IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

FACE RECOGNITION-BASED ATTENDANCE MANAGEMENT SYSTEM

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***Abstract*—**Face recognition technology is essential in today's digital world and is used in practically every industry. Face recognition is one of the most often used biometrics. It has numerous benefits and can be used for security, identity, and authentication. Despite being less accurate than iris and fingerprint identification, it is nonetheless commonly utilised since the technique is non-intrusive and contactless. A facial recognition system may also be used to track attendance in settings such as businesses, colleges, and schools. The goal of this system is to create a facial recognition-based class attendance system, as the current manual approach is time-consuming and difficult to administer. Furthermore, it's possible that a proxy will appear. Consequently, the demand for this system rises. This system includes four phases: database creation, face detection, face recognition, and attendance updates. Students' in-class photos are used to develop databases. Using the Haar-Cascade classifier and the Local Binary Pattern Histogram technique, face detection and identification are accomplished. Faces are picked up and identified in the classroom's live streamed footage. At the conclusion of the session, attendance will be forwarded to the relevant professors.

***Index Terms* - Attendance system; Face Recognition; Face Detection; Haar-Cascade OpenCV classifier; Local Binary Pattern Histogram**.

I. INTRODUCTION

In many schools and universities, recording attendance using the traditional technique is a laborious effort. Additionally, the faculty must personally call out each student's name in order to record attendance, which might take up to five minutes for the whole session. This takes a lot of time. There is a potential that a proxy will show up. In order to implement additional methods of tracking attendance, several institutions began using RFID [3], iris recognition [4], fingerprint recognition, and other methods.

expressions on the face. A face recognition system has two components. categories: facial identification and verification. Face Verification compares faces in a 1:1 matching method. is a 1:N picture compared to the template face images. comparison issues with query face pictures [1]. This system's goal is to create an attendance system based on face recognition methods. Here, a person's face will be taken into account while recording attendance. Face recognition is a technology that is becoming more and more popular today. In this research, we suggested a system that tracks students' faces in real-time classroom video and records their attendance if the detected face is recognised in the database. Compared to the old methods, the new one will take less time.

The meticulous recording of attendance data forms the backbone of efficient management in a multitude of domains. From educational institutions meticulously tracking student engagement to workplaces ensuring adherence to work schedules and event organizers verifying participant presence, accurate attendance records are paramount. Traditionally, attendance management has relied on manual techniques like roll calls, paper sign-in sheets, or swipe cards. While these methods have served their purpose, they are riddled with limitations that hinder operational efficiency and data integrity.

The inherent pitfalls of manual attendance systems are well documented. Roll calls, for instance, are time-consuming and vulnerable to human error. Paper sign-in sheets are susceptible to manipulation, and buddy punching – the act of one employee clocking in for another – becomes a possibility with swipe cards. These limitations highlight the need for a more robust and reliable attendance management solution.

Enter face recognition (FR) technology, a rapidly evolving field with the potential to revolutionize attendance management practices. FR systems leverage the power of artificial intelligence (AI) to uniquely identify individuals based on their facial characteristics. By capturing a digital image of a person's face and comparing it to a pre-enrolled database, FR technology can verify their identity with remarkable accuracy. This paves the way for the development of Face Recognition-based Attendance Management Systems (FR-AMS), a technological leap forward with the potential to transform how we track and record attendance.

This research paper delves into the world of FR-AMS, meticulously dissecting its functionalities, advantages, and potential challenges. We begin by providing a comprehensive overview of the shortcomings of traditional attendance systems and highlighting the pressing need for a more efficient and reliable solution. Subsequently, we embark on a deep dive into the fascinating world of FR technology, explaining its core principles and functionalities. We then unveil the intricate workings of FR-AMS, outlining its key components and operational flow.

The heart of this paper lies in a thorough analysis of the numerous advantages offered by FR-AMS. Automation streamlines the attendance process, freeing up valuable time and resources for administrators. Enhanced accuracy, achieved by comparing captured faces with a pre-enrolled database, minimizes the risk of errors and fraudulent attendance. Real-time data collection enables immediate verification and facilitates the generation of detailed attendance reports for insightful decision-making.

However, the deployment of FR-AMS necessitates a nuanced approach that acknowledges potential challenges. Privacy concerns surrounding data collection, storage, and potential misuse require a robust legal and ethical framework. Data security measures must be implemented to mitigate the risk of breaches and unauthorized access. Additionally, potential biases in facial recognition algorithms, particularly related to race and ethnicity, need to be acknowledged and addressed with utmost seriousness.

