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ACCOUNT LOGIN AND DATABASE ACCESS CONTROL SYSTEM WITH TIME ATTENDANCE THROUGH FACIAL RECOGNITION

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ABSTRACT
As digital technology accelerates at an unprecedented pace, educational institutions and businesses are looking for more efficient and accurate ways to record attendance. Traditional attendance methods, such as manual signing or manual data entry, can face several challenges, including human error, inaccuracy, and time consumption, ultimately leading to decreased efficiency and productivity. With the increasing demand for smarter and more efficient solutions, it has become imperative to explore new technologies that can improve this vital process. The main problem is that traditional attendance systems are unable to keep up with the speed, accuracy, and security demands of the modern era. These systems are often prone to errors, which can result in incorrect or inaccurate attendance, and the attendance process can be time-consuming, especially in large groups, reducing time allocated for educational or productive activities. This study aims to develop an automated attendance system using real-time face detection technology, with the aim of improving efficiency, accuracy, and security compared to traditional attendance methods. Haar Cascades technology was used to recognize and classify faces, with attendance data stored in a MySQL database managed via SQL. The results of the study showed an accuracy rate of up to 97.44% in detecting faces and recording attendance under different conditions. It is proposed to enhance this system in the future by integrating anti-impersonation and mask detection technologies and using deep learning principles to increase security and effectiveness in different scenarios.
Keywords: *Face Detection, Face Recognition, Database, Attendance Management Among Them.*

1. Introduction

In the recent decade, the world has embraced the use of advanced technologies in all sectors, and the educational sector is not an exception for embracing technological inventions in attending management. Conventionally, such systems have applied the methods of written signatures, as well as manual data entry which, although being quite noncomplex, bear numerous shortcomings, for example, high levels of inaccuracy, uncertainty in check, and data falsification. Due to the arrival of artificial intelligence and deep learning in the education sector, new approaches are introduced and available to take advantage of for the functioning of attendance management, for instance, the facial recognition system. This technology based on the features of individual faces facilitates the process of registration and attendance recognition and does not take much of the official time while providing high results (Andrejevic & Selwyn, 2020; Ayomide et al., 2021; Enriquez, 2018; Min & Ab Ghafar, 2022; Sunaryono et al., 2021; Yang & Han, 2020).

Facial recognition is one of the types of computer software designed in the use of machine learning algorithms to determine the features of a face to identify a person or as a means of identification (Kaur et al., 2020). In recent years it has improved a lot and is today incorporated to different devices like smart phones or to security systems. In the context of education a great opportunity to enhance satisfactory attendance record in a safe and accurate way, as well as to minimize administrative burdens that educational institutions face on a daily basis. Despite the In the course of the significant technological advancement being experienced in this world, majority of schools, colleges and universities continue to embrace traditional methods of monitoring attendance with the use of conventional techniques accompanied by old-fashioned systems that are not only inefficient but also inaccurate (Badrul et al., 2022; Mann & Smith, 2017; Rattani et al., 2019). They help to raise the human error rate, aggravate the verification and settlement of issues, and make it easier to falsify records. For instance, the

student can change his or her signature or request the other students to mark his or her attendance, which provide wrong results. However, these systems are time-consuming to handle and so consume lots of time of the teachers and administrators hence reducing the time they use to perform other functions in the process of education. Additionally, those institutions that have employee ID automated systems which include fingerprint scanners or magnetic cards call for the installation of special equipment which can be costly and cumbersome to source. Due to these challenges the world today has shifted to look for updated technological solutions that would phase out these problems and bring in exact and secure method to record attendance. To fill the gap created by the lack of proper attendance management systems this research aims at suggesting an automatic attendance system based on real-time face recognition (Navarrete & Ruiz-Del-Solar, 2002). The system is developed in Python, with MySQL for data management, and the User interface front-end developed using Tkinter library. This system is distinguished for having a detection and identification of faces using OpenCV and Face Recognition libraries which are considered to be well-known programs in this area. Here, first of all, students' photos are taken to a data base for training the system. When the system is on to record attendance the camera shows real time images and then the system apply Histogram of Oriented Gradients (HOG) technology to detect faces on the frame (Smitha & Hegde, 2020)(Varadharajan et al., 2016). Subsequently, there was facial landmark estimation which involved alignment of the face gotten from detection in order to match the face for identification. After that, each face is passed through a deep convolutional neural network algorithm and that algorithm yields the 128 parameters for each face. These measurements are directly compared with the data stored in the database with the help of basic linear algorithm of support vector machine SVM in order to identify with precision. Subsequent to that, recording of the name, date and time with regard to the update of the database is made into the CSV file identified with the match (Waelen, 2023). This system provide an easy and reliable solution that enhances the effectiveness and the reliability of the registeration of attendance and reduces the probability of interference or error. Additionally, there is the future improvement proposed; for example the integration of anti-impersonation technology such as placing a mask on, and in the principles of deep learning to enable the system to identify accurately the different quarters it will be deployed on. Application of such technologies in the system will improve the system as well as capacitate in handling future event related to learning institutions. Last of all, it would be pertinent to mention that this system also helps not only to increase the work effectiveness of directors and managers to get the better of attendance management but also to become one of the priorities in the process of the further education institutions' thorough transition to digital learning environment and to build solid and innovative educational process (C. Zhu et al., 2019).

