas for improvement and to develop targeted interventions that can help students and teachers achieve better outcomes. The proposed framework represents a significant advance in the field of educational assessment and has the potential to revolutionize the way that student and teacher performance is evaluated. By leveraging the power of machine learning, this framework can provide insights and recommendations that can help educators optimize learning outcomes and improve educational outcomes for all students.

Keywords: Classification Techniques, Machine Learning, Education System.

1. INTRODUCTION

Education is a fundamental aspect of human development, and the quality of education plays a crucial role in shaping the future of individuals and society as a whole. In recent years, there has been a growing interest in using machine learning techniques to optimize the learning outcomes of students and improve the performance of teachers. The use of machine learning algorithms in education can provide valuable insights into the learning process, help identify areas of weakness, and suggest personalized learning strategies for individual students. Additionally, machine learning can assist in assessing the performance of teachers and provide valuable feedback for improvement. In this paper, we propose a machine learning-based framework for assessing student and teacher performance to optimize learning outcomes. We discuss the key components of the framework and how it can be used to improve the quality of education. The proposed framework has the potential to revolutionize the way education is delivered and contribute significantly to the achievement of better learning outcomes for students. The proposed framework involves the use of machine learning algorithms to analyze student data and identify patterns and trends in their performance. The framework also includes the use of data analytics to evaluate teacher performance and provide targeted feedback for improvement. By leveraging the power of machine learning, this framework can help teachers identify students who are struggling and provide them with personalized support and resources. It can also provide teachers with valuable insights into their own teaching practices and suggest strategies for improvement. Overall, the use of machine learning algorithms in education has the potential to transform the way we approach teaching and learning. By providing personalized support

and feedback, we can improve learning outcomes for all students and ensure that every student has the opportunity to reach their full potential. The proposed framework represents a significant step forward in this direction and has the potential to revolutionize the field of education

2. LITERATURE REVIEW

(Sekeroglu et al., 2019) Education is vital for a productive life. Technology, including AI, has evolved and is being used in teaching and learning. Two datasets were used to predict and classify student performance using machine learning algorithms. Pre-processing the raw data before implementing these algorithms may increase classification accuracy.
(Alam et al., 2021) The study's results showed that artificial neural networks outperformed other models and achieved an accuracy of 82.9% when the relief-F based feature selection method was used. This finding has significant implications for policy formulation, target-setting, evaluation, and reform efforts aimed at improving educational outcomes worldwide.

B. et al., (2021) this paper discusses the potential benefits of utilizing Block chain technology in the context of machine learning. The decentralized nature of Block chain and its ability to handle large amounts of data make it an attractive framework for various machine learning applications. The paper identifies several areas where the integration of Block chain and machine learning could be particularly beneficial, such as data management; secure sharing of data, and fraud detection.

Kucak et al., (2018) The paper provides a detailed analysis of the current and future applications of machine learning in education. It highlights the potential of machine learning in areas such as personalized learning, student assessment, and educational research. The authors also discuss the challenges associated with the adoption of machine learning in education and provide recommendations for future research.

Kasinathan, (2020) This article explores the impact of technological advancement on the Future of Work. The author highlights the significant role of technology in driving progress and innovation, with examples ranging from Industry 4.0 to Artificial Intelligence for All strategy. However, the article also notes the social dimension of technology and its effects on the bargaining power of suppliers and workers. The platform economy is cited as an example of a disruptive force that has impacted the labor market.

Jaiswal & Arun, (2021) This article explores how Artificial Intelligence (AI) is being utilized in the education system in India. The focus of the study is on how educational technology firms are leveraging AI to enhance teaching and learning experiences for students. The authors conducted in-depth interviews with subject matter experts and senior managers from leading educational technology firms to identify the potential of personalized learning, recommendation systems, and adaptive assessments. By applying grounded theory, the authors provide insights into the views of the educational technology firms and experts on the use of AI in the education system, highlighting gaps that exist and potential for future applications. The study has practical implications for transforming the education system in emerging countries.

Alam, Selangor Darul Ehsan, Malaysia et al., (2020) This paper discusses the prevalence and contributing factors of mental health problems among higher education students in Malaysia. The author compares different research papers and identifies gaps in the research. The paper also reviews existing machine learning techniques to analyze and predict mental health problems, with Support Vector Machine being the most commonly used algorithm with high accuracy.