This research aspires to provide a comprehensive exploration of FR-AMS. We will delve into the technical aspects of the system, analyze its benefits and drawbacks, and explore potential future directions for this evolving technology. By critically examining the potential and limitations of FR-AMS, this paper seeks to contribute to a well-informed discussion about its role in shaping the future of attendance management. The ultimate goal is to determine whether FR-AMS represents a transformative solution or simply another technology fraught with ethical and practical concerns.

II. Literature Survey

A model for an automated attendance system was put forth by the authors in [3]. The concept focuses on how facial recognition and Radio Frequency Identification (RFID) work together to identify and count approved pupils as they enter and exit the classroom. Every student Whoever has registered with the system has an authentic record. Additionally, the system maintains information about each student registered for a specific course in the attendance log and provides necessary data as needed. The authors of this paper [4] have created and implemented an attendance system that makes use of iris biometrics. The participants were initially required to register their personal information and distinctive iris template. The system took attendance for the class automatically by taking a picture of each student's eye, identifying their iris, and looking for a match in the built in database. The prototype ran on the web.

Authors in [5] proposed a facial recognition based attendance system. The system was implemented using support vector machine (SVM) classifiers and techniques like Viola-Jones and Histogram of Oriented Gradients (HOG) features. The authors took into account a number of real-time scenarios, including scaling, illumination, occlusions, and pose. Peak Signal to Noise Ratio (PSNR) values were used as the basis for quantitative analysis, which was carried out using the MATLAB GUI. By comparing the Receiver Operating Characteristics (ROC) curve, authors in [6] investigations to obtain the best facial recognition algorithm (Eigenface and Fisherface) offered by the Open CV 2.4.8 and then integrate it in the attendance system. The ROC curve demonstrated that Eigenface outperforms Fisherface in the studies conducted for this article. A system that used the Eigenface algorithm has a 70% to 90% accuracy rate. A method for tracking student attendance in a classroom that combines discrete wavelet transforms (DWT) and discrete cosine transform is described in [7]. These methods were utilised to extract the facial characteristics of the learner, and then Radial Basis Function (RBF) was applied to categorise the facial objects. The accuracy rate for this method was 82%.

The paper "Individual Stable Space: An Approach to Face Recognition Under Uncontrolled Conditions" by Xin According to Geng, the majority of face recognition systems require the input of faces according to specific guidelines, such as in a regulated lighting environment. at a specific location, under a specific viewing angle, and with no impediments. Under regulated circumstances, these technologies are referred to as facial recognition. Due to their inability to be satisfied, these constraints limit the applications of facial recognition in many real-time scenarios. Real-time applications require facial recognition systems that do not require stringent human oversight. These systems require facial recognition under uncontrolled settings. So, this study suggests one such system, but it requires an image as input and one person per image, which is a limitation and prevents it from being used in real-time applications such as attendance systems.[1]

Edy Winarno proposed a method in his article "Anti-Cheating Presence System Based on 3WPCA-Dual Vision Face Recognition" that uses a photograph of an authorized person or an image that resembles the authorized person to predict cheating in a facial recognition-based system. T They employed a dual vision camera, also known as a stereo vision camera, which captures one image from each of its two lenses. After obtaining the two images, they employed the half-join approach to combine half of the left image and half of the right image of a person into a single image, which can then be extracted using the 3WPCA method. The recognition of cheating using this system is 98%.[2] In this study, the author designed and explained an upgrade to a picture-based attendance system that captures the faces of numerous students and could be the next generation of biometric devices that are already in use. Human faces are unique and have a high degree of changeability, thus it must be fast and precise when detecting student facial structures. Processing the system will entail registering students by taking their pictures and then using them to set attendance. Continuous registration is essential to attain high and precise precision. Within this system. This paper describes the system, and evidence will be presented to support it. The project can be utilized as part of an online certification test. Identification of the student taking the exam. [3]. There are a variety of attendance systems available, including traditional methods of data collection, which have limitations and are difficult to use, as well as biometric presence. There is a lack of human error in the system. For example, fingerprint scans are not accepted due to moist conditions. Dirty, very dry, or peeling fingertips. So, the author proposes that the Authority include a mobile presence system and a face with NFC safety features, as well as the ability to store data in the cloud using Raspberry Pi. The study examines related works. Attendance management system, NFC, face authority zone, microcomputers, and cloud area. Then it introduces new methods, design systems, and planning. The result of this is a system that reduces the use of paper, reducing the time and energy lost by attendance. A mobile-based attendance system.[4] Computers are clever enough to converse with people from a variety of angles. There will be involvement. If it is based, it will be more acceptable to both humans and machines. About the validation process. The author is concerned. Integrating and designing a student recognition system based on the "survival-Ing" algorithm. The algorithm then applies embedding to categorize a person's face. It has a number of applications, including attendance systems, security, and so on. The paper shows the result of creating a system and displaying it.[5]