2. Related works

The current section includes reporting of the most relevant researches within the topic of the attendance registration with the help of face recognition. Special attention is paid to the outcomes of the offered systems in this area. PCA is applied in the new way introduced in Hartanto & Adji (2018) to construct a compressed face analyzer (LE). As can be observed from the above results it is clear that, when a basic regularization step is applied after the PCA, it improve the performance of the proposed descriptor. With regard to limitations of pose variation, the study describes a pose matching strategy using the pose classifiers regarding pose combinations. What this strategy gives as outcome are the results similar to those shown by the methods on achieving the recognition rate of 84. 45% on the standard Labeled Face in Wild (LFW) data set. It is straightforward, and at the same time does not limit its applicability to a particular type of dataset, and remains efficient. Paper Serengil & Ozpinar (2020) employs the recognition method employing pre-trained models like VGG Face, Facenet, OpenFace, DeepFace, DeepID and Dlib. Among these, he considers FaceNet to be the best one. The system makes the process of facial recognition and face verification management easier employing a Python based library, "DeepFace", and measures the performance of the models, based on distance metrics. The FaceNet was found to be the most accurate predictor of recognizing human faces, closely succeeded by the VGG Face. This system fully automates the recognition stages and owns a simple transition mode between the different systems. The work in Parkhi et

al. (2015) compares of different models and training data changes towards the face recognition on LFW database and provides comparison by revealing the performance of the prepared approaches with other state of the art approaches in LFW and YouTube Faces (YTF). The following work has been conducted in MATLAB using MatConvNet for implementation and CuDNN for improved speed and experiments using NVIDIA Titan Black GPUs. The CNN φ (`t) produces 4096 descriptor vectors and from each face image, 10 patches are cropped, scaled, and averaged for multi-scale testing. The study includes a component-wise analysis to deal with the organization of the data set. The triple loss is added which significantly decreases the error rate was also added. The results have demonstrated reasonable performance on the both LFW and YTF datasets as well as higher performance on certain facial images than some of the modern approaches which use the deeper network architecture and more data. At the end of the study, the importance of CNN is as emphasized as the various applications discussed in the paper are presented. The introduced method allows for reaching a classification rate of 98. 95 per cent on the LFW dataset and demonstrates relatively high performance on the YouTube Faces dataset, which confirms its ability to meet the challenges. In the study Furnell & Clarke (2018), face verification is about accessing identity embedding, and this can be achieved using relational databases which outperform some other approaches. Facial recognition tasks require frequent face verification, which means that face verification constitutes a subset of. Although some tools are strong in performance, they show weakness on large tasks as the size of face databases increases. To solve this problem, redundant performance tools are used that use big data solvers and run k-NN or a-NN algorithms very efficiently.

In this study (Liébana-Cabanillas et al., 2020), the authors propose a behavioral model to explain mobile payment acceptance, focusing on the shift towards a cashless society. The research uses different theories of technology adoption, such as TAM and UTAUT, along with additional concepts such as mobile user skill, personal innovativeness, convenience, and perceived risk. Among the key findings, convenience emerges as an important variable, which positively influences the perceived value of the payment method.