Hidalgo et al., (2020) This study explores the impact of ICT on the labor market and the digital divide in Spain, using advanced data analysis techniques to identify the main socioeconomic drivers of

digital skills. The goal is to assess the population's training needs and improve the level of sustainable development in the country. Previous research has focused on inequalities arising from the emergence of digital technologies, particularly socioeconomic variables such as gender, age, educational level, income, and habitat. This paper contributes to the field by analyzing the digital skills drivers of the Spanish population and identifying potential training needs.

Santos-García et al., (2021) The study identified the best predictors of high AP using the Boruta algorithm and backward elimination and mapped the AP classification probabilities. Results showed that high AP was primarily related to answers regarding the academic environment and cognitive skills, and the identified answers varied depending on the region. The study also found that a rural-to-urban transition of 8-17 years was correlated with achievement of high AP. Overall accuracies of around 0.83-0.84% and Kappa values of 0.65-0.67% were achieved.

Gupta Anuj, (2015), this paper compares various classification techniques in Data Mining using datasets from the UCI Machine Learning Repository. Classification is the process of assigning an input to a specific category, and Data Mining involves extracting knowledge from large amounts of data. The study evaluates the accuracy and time complexity of each classifier, and uses the Confusion Matrix to compare the different classifiers. The goal is to classify items in a dataset into predefined classes or groups.

Jagadhesan et al., (2021) This paper presents a comparison of different classification techniques in Data Mining by using datasets from the UCI Machine Learning Repository. The study evaluates the accuracy and time complexity of each classifier and uses the Confusion Matrix to compare them. The main objective of the paper is to classify items in a dataset into predefined classes or groups.

Mduma et al., (2019) this paper presents a survey of machine learning techniques for addressing student dropout, highlighting several conclusions. There is a lack of research on using machine learning to address this problem in developing countries, and data imbalance is often ignored by researchers, leading to improper evaluation metrics. Many studies focus on early prediction rather than including ranking and forecasting mechanisms, and school-level datasets must be considered to identify at-risk schools for early intervention.

Padmapriya S. et al., (2015) This research paper explores the use of data mining algorithms in educational data mining to improve students' academic performance and experience. The paper highlights the importance of students' satisfaction and academic performance in educational institutions, and discusses the complex factors that contribute to accurate evaluation and prediction of exam performance. The development of an accurate performance monitoring and evaluation system is identified as a crucial need, and data mining is recognized as a valuable tool to mine raw educational data and support this process. The paper further discusses various data types that can be applied in educational institutions. Overall, this paper provides valuable insights into the potential of data mining in the field of education.

Sean et al., (2012) in this essay, we assess how Teaching Assistants (TAs) affect students' grades. We examine the performance of students in six different basic computer engineering courses with a total of 12 different teaching assistants (TAs) and about 800 students.

Harvey & Kumar, (2019) This review examines the use of predictive classifiers in analyzing K-12 education data. Three classifiers, including linear regression, decision tree, and Naive Bayes techniques, are evaluated and compared in terms of their accuracy in predicting student performance. The Naive Bayes technique is found to be the most accurate for predicting SAT Math scores for high school students. The results of this review can be used by educators and stakeholders to implement

timely intervention strategies for at-risk students.

Bhutto et al., (2020) This paper explores the use of machine learning algorithms, specifically support vector machine and logistic regression, to predict students' academic performance. The results indicate that sequential minimal optimization algorithm outperforms logistic regression in terms of accuracy. The study highlights the importance of identifying impactful features such as teacher's performance and student motivation to reduce dropout rates and improve academic outcomes. The findings can be useful for educational institutions to predict student behavior and intervene in a timely manner.