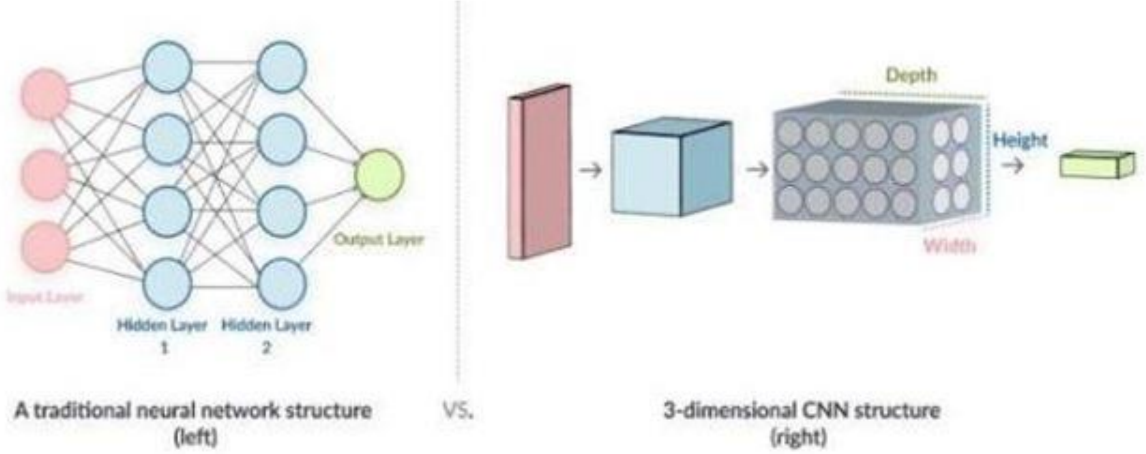

Figure 1 compares CNN With the Traditional neural network

Radhika C. Damale's work "Face Recognition Based Attendance System Using Machine Learning Algorithms" focuses on identifying individuals based on facial traits. This is known as facial recognition. Face features can be utilized for computer vision algorithms, including face identification, emotion detection, and surveillance. The face recognition technique is gaining popularity among scholars. This article discusses various approaches, including SVM, MLP, and CNN. DNN is utilized for "face detection". SVM and MLP techniques use extraction algorithms to extract features such as PCA and LDA. In the CNN technique, photos are transmitted immediately to CNN.

Module is a feature. The technique has a good detection accuracy percentage for CNN-based approaches. SVM, MLP, and CNN achieved test accuracy of 87%, 86.5%, and 98% on self-generated databases, respectively. [6]

Priyanka Wagh's paper "Class Attendance Framework: Face Recognition" explores this topic. To easily identify students in the last columns, complete the histogram leveling of the image. The image will be shared for the individual's facial identification. Ada-Boost calculation has the highest productivity among these methods.

This paper uses Haar highlight classifiers and Ada-Boost algorithms to detect students' faces.

Eigen trims each understudy's face and removes features such as separation between eyes, nose, and face shape. The understudy's participation is stamped by comparing their appearance to the face database. Create a database of faces for examination purposes. [7]