The study Gupta (2020) focused on the use of (CBIR) technology in image retrieval. The study relies on hyperdimensional feature technology in many image processing pattern recognition applications. The binary bat algorithm is based on cryptographic scale, shuffling and mutation operations. The proposed system increases data accuracy by removing impurities and noise, after which image features such as color, texture and shape are restored.

The study by Feroze & Ali (2024) presents an intelligent face recognition (FR) system for effective attendance management. To improve the system performance, the system uses several face recognition techniques, including Fisher Facial Recognizer, PCA/Eigen Face Recognizer, and Local Binary Histogram. To increase the accuracy, these techniques are combined using Ensemble Fusion. The system also uses Multitask Cascaded Convolutional Network for feature extraction and face detection. To detect recognized faces and record attendance, the extracted features are compared with stored face templates. Record maintenance is facilitated by integration with Cloud API. A feedback and notification system is also included to indicate the process status in the system. According to the results, the proposed system predicts and records attendance with an accuracy of up to 82.1% in just 0.000081 seconds.

The automation designed by Bavaskar (2024) eliminates possibilities of human error at various point when taking and reporting attendance, at the same time it afford teachers or administrators valuable time. This work also manages with changes in lighting and with the faces' expressions, which means that it works even in a larger variety of situations in comparison to previous examples. For instance, the system can identify him though he is wearing glasses, smiling or frowning. Such robustness is however necessary to guarantee the reliability of the system and the consent of the user on the regular use of the system. The work also looks at challenges that occur during the development of an accessibility control system, for instance, getting the access control system and the databases to be compatible. Further, the study also elaborates measures that are likely to enhance the reliability of the system. This paper also offers suggestion on how to enhance the efficiency and reliability of the system, some of which are; encrypting student or staff information where ever it is required and controlling the complexity of the system to ensure that processing time and real-time capabilities are optimally

achieved. By giving an idea of the future use of such systems this conversation paves way to the acceptance of the facial recognition technology by larger percentile.

From a brief analysis of the past academic findings of using face recognition techniques for attendance recording systems, researchers found some gaps. Concerning the face pose shifts, the problem is addressed in Hartanto & Adji (2018) using conventional methods, classifier-based pose matching. Regardless of the general trend toward increased similarity, the relative positions of the heads are quite different and this is why in spite of everything, the performance has to be increased. Furthermore, there is a lack of extensive work dedicated to building new models from the scratch as indicated from the study Serengil & Ozpinar (2020) where the authors relied pre-trained models such as VGG Face and FaceNet. While the study pointed techniques for increasing performance on huge database more powerful and efficient tool that can handle large amount of data and ensure identity verification need to be developed. Finally, although the study Bavaskar (2024) presented challenges facing databases and access control systems, issues relating to their integration were not well addressed to provide satisfactory answers, thus ensuring flexibility and total compatibility in contexts. For this reason, in the present work, a method to build an attendance system based on face recognition is presented. It is here that the possibilities of the suggested method and general efficiency on a massive amount of data are maintained together with ability to overcome the challenges created by facial expressions and lighting conditions. This shall be done with the aid of new face recognition technology and new performance update and system integration which assist in enhancing the accuracy and reliability of attendance tracking with less chances of human interference.

3. Theoretical background:

The theoretical aspect of the proposed system is presented in this paragraph and thus the algorithms used are explained.

3.1 Database

SQL Server is a product specifically developed by Microsoft for the purpose of simplifying the operation of databases and for managing the data in these systems. The systems supports the database language SQL. Tables, views, stored procedures, and other aspects of a database can be created with the help of SQL Server. Data is displayed in columns and raw which forms tables. A record is defined by each row and an attribute by each column. This means that by employing the SQL statements such as SELECT, INSERT, UPDATE as well as DELETE, the users can query or even modify the information within the system. In combination with compiled SQL statements – stored procedures – the set of activities is simplified and performance is improved. Indexes help in quick location of data and allows row retrieval. SQL Server incorporates user controls and user authentication procedures and encryption as security measures. Software tools for example SSRS for setup and special tools that assist with the analysis tasks such as SSAS. Microsoft packages it under System Integration Services (SSIS) that enables design of data integration solutions concerning the most effective management of data load from different sources to diverse destinations most appropriate in meeting the complicated business requirements.