3. METHOD OF STUDY

This essay covers relevant case studies, scholarly articles, and books. The objective is to gather, organise, and synthesize the most recent information on machine learning techniques for forecasting student and instructor performance. The publications that were surveyed focused on a range of research on machine learning in education, including the predicting of final outcomes, academic accomplishment, and student and teacher performance. The findings of this research are highly beneficial for comprehending the problem and improving solutions. Numerous databases, such as Research Gate, Elsevier, and the Association for Computing Machinery (ACM), as well as Science Direct, Springer Link, IEEE Explore, and others are available. With the use of machine learning techniques and prediction algorithms, we used the words "teacher and student performance" and "teacher and student performance" in our keyword and phrase searches. We searched each article's reference list for any titles of potentially relevant studies or journals. The publication periods taken into account range from 2011 to 2021. We use an abstract and keywords to search PDF files, documents, and full-length publications. In addition, when looking for information, we looked for blog posts, expert seminars, conference papers, workshop papers, and other topic-related communities, for instance, the community for instructional machine learning. The inclusion of the papers in this analysis was supported by a substantial portion of those publications.

4. CONCLUSION

In conclusion, this paper highlights the potential of machine learning algorithms in predicting students' academic performance in educational institutions. The study focused on supervised learning algorithms such as support vector machine and logistic regression, and found that sequential minimal optimization algorithm outperforms these algorithms in terms of accuracy. The results of this research can be used by educational institutions to identify students who are at risk of poor performance and to provide timely interventions to improve their academic outcomes. The study also emphasizes the importance of identifying the most impactful features such as teacher's performance and student's motivation, which can be targeted to decrease the student's dropout ratio. Overall, this research provides valuable insights into the use of machine learning techniques in educational institutions, which can help in improving the quality of education and student outcomes. The goal of this study was to evaluate the current state of machine learning in the context of educational systems. Due to the overwhelming amount of studies (papers and articles) that were accessible, only a small number of them—which we thought were excellent representations—were highlighted in the study's findings. This study indicates that machine learning applications in the realm of educational systems may be useful in a number of different, interesting ways. For the purpose of addressing the problem of teaching performance, a review of machine learning approaches and classification methods is offered. The first of the report's many conclusions is that while machine learning has been effectively employed in wealthy countries to solve the problem of teaching performance, less study has been conducted in undeveloped countries. Second, despite serious attempts to employ machine learning in education, many academics have decided to ignore the issue of data imbalance. This makes it simpler to assess algorithm performance with erroneous data. Third, many research focus on early prediction rather than ranking and forecasting systems to solve the issue of teaching

performance.

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BRAIN TUMOR CLASSIFICATION USING MRI IMAGES WITH PROPOSED DEEP TRANSFER LEARNING METHODS

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ABSTRACT

The Brain tumor is one of the fatal diseases of all types of cancers. A brain tumor's detection and classification in medical images is a difficult job because, based on the tumor's precise location, shape, and size the only effective treatment option may be radiosurgery. The goal of this research work is to create an automated method for identifying brain tumors in magnetic resonance imaging (MRI) scans using deep neural networks. To conduct this study, more than 3000 MRI images are employed. The dataset is divided into four categories: depict of healthy normal brain tumors, images of meningiomas, gliomas, and images of pituitary tumors. Grayscale transformation and input image resizing are done to start preprocessing, which helps to simplify complexity. The number of datasets has then been increased by using data augmentation. The classification accuracy is improved by enhancing the contrast and normalizing the intensities of the MRI image. We classify brain tumors using VGG, ResNet, and the proposed DenseNet pre-trained deep learning model. Our proposed DenseNet model with hyperparameter optimization achieved 97.08% accuracy. Which is better than the other two deep transfer learning models. The proposed model not only performs admirably in classifying images of brain tumors, but it also improves neural network design methods.

Keywords: Brain Tumor Classification, Deep Learning, Deep Transfer Learning, Brain MRI Classification, CNN Methods.

1. INTRODUCTION

A brain tumor is a medical disorder brought on by the growth of abnormal cells or tissues inside the brain. Because the human brain is inflexible and volume-restricted, it can be affected by unanticipated developments. As per the World Health Organization (WHO) report Brain tumor accounts for less than 2% of all cases of human cancer; it is also extremely depressing and complicated (Rizwan et al., 2022). Based on the genesis of the tumor and the cellular behavior of the tumor, the World Health Organization divides brain tumors into 120 types, and meningioma, glioma, and pituitary as the most popular types have been detected and identified. Additionally, tumors are categorized according to grades, reflecting tumor aggressiveness and dissemination pace (Khan et al., 2022).