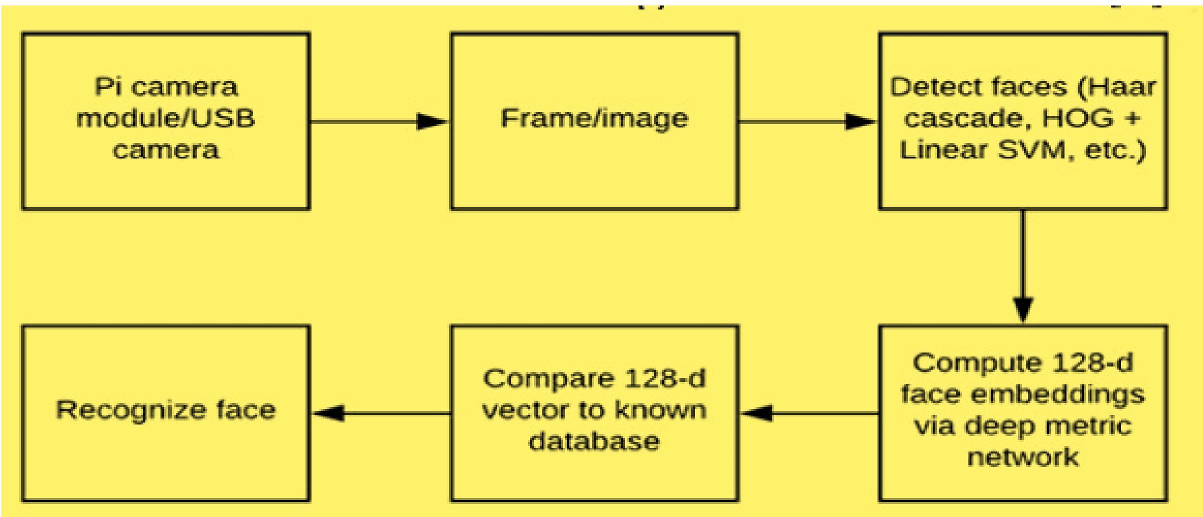

Figure 2: Face Recognition model

The classroom attendance system utilizes facial recognition technology and a camera to monitor scene information. The system takes photos of students and reads their information when they sign in with their campus card. It also stops non-school workers from accessing the classroom or substituting classes. [8]

Akshara wrote the paper "Computerized Participation Framework Using Face Acknowledgement." Jadhav and Akshay Jadhav Tushar Ladhe and Krishna Yeolekar.

The identified face is separated and exposed for preparation. The pre-preparing stage involves histogram

leveling and resizing the extricated face image to 100x100. After assessing the needs of the students, their names are updated in an excel sheet.
The exceed expectations sheet is generated by trading instruments within the database structure. The database may generate monthly and weekly reports on students' participation records. Capture the Understudy's Picture. To identify faces, use face recognition algorithms, convert to a dark scale, adjust histograms, and resize to 100x100. If enrolling, store the images in a database. Otherwise, use PCA/LDA/LBPH for highlight extraction (9).
The paper "Recognition" by Khem Puthea, Rudy Hartanto, and Risanuri Hidayat proposes using principle component analysis (PCA) for face recognition and other computer vision methods. The Haar classifier technique trains the system to recognize faces. Faces are taken by cameras, transformed to grayscale, and then subjected to an image removal procedure. The photograph is saved on the server and processed later. [10]
The author advocated using the framework as an online Web Server to make participation results available to validated web customers. Facial recognition is achieved by the use of Local Binary Patterns (LBP). The first step is to identify and alter the ROI region of interest, which is the human face. The Haar Feature-based Cascade calculation is then applied. LBPs are used to extract visual highlights, which are then compared to preset datasets. By clicking 'c' in catch on the console framework, the participation results are saved in a MySQL database, making them available to the web server. [11]
According to Nandhini R.'s paper "Face Recognition Based Attendance System," the project involves converting video footage into images to identify and recognize individuals. CNN calculations are used to recognize faces. A CNN (Convolution Neural Network) uses a multilayer perceptron structure to process requirements more quickly. After recognizing and processing the face, it is compared to those in the database to ensure student involvement. The post-preparation component involves updating the understudy names on an excel file.
Exceed expectations sheets can be updated weekly or monthly to track understudy involvement.[12]. According to the paper "Student Attendance System in Classroom Using Face Recognition Technique" by Samuel Lukes, Aditya Ram Mitra, Ririn Ikana Desanti, and Dion Krisnadi, the number of highlights in a facial understudy image is consistent, with a DCT coefficient of 16. The process is complete with grayscale standardization, histogram balance, DWT, and DCT.

The study suggests that an understudy may be mistaken for another student due to a lack of recognition due to the investigation, which did not meet all requirements.[13]

Venkata Kalyan Polamarasetty, Muralidhar Reddy Reddem, Dheeraj Ravi, and Mahith Sai Madala authored a paper called "Attendance System Based on Face Recognition."They advised taking pictures with a webcam or an outside camera. To do this, MATLAB incorporates drivers from math works.

Location depends on the type of camera we are using. Next, they use a pace of 500 to 1000 catches each individual. They used HD cameras to get greater accuracy in their results. To distinguish faces, we can use the article falling class and the b-box approach. Faces are captured and reduced into 112x92 images of goals. It would correspond to 11 KB of size. Faces captured in the database are intended to stack in our workspace. We will stack the gallery photographs in there. Separate the HOG highlights and store them in an exhibit list. This creates a reference point for matching or coordinating material.[14]

Table 1: Comparison of different techniques used in face recognition-based attendance system.