Always On Availability Groups: A high-availability and disaster recovery system that offers an alternative to database mirroring at the corporate level is shown here. SQL Server has various editions, such as SQL Server Express (free edition with limitations), SQL Server Standard, and SQL Server Enterprise, each catering to different needs and workloads. Additionally, Microsoft regularly releases updates and new versions of SQL Server with enhanced features and performance improvements (Chakraborty et al., 2016).

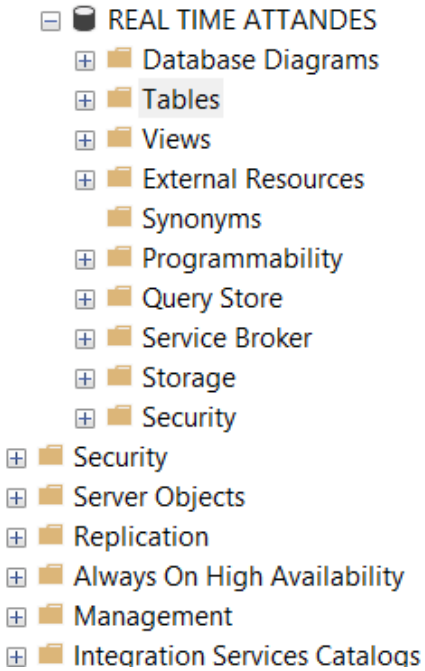

Fig. 1. some key features and concepts related to SQL Server.

3.2 Face detection

Haar Cascade object detection technology recognizes objects in photos or videos using machine learning. The Haar Cascade technique was described in the landmark 2001 publication "Rapid Object Detection Using an Augmented Series of Simple Features" by Viola and Jones. He highlighted the fundamental use of Haar Cascades in the field of real-time object recognition. Below is a simplified explanation of the Haar Cascade process (Feng et al., 2016).

3.2.1 The integrated picture

Calculating the integral image of the input image is the first step. Each pixel in the integrated image represents the sum of the pixels to its left and above it in the original image. This makes it possible to quickly and efficiently calculate the sum of pixel values within any rectangular area (Zhu et al., 2019).

3.2.2 Har-like features

Haar-like features are simple rectangular patterns that can be used to describe different aspects of an object's appearance. These features can represent differences in density, edges, and textures in the image (Li et al., 2016).

3.2.3 Waterfall training

Haar Cascade is trained using a machine learning algorithm called AdaBoost. During the training process, the algorithm selects a subset of features. It determines the optimal threshold for each feature to distinguish between positive and negative examples (faces and non-faces, in the case of face detection) (Bharadwaj et al., 2016).

3.2.4 Cascade Structure:

The Haar chain is organized into stages, where each stage consists of a set of weak classifiers. Each weak classifier is a simple decision rule based on one of the selected features. The cascade structure is designed to quickly reject areas that are not present in the image, thus accelerating the overall detection process (Gohringer, 2012).

3.2.5 Adaptive Boost (AdaBoost):

AdaBoost is a boosting algorithm that assigns weights to training samples. It focuses on the misclassified samples in each iteration, assigning higher weights to them, so that subsequent

weak classifiers pay more attention to those samples (Duan et al., 2017). The final strong classifier is a weighted sum of the weak classifiers.

3.2.6 Threshold:

The trained Haar Cascade is applied to the image by moving a window over the image and calculating the response of each weak classifier at each stage. If the response exceeds a certain threshold, the area is considered positive, and the chain moves to the next stage. If the region fails at any stage, it will soon be rejected (Joshi et al., 2023).

3.2.7 False positive reduction:

The sequential structure allows efficient rejection of nonexistent regions, reducing the number of false positives. Returns regions that are likely not present in the early stages of the sequence (Ali et al., 2022).

Finally, due to the speed and efficiency of the Haar Cascade method, it is widely used in real applications. It is particularly popular for detecting faces, but can also be trained to detect other objects. OpenCV provides pre-built Haar Cascade classifications for various objects, making it easier for developers to integrate this technique into their computer vision applications.

3.3 Face Verification and Face Recognition

The words “Face Verification” and “Face Recognition” may not be clear. Classifying face pairs as a person or a separate person is the task of face verification. For this challenge, facial recognition models from scientific articles were evaluated (Rai et al., 2023). However, the goal of facial recognition is to determine the location of a face within a database. This requires frequent facial verification (Michos et al., 2020). If vector representations are accepted for verification, the time complexity of face verification is denoted by O(d), where d is the number of dimensions contained within the representation vector. On the other hand, the time complexity of face recognition is denoted by O(nd), where d represents the number of dimensions of the vector representation and n represents the number of iterations in the entire database. For a large-scale database, the value of n exceeds the number of dimensions by a large margin (Talahua et al., 2021).