All patients with tumors need to get a proper diagnosis and course of treatment. Early illness detection and treatment are essential to minimizing the rapidly increasing mortality rate caused by brain tumors (Hu A. & Razmjooy N., 2021). There are a variety of factors that contribute to brain tumors, including smoking, heredity, radiation hazards, substance abuse, aging, etc. The term "primary tumor" refers to those that originate in the brain. They can be divided into three groups: pituitary tumors, meningiomas, and gliomas. Diagnosing tumors at an early stage is crucial to save a patient's life.

Magnetic resonance imaging (MRI) helps detect tumors in the early stages of development. A radiologist even with extensive experience may grade the tumor incorrectly if he or she analyses it manually (AS R. A. & Gopalan S., 2022).
In recent years, computer vision techniques have advanced rapidly, resulting in highly improved

algorithms for predicting tumors using deep learning and machine learning. These cutting-edge algorithms offer superior classification models that more accurately grade the tumor even in the absence of a medical expert. Once the medical condition has been identified, a doctor can perform additional diagnostic procedures (AS R. A. & Gopalan S., 2022). Detecting tumors in the low-grade range early improves the likelihood of survival and enhances the potential for a better recovery and quality of life after cancer treatment.

The use of artificial intelligence (AI) tools in clinical research is rapidly expanding due to its success in predicting and categorizing medical conditions, particularly in the analysis of brain tumors. AI has demonstrated promising results in the characterization of brain tumors, and its use can lead to more accurate diagnoses and treatment plans for patients. Deep learning (DL), a category of machine learning, often relies on hierarchical features and data representations. To extract descriptors from the data, DL algorithms use a hierarchical organization of multiple layers of nonlinear processing methods. This approach enables DL to learn intricate patterns and features from vast datasets, making it a potent tool for tasks such as speech and image recognition, predictive analytics, and natural language processing **(**Alshazly et al., 2021**)**. In the field of bioinformatics, where it has achieved remarkable success and gained popularity in the field of disease diagnosis and treatment, deep learning algorithms have produced notable results (Min S. Lee B. & Yoon S., 2017).

In this proposed research work, our research focuses on evaluating various classification algorithms' abilities to accurately identify brain tumors in MRI image data. To ensure accuracy and reliability in subsequent analysis, the initial step in analyzing raw image data involves pre-processing to eliminate noise. After the pre-processing step, the MRI tumor images are processed using deep learning algorithms like VGG, ResNet, and DenseNet to classify the grade of the tumor. This process involves training the deep learning model to identify patterns and features in the pre-processed images that are indicative of tumor grade. By using deep learning algorithms, this process can be highly accurate and can provide valuable insights for clinical decision-making.

The remaining sections of this paper are divided and structured as follows: Section 2 deals with the literature review, Section 3 deals with the proposed methodology followed by this research work, and Section 4 deals with the performance evaluation and result. Finally, Section 5 provides the conclusion and future study.

2. LITERATURE REVIEW

There are numerous research papers in the literature, depending on how brain tumors are categorized. Some of the works that have been discussed are listed below.

Alnowami et al. (2022) proposed a Densely Connected Convolutional Network (DenseNet)with 10-fold cross-validation using the three different datasets. The proposed technique achieved 96.52% accuracy, the sensitivity is 98.5% and the specificity was 82.1%.

Shanthi et al. (2022) proposed an automatically optimized hybrid deep neural network (OHDNN) technique which is a combination of CNN-LSTM. The proposed hybrid deep neural network attained 97.5% accuracy. The proposed technique has an advantage for automatic brain tumor classification.

Irmak E. (2021). proposed CNN model with hyper-parameters is tuned by the grid search optimizer. When compared to other well-known, cutting-edge CNN models like AlexNet, Inceptionv3, ResNet-50, VGG-16, and GoogleNet, the proposed model had the highest accuracy.

Anaya-Isaza et al. (2023) proposed seven pre-trained deep learning models InceptionResNetV2, InceptionV3, DenseNet121, Xception, ResNet50V2, VGG19, and EfficientNetB7 networks. The

InceptionResNetV2 network achieved up to 97 % accuracy as compared to another model. When it comes to training time, the suggested model was found to be the most efficient, taking only about half the time for the classification of the FLAIR dataset.