Ref No.	Title & Authors Name	Concept Used	Advantages	Disadvantages
1.	Individual Stable Space: An Approach toFace Recognition Under Uncontrolled ConditionsXin Geng, Zhi-Hua Zhou, & Smith-Miles	Face recognition under uncontrolled condition. [1]	This paper projects on face recognition under uncontrolled conditions.	Video sequences, verification, and multiple persons per image required by most of the real applications can't be implemented.
2.	Anti-Cheating Presence System Based on 3WPCA Dual Vision Face Recognition Winarno, Wiwien Hadikurniawati, Imam Husni Al Amin, Muji Sukur	Dual vision face recognition using 3WPCA. [2]	It can anticipate falsification of face data with recognition accuracy up to 98%	The relative angle of the target's face influences the recognition score profoundly.
3.	Prototype model for an Intelligent Attendance System based on facial IdentificationRaj Malik, Praveen Kumar, Amit Verma, Seema Rawat	ADABoost algorithm with techniques PCA and LDA Hybrid algorithm [7].	By using this system chances of fake attendance and proxy can be reduced.	Works only for single image of a system.
4.	Convolutional Neural Network Nusrat Mubin Ara1. Neural Network Approach for Vision Based Student Recognition System	Alex NET CNNs and RFID Technology [8].	Uses the camera system to Monitor the scene information.	Alex NET won't work on all the students until it is improved. RFID technology uses electronic toy which can't be used in all the cases.
5.	NFC Based Mobile Attendance System with Facial	Iris Recognition [9].	Real time face detection and efficient	Iris condition needs to improve in different light conditions

	Authorization on Raspberry Pi and Cloud Server Siti Ummi Masruroh			
6.	Facerecognition-based Attendance System using MachineLearning Algorithms Radhika C. Damale	Local Binary patterns (Support vector machine), LDAbased OpenCV and FLTK.[10].	Continuous and automatic attendance system.	System has issues with system performance and accuracy.
7.	ClassAttendancesystem based on Face Recognition" Priyanka Wagh.	Local Binary patterns(Support vector machine), LDA based OpenCV and FLTK.[11].	continuous and automatic attendance system.	System has issues with system performance and accuracy.
8.	Design of Classroom Attendance System Based on Face Recognition, Wenxian Zeng	CNN uses a system like a multilayer perceptron that has been designed to process the requirements faster.[12]	The Automated Classroom Attendance System helps in increasing the accuracy and speed ultimately achieve the high-precision real-time attendance to meet the need for automatic classroom evaluation.	Other methods with greater accuracy can be used to build
9.	Automated Attendance System Using Face Recognition Akshara Jadhav, Akshay Jadhav Tushar Ladhe, Krishna Yeolekar	DWT	Facial images can be recognized successfully giving a total level of recognition of 82%. This figure is perceived as the best recognition rate which can be obtained from the data.	Higher accuracy can be obtained.
10.	An Attendance Marking System based on Face Recognition"	The complete system is implemented in MATLAB [14]	User-friendly application on face recognitions created.	Similar techniques are used.

	Khem Puthea, Rudy Hartanto and Risanuri Hidayat.			

III. PROPOSED SYSTEM

Each student in the class must register and provide the appropriate information before their images are taken and included to the dataset. During each lecture, faces will be detected using the classroom's live streaming camera. The detected faces will be compared to the dataset's image data. If a match is found, the attendance of the appropriate student will be recorded. At the end of each session, the faculty member in charge will receive a list of absentees by email. The suggested system's architecture is illustrated below. RE