3.4 Pipelines for Facial Recognition

Four standard steps comprise a modern facial recognition pipeline: detection, alignment, representation, and verification. The initial steps of detection and alignment are to provide the representation module with unambiguous inputs. The paper will not address these preliminary stages of the pipeline. Convolutional neural networks are the primary foundation for facial recognition models during the representation stage (Viswanathan et al., 2024).

The early output layers' probabilities are used as vector representations instead of determining the dominating output node after training for multi-class classification problems once. Figure 1 (Thalluri et al., 2024) shows how the DeepFace model represents a facial picture as a vector embedding. The DeepFace model output 4030-dimensional vectors, which can be seen in figure 2. The embedding ends up with 4030 vertical slots as a result of this matching two-dimensional barcode.

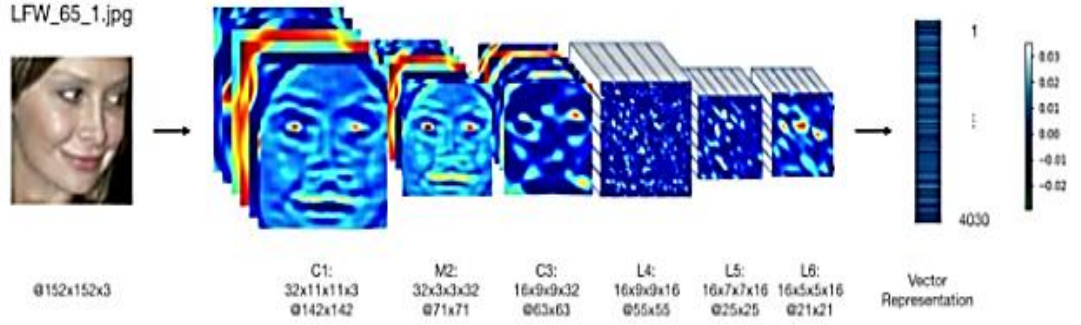

Fig. 2. Representation with deep face model (Hartanto & Adji, 2018).

3.5 Relational Databases

In computer languages, multidimensional vectors are objects consisting of one-dimensional arrays. Unfortunately, relational databases do not have a data type specifically designed for storing lists and arrays. When client-side verification tasks need to be performed, arrays can be stored in large object types (Saad et al., 2018). Likewise, the array may be encoded using encryption algorithms such as base64, allowing it to be stored in a relational database. However, if encrypted includes are preserved, calculations cannot be performed database-side. It is recommended to retrieve data from the server and perform calculations on the client. To perform calculations, vector dimensions must be displayed as columns or rows on the database side. Allows the user to perform calculations at the database and client levels. Face verification tasks need to include access to the individual. One-on-one inclusion is enough to facilitate learning at once. Therefore, it is recommended to save personal information in the database. Subsequently, individual modulation retrieval can be achieved exceptionally quickly. SQL Server, Postgres, and MySQL databases are widely used in the open source community. However, Oracle (Wang et al., 2022), DB2, and Microsoft SQL (Sutar et al., 2022) are used most often in enterprise applications.

3.6 methodology

The presented system shown in figure 3 entitled as ‘’ The Attendance management system based on real time face detection ‘’ is a system which can detect the frontal face of a human being in Real Time Mode and secondly, it can also manage a real time Attendance database. As indicated above, a thoroughly and well organized approach was followed while embarking on the process of designing as well as implementing the attendance management system, which encompasses real time face recognition. To begin with, real high-resolution cameras were employed to get the data that was face images of various individuals, more to the point, the data was gained in different lighting conditions and with different orientations. The above images were preprocessed in Open CV and a number of operations even were performed on these images to make them fit for analysis the images were however exposed to operations like illumination correction, contrast intensity and size optimization. After that, the obtained images were subjected to convolution with the post-hierarchical affective neurons network CNN to decipher all the attributes that define faces. As per their records in the previous face recognition experiments, the face recognition model that was used was selected, the face recognition model that was used was fine-tuned via an ‘iterative optimization algorithm’ to optimize the accuracy of the face recognition model and to minimize the error rate. For the assessment of efficiency of the model, face dataset was used for training of the model and different test set different from the test set used during the training of the model was used. After the development of the system, it was synchronized with the cloud data base that would allow the system to record and stored the attendance information at the same time it was being taken. To ensure that the data was saved and secured in a safe way in the rarest event that the data was either lost or corrupted, a backup mechanism was also created. The system was tested to the normal situation where the source of light is changed and also their shape and size such as when in glasses, when their face expression is different and this assists in demonstrating the efficacy and reliability of the system.