Turk et al. (2022) proposed ensemble deep learning architectures for automatic brain tumor detection using four deep learning models ResNet50, VGG19, InceptionV3, and MobileNet with class activation function (CAM). The ResNet50 deep learning model achieved 96.45% accuracy which is higher than the other model for multi-class brain tumor classification. The proposed ensembled architecture can be used in multi-class classification, detection, recognition, and time performance in future research work.

Rammurthy D. & Mahesh P. K. (2022) proposed an optimization-driven method using the Whale Harris Hawks optimization (WHHO) method and DeepCNN for brain tumor detection. The proposed WHHO-based DeepCNN method outperformed compared to other different methods with an accuracy of 0.816%. This method can be used in brain tumor detection with better accuracy.

Srinivas et al. (2022) suggested a transfer learning-based CNN pre-trained ResNet50, VGG16, and Inception-v3 models for automatic brain tumor cell prediction. The pre-trained model VGG16 gives better accuracy than the other model with 90% training accuracy and 88.26% validation accuracy.

Rinesh et al. (2022) proposed a hybrid method combining deep learning and machine learning techniques. ResNet18 and AlexNet are combined with the SVM algorithm for brain tumor classification. The AlexNet+SVM hybrid technique gives the highest 95.10% accuracy, 98.50% specificity, and 95.25% sensitivity.

Sultan et al. (2022) proposed a convolutional neural network for the classification of brain tumors into various grades that are based on deep learning. The suggested network structure performs admirably, achieving the best overall accuracy. The outcomes show the model's suitability for multiple classifications of brain tumors.

Alhassan A. M. & Zainon W. M. N. W. (2020) Suggested Bat Algorithm with Fuzzy C-Ordered Means (BAFCOM) for segmentation and four other classifiers Enhanced Capsule Networks (ECN), Residual Networks (ResNet), KE-CNN, and Convolutional Neural Networks (CNN) for brain cancer classification. The proposed ECN classifier obtains maximum accuracy of 95.91% as compared with CNN, KE-CNN, and ResNet.

3. RESEARCH METHODOLOGY

This research aims to create a robust and effective method for classifying brain tumor MRI images. Figure 1 depicts the proposed architecture of the work.

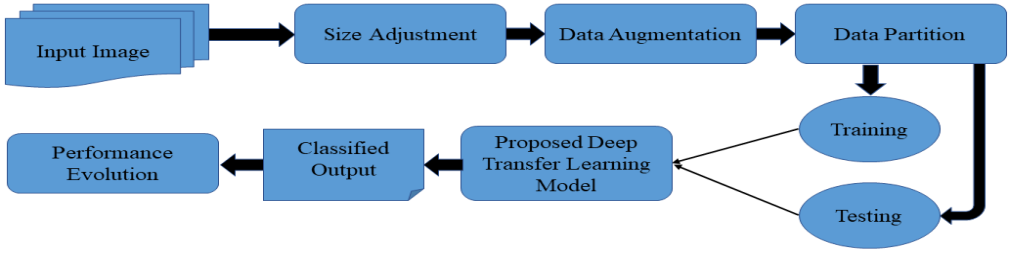

Figure 1: Proposed Architecture for Brain Tumor Classification

The above diagram shows how the processes are employed for the classification of the brain tumor dataset. In the first step, the dataset was collected from Kaggle open-source repository. In the second

step, the dataset was not in a similar shape and size, so in this case, the pre-processing technique was employed for making the dataset homogeneous, and for increasing the dataset size we employed the data augmentation technique. In the third step dataset was partitioned into 80:20 for training and testing. Finally, a proposed deep transfer learning model was used and compared the performance using performance evolution metrics and suggested that the proposed DenseNet102 deep transfer learning model is more accurate for the classification of brain tumors as compared to other deep transfer learning models.

3.1 Data Set

For research work, more than 3000 images were collected from an open-access Kaggle datastore (Saleh A. Sukaik R. & Abu-Naser S. S., 2020). It contains 826, 822, 395, and 827 images of brain MRIs with glioma, meningioma, no tumor, and pituitary tumors, respectively. The basic structure of the MRI image is heterogeneous, and the dataset's size and form are non-linear. The MRI dataset is shown in Figure. 1 using their labels.