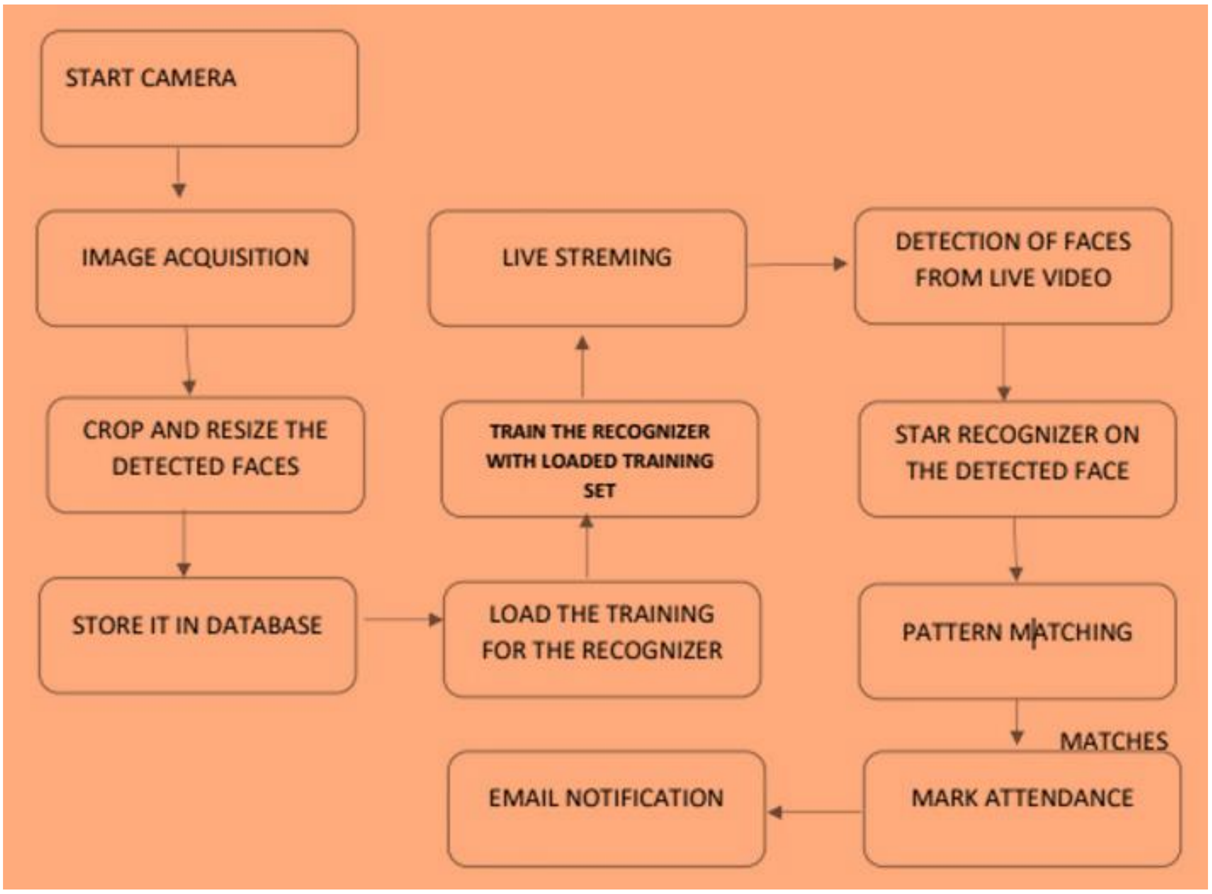

Figure 3: System Architecture

Typically, this method involves four stages:

1. Dataset creation.
A webcam is utilized to photograph the students. A single student will be photographed from multiple perspectives and motions. These images are pre-processed. Cropping pictures is used to determine the Region of Interest (ROI) for identifying purposes. The clipped photographs must be resized to a specific pixel spot. The RGB photos will be converted into grayscale ones. The images will be saved in a folder labeled with the students' names.

2. Face Detection
Face detection is done using OpenCV and the Haar Cascade Classifier. To use the Haar Cascade method for face identification, it must be trained to recognize human faces. The process is known as feature extraction. The haarcascade frontalface default.xml file contains training data for the haar cascade. Figure 4 depicts the haar qualities that will be utilized to extract features.

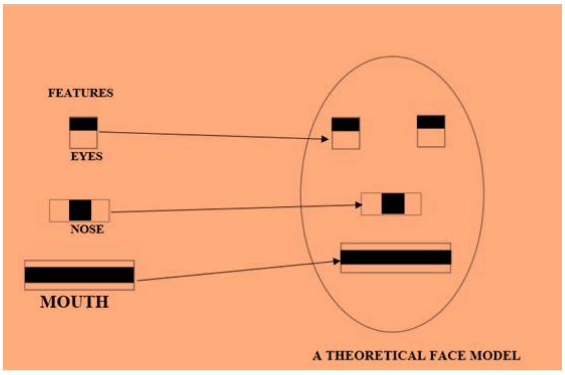

Figure 4: Haar Features

We utilize the OpenCV detectMultiScale module. To draw a rectangle around the faces in an image, this is required. There are three variables to consider: scale- Factor, minimum number of neighbors, and minimum size. scale A factor determines how much a picture should be scaled down. Min-Neighbors determines the minimum number of neighbors for each candidate rectangle. Higher values indicate fewer faces but higher-quality photos. Min-Size specifies the minimum object size. It's always (30, 30) [8]. This system uses the parameters ScaleFactor and minNeighbors with values of 1.3 and 5, respectively.

3. Facial Recognition

Face recognition can be broken down. divided into three parts. Generate training data, train a face recognition system, and generate predictions. The dataset contains photos that will be used as training data. Individuals will be assigned an integer label indicating their student group. Face recognition software is then used to the photos. This system employs the Local Binary Pattern Histogram to distinguish faces. First, the entire face's local binary patterns (LBP) are compiled. After decimalizing these LBPs, histograms of all decimal values are generated. A histogram will be generated for each image in the training data. The best-match label for a student is determined by calculating the histogram of the face to be recognized and comparing it to previously computed histograms [9].

4. Attendance Update.

After the face recognition method, the excel sheet will mark the identified faces as present and the remaining faces as absent. The list of absentees will be provided to the appropriate faculty. Each month, faculty members will receive an update on their attendance sheet.