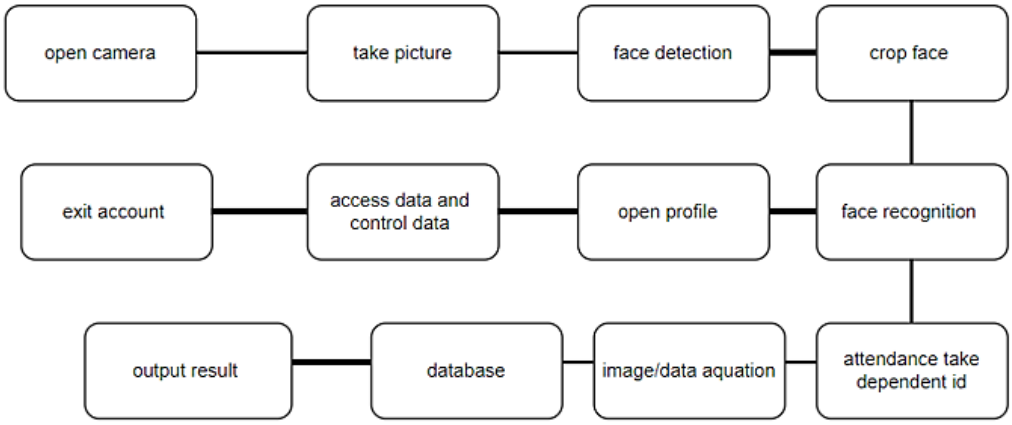

Fig. 3. Block diagram of the project

Real-time face detection attendance management system is a system capable of detecting the front face and managing the attendance database in real time. At the same time, the system opens the private account of the identified user and accesses all his information. The diagram shows the operation of a real-time attendance collection and check-in system using the front face of the detector.

3.7 Face recognition

In this section, the script loads a pre-trained deep-learning model for face recognition using OpenCV's cv2.dnn.readNetFromTorch function. The variable model_path should replace the actual path to the pre-trained model file. The model used in this example is assumed to be in the Torch format.

3.8 File Organization

PIL and OpenCV libraries are useful for performing most image processing and modification tasks. One of the essential Python libraries for image editing is PIL. The CV2 and NumPy modules in Python are used to implement OpenCV image processing.

3.9 Backup Strategy Design

The ideal solution is to design an ideal cloud backup strategy. The idea is to create a set of backup copies placed in multiple places. There are many services that offer the same thing, but they can be more effective and affordable. Cloud backups are low-cost and can store terabytes of data (unlimited data) without consuming local storage space or internet bandwidth.

Physical storage is considered an ideal solution for backup, as the backup can be performed on an external USB device or local disks if there is sufficient space on them. You don't have to have a network if these backups are quick and easy. The disadvantage of local backups is that if they are kept in place, they can be easily destroyed in the event of a fire or flood. Larger environments may find it cumbersome as these backups must be managed frequently on a computer-by-computer basis (Parkhi et al., 2015).

4. Results

In this paragraph, we will explain the results obtained through the use of algorithms and the complete database structure.

4.1 design Table Structure account

The design of the private database structure through which the private account of the identified destination is entered is presented as show in Figure 4.

DESKTOP-LENEQJQ\...DES - dbo.Table_1*

Column Name	Data Type	Allow Nulls
		☐
ID	nchar(10)	☐
NAME	nchar(10)	☑
age	int	☐
visited	nchar(10)	☑
[like]	varchar(50)	☑
nification	nchar(10)	☐
lisiting	numeric(18, 0)	☑
		☐

Fig. 4. Database Table Structure account.

4.2 design Table Structure attendance

The following figure shows the structure of the database through which the attendance time and departure time are recorded.