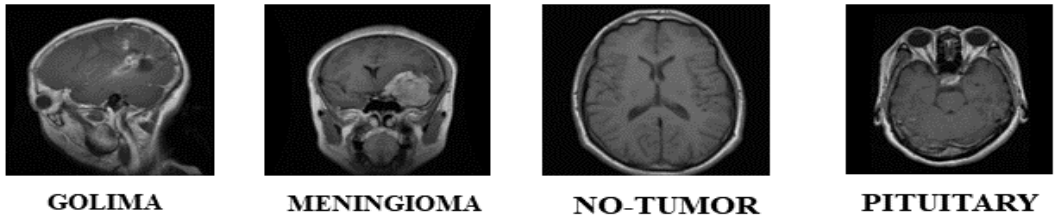

Figure 2: Brain Tumor MRI Image Dataset

3.2 Pre-Processing

The pre-processing of data increases the effectiveness and accuracy of a deep-learning model by cleaning the data. Although not all the brain images in the MRI datasets are the same size, height, or width, all the MRI images are scaled to 224*224 to provide uniformity for training purposes. Additionally, we have created various variant images using image augmentation to obtain a generalized model.

3.2 Data augmentation

For deep learning to function, there is a need for a large amount of data, so data augmentation helps to increase that amount. The effectiveness of categorized results can be increased by enhancing them. It is also referred to as the process of making numerous copies of the original image from various angles by applying scrolling, rotating, enlarging, etc. to the original dataset.

3.3 Deep transfer learning models

Deep transfer learning is a method for using a model's previously acquired knowledge to learn a new set of data (Tan C. et al., 2018). Different settings for transfer learning are defined based on the type of task and the nature of the data available at the source and target domains (Shao L. Zhu F. & Li X., 2014). When labeled data is available for a classification task in both the source and target domains, the transfer learning approach is referred to as inductive transfer learning. In this research work, we used three pre-trained models: VGG19, ResNet50, and DenseNet102.

3.3.1 VGG19

The VGG19 transfer learning model contains 19 layers proposed by Simonyon and Zisserman (Simonyan K. & Zisserman A., 2014). The convolution process in this architecture makes use of 3x3 dimensional filters. It includes Conv layers with fixed 3 x 3 filter kernels and a 5 maximum pooling layer. The fact that this architecture obtains a high level of features from the images is another reason why it is preferred. It has 138 million hyperparameters. The hyperparameters are crucial because they regulate the mode's overall behavior (Srinivas et al., 2022).

3.3.2 ResNet50

ResNet-50 was created by Kaiming with the intention of residual learning, which could be easily interpreted as the derivation of input characteristics from a particular layer. ResNet can accomplish this by establishing shortcut acquaintances with each pair of the thirty-three filters, directly

connecting the input of the k^{th} layer to the $(k + x)^{th}$ layer. By re-using initiations from the previous layer until the neighboring layer has learned its weights, the problematic vanishing gradients can be retained without using layers (Saleh A. Sukaik R. & Abu-Naser S. S. 2020).

3.3.3 Proposed DenseNet121 model

DenseNet and Resnet are both deep learning techniques, but DenseNet has some key distinctions. DenseNet concatenates the output of the previous layer with the next layer while ResNet uses an additive method that merges the previous layer with the next layer. The first convolutional layer in a traditional feed-forward convolutional neural network (CNN) receives the input and output of the previous convolutional layer, which produces an output feature map that is then passed on to the next convolutional layer. A DenseNet solves this problem by streamlining connectivity between layers and modifying the typical CNN architecture. Each layer in a DenseNet architecture is directly connected to every other layer, giving rise to the term densely connected convolutional network. The proposed DenseNet121 has 1 7*7 convolution,58 3*3 convolution,61 1*1 convolution, 4 avg pool layers, and 2 fully connected layers for the classification of MRI images.

4. EXPERIMENTAL RESULTS AND DISCUSSION

In this section, we discuss the performance metrics and results of the experimental work.

4.1 Performance Evaluation Metrics

There are several metrics that can be used to measure the accuracy, precision, recall, and F1 score of different classifiers. These performance metrics associated with the terms true negative (tn), true positive (tp), false negative (fn), and false positive (fp) are used. The performance metrics of the classification model are shown in Table 1.