To track attendance, we follow a process that includes enrollment, face detection, and verification. Recognizing and recording attendance in a database. Unlike Eigenfaces and Fisherfaces, most modern face verification systems separate training and enrollment. Training is done on millions of photos. Enrolment requires only a minimal amount of photos. Enrolling in Dlib involves sending a few photos of the individual via the network to obtain 128-dimensional feature descriptors for each image. We transform each image into a feature in a high-dimensional space. In this high-dimensional realm, individuals' features may be near together or far apart.

A. Traditional Image Classification Pipeline vs. Dlib's Face Recognition Model

A traditional image classification pipeline involves converting an image into a feature vector (or point) in a higher-dimensional space.

This involved determining the feature descriptor (e.g., HOG) for an image patch. After representing the image as a point in higher dimensional space, we employ a learning method like SVM to split the space into hyperplanes representing distinct classes.

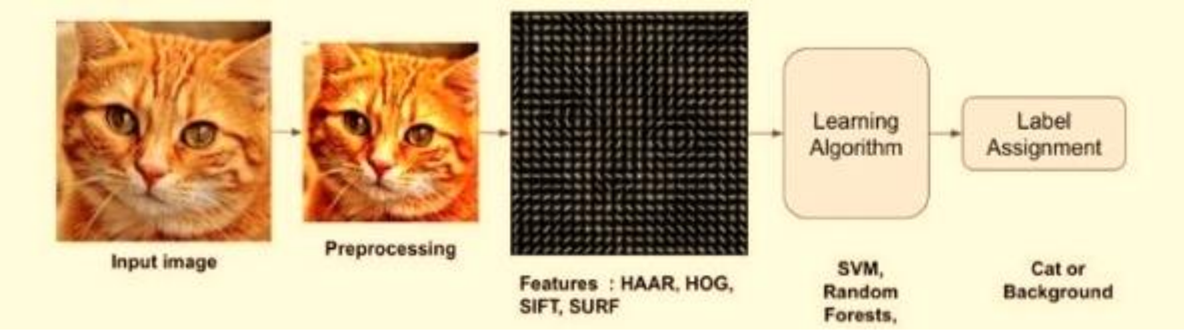

Figure 5: Traditional image Classification pipeline.

Deep Learning and the aforementioned model share conceptual commonalities, despite their apparent differences.

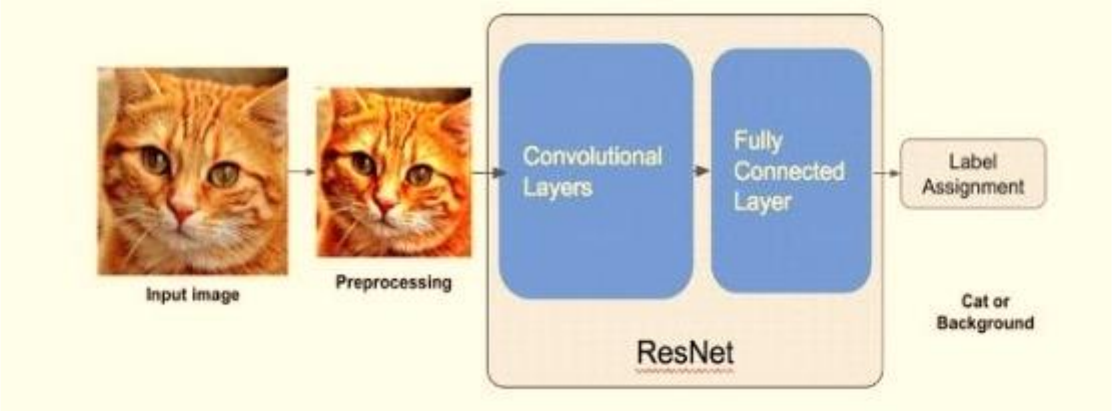

Figure 6: Dlib's Face Recognition module

Figure 6 shows that Dlib's Face Recognition module uses ResNet, a CNN architecture. ResNet consists of a bank of Convolutional Layers followed by a fully connected layer. ResNet, like most CNN architectures, consists of Convolutional (Conv) Layers followed by a Fully Connected (FC) Layer. The bank of convolutional layers generates a higher-dimensional feature vector, similar to the HOG descriptor.

The main distinctions between banks of convolutional layers and HOG descriptors are:

1. HOG is a fixed descriptor. The descriptor is calculated using a specific formula. A bank of conv layers has many convolution filters. These filters are learned from the data. Unlike HOG, they adapt to the task at hand.

2. The FC layer serves the same purpose as the SVM classifier in older techniques. It classifies feature vectors. In some cases, an SVM replaces the final FC layer. Typically, "distance" refers to the Euclidean distance between two places.

Consider the distance between 3D points (1, 0, 1) and (1, 3, 5).

$$\sqrt{(1-1)^2 + (3-0)^2 + (5-1)^2} = 5 \qquad \text{Eq(1.1)}$$

For n-dimensional vectors x and y, the L2 distance (also known as the Euclidean distance) is defined as:

$$d_{L2} = ||\mathbf{x} - \mathbf{y}|| = \left[(\mathbf{x} - \mathbf{y})^T(\mathbf{x} - \mathbf{y})\right]^{\frac{1}{2}} = \left(\sum_{i=1}^{n}(x_i - y_i)^2\right)^{\frac{1}{2}} \qquad \text{Eq(1.2)}$$

In mathematics, the term "distance" (sometimes called a metric) has a larger definition. The L1 distance refers to a distinct type of distance. The sum of the absolute values from the two vectors.

$$d_{L1} = \sum_{i=1}^{n} |x_i - y_i| \qquad \text{Eq(1.3)}$$

The principles below determine when a function involving two vectors can be considered a metric.

1.A mapping d(x,y) is considered a metric when the distance between any two points is greater than or equal to zero (d(x,y) > 0).

2. A point has zero distance from itself, that is, d(x,x)=0.

3. The distance from x to y is equal to the distance from y to x (d(x,y)=d(y,x).

4. Triangle inequality: For any three points (x, y, and z), the following holds true. For example, d(x,y) + d(y,z) is greater than d(z,x).

1) Deep Metric Learning.

To vectorize an image, just save its pixel values in a tall vector. This vector denotes a point in higher-dimensional space. However, the space is not ideal for measuring distances. In a facial recognition application, points representing distinct photos of the same person may be far apart, while those representing different people may be nearby.

Deep Metric Learning is a technique that employs Deep Learning to create a lower-dimensional metric space. photos of the same class are clustered together, while photos of different classes are separated. Convolution layers analyze relevant features before creating the metric space, rather than directly reducing pixel dimension. We can apply the same CNN architecture used for image classification to deep metric learning.

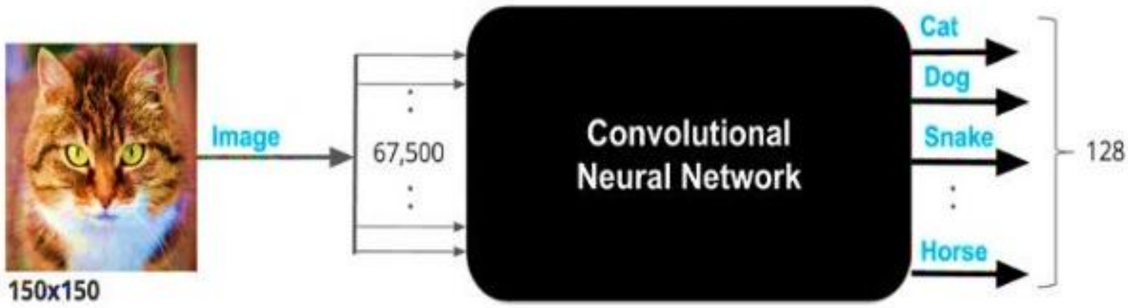

Figure 7: CNN for clarification task

Figure 7 depicts a CNN trained to classify a 150x150 color image (equivalent to 67,500 vectors) into 128 animal types based on its input.
Deep Metric Learning alters the loss function while maintaining the same architecture.

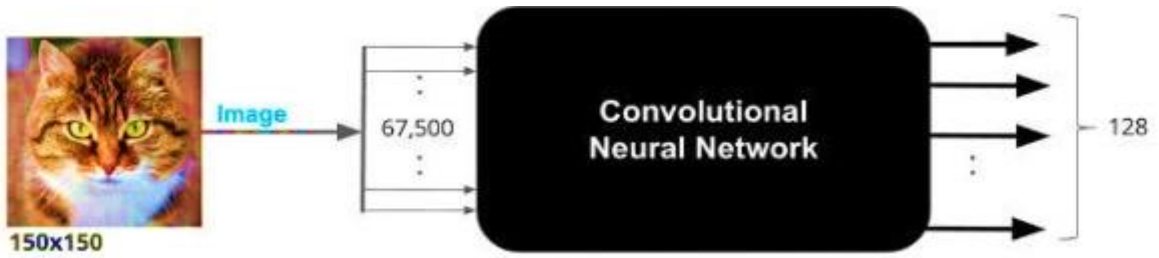

Figure 8: CNN for metric learning

Figure 8 shows that Deep Metric Learning uses the same architecture as CNN classification, but with a different loss function.
Input a picture and receive a point in 128-dimensional space as the output. To determine how closely connected two photos are, run them through a CNN and obtain two points in the 128-dimensional space. To compare two points, use the Euclidean distance (L2) between them.

2) Loss