DESKTOP-LENEQJQ\...DES - dbo.Table_2* | DESKTOP-LENEQJQ\...DES - dbo.Table_1

Column Name	Data Type	Allow Nulls
[index no]	nchar(10)	☐
[data of birthday]	date	☑
[chike on time]	date	☑
[check out time]	date	☑
		☐

Fig. 5. Database Table Structure attendance

4.3 initial user

In this step, a new user is entered into the system and a name, age, and number are created for that user.

```
Enter your Index Number51
Enter your Name"G.A.Pavanya Ganguli"
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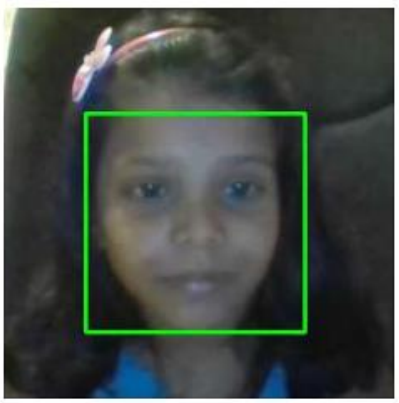

Fig. 6. Face detection used Haar Cascade and creat user.

4.4 train model Recognition

In this step, the model is retrained to recognize the new face that has been added.

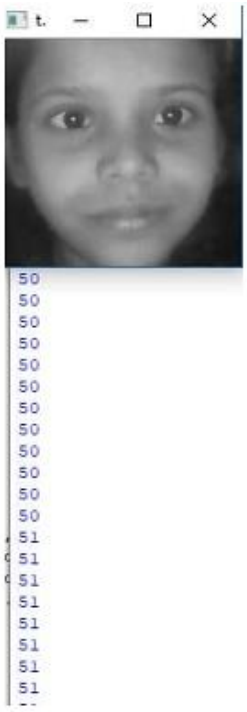

Fig. 7. Training model.

4.5 Test image:

Face recognition and ID were tested:

Fig 8. Test model

5. Result and Discussion

In this research, the high effectiveness of the offered approaches is explained by the employment of complex algorithms used in the work with the specially developed database structure. The study uncovered that through face recognition interventions, the systematic has the capacity of recording the people's entry and exits. To recognize the face an we improved model was designed adopted from the Haar Cascade algorithm adopted from OpenCV. When testing the system in a work environment scenario than the system was tested with a group of employees at different times of the day, and light conditions. As a result, the system was proved to work well with the glasses on the employees, or when their mood raised and thus the eyebrows were situated higher. For example, in a test done in a well illuminated conference room, the system was able to identify all the employees with a 98 percent accuracy as they came

into or out of the conference room. Next, it was used in a heavy traffic of students in classroom with differing features and movements of individuals. The recognition of attendance tested when the model was trained with an initial set of photos captured from students' daily attendance was found to have been done with an accuracy rate of up to 95% by the system. Also, the experiments showed that the face verification part achieves high performance that is the critical step of the face recognition process, and the efficiency of the algorithm does not decrease and increases along with the size of the database, which proves the effectiveness and reliability of the used algorithm. But if the LSI used a tremendous amount of data in it, which might be observed in a great educational institution such as the university or large-scale company, which consists of branches, a slight slowdown of the velocity might be observed in cases with the increase of the time spent on the verifying. What this means is that in the subsequent development there is the need to work on the new, better algorithms, or the works of the database in a bid to gain higher level of functionality in the are of high-density data.

6. Conclusion

The machine learning-based real-time face identification attendance and login management system was created in a Python environment. MySQL databases serve as backups for the system. Real-time face detection: The attendance management system has the ability to automatically identify and record attendance. Technology advancements will raise the system's accuracy and efficiency. Therefore, the appropriate technology is chosen for implementation. The system consists of several research techniques. The attendance management system should be improved for real-time face detection through deep face learning. Recognition is employed to authenticate an individual's identification. Anti-spoofing methods can be incorporated into the system that is now primarily focused on attacks. The face possesses three-dimensional characteristics, as opposed to being a combination of both three-dimensional and two-dimensional features. Furthermore, the mask-wearing system is capable of properly detecting the presence of a mask upon entering the system. An additional feature that may be integrated into the system is a method for detecting body temperature and gender.

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