Table 1: Performance evaluation metrics for classification models

Metrics	Formula
Accuracy (acc)	acc = (tp + tn)/tp + fp + tn + fn
Recall (rec)	rec = tp/(tp + tn)
Precision (pre)	tp/(tp + fp)
F1 Score (f-score)	f-score = 2∗rec∗pre/ re*c*+pre

5. RESULT DISCUSSION

The experimental simulation is performed using an Intel Core i7-11500H CPU running at 1.00GHz to 2.30GHz, 8 GB of RAM, Windows 11, and Nvidia GeForce RTX graphics. Python 3.10 is used to program the networks in Jupyter Notebook. Both the Keras library and the TensorFlow backend have been used. To classify different types of brain tumors from MRI images, three deep transfer learning models were applied: VGG19, ResNet50, and the proposed DenseNet. The ReLU activation function was used in a fully connected layer. Testing was done on all three deep transfer learning models using a batch size of 32 and 50 epochs. The batch size specifies how many training samples will be distributed throughout the network and the epoch has passed, the entire training dataset is precisely once passed forward and backward through the neural network. As a result, the Proposed DenseNet network provides excellent results for the classification of brain tumor types when considering the maximum and average performances obtained from the tests. The proposed DenseNet model outperformed compared to other models, with a data augmentation method to detect all brain tumor cases with a 97.08 % accuracy rate. The VGG19 and ResNet50 deep transfer learning

models showed 96% and 95.29% accuracy for the classification of MRI images. Table 2 displays various model performance comparisons in terms of F1 score, precision, recall, and accuracy of different deep transfer learning models. Figure 2 depicts a graphical representation of the performance of the deep transfer learning model. Finally, it is recommended that the proposed DenseNet deep transfer learning model is the best and most significant classifier for the classification of brain tumor MRI Images.

Table 2: Deep transfer learning experimental results

Classifier	Precision	Recall	F1-Score	Accuracy
ResNet50	93.66%	92.24%	91.45%	95.29%
VGG19	94.64%	89.05%	93.78%	96.00%
Proposed DenseNet model	**94.62%**	**98.66%**	**96.83%**	**97.08%**

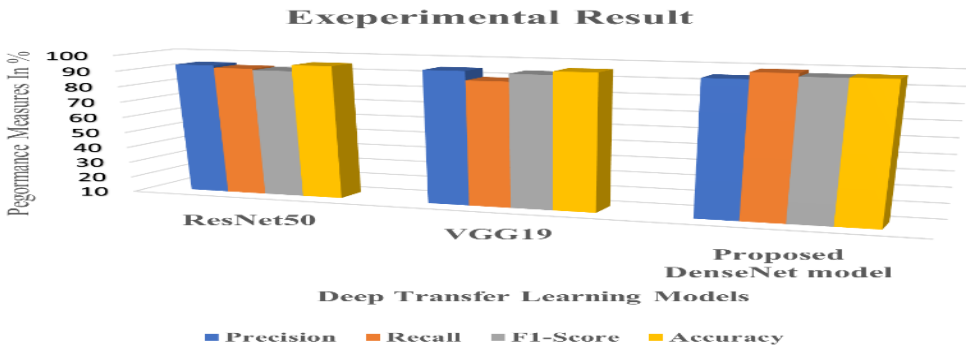

Figure 3: Performance measurement of the Deep Transfer Learning models

6. CONCLUSION AND FUTURE WORK

In this study, deep transfer learning proposed of classification brain tumor grades from MRI image datasets. ResNet50, VGG19, and DenseNet102 deep learning architecture are used for training transfer learning networks. The tumor MRI images were pre-processed and augmented before training the transfer learning network model. The experimental result showed that the Densenet102 deep transfer learning model with ReLU activation function gave remarkable accuracy with 97.08%. This proposed deep transfer learning model achieved the highest accuracy among all other used transfer learning models. In the future, we will apply metaheuristic feature extraction methods to improve the classification model's output and overall performance. We will also develop a robust automated brain tumor identification model based on the deep learning ensemble method with a multi-class MRI dataset.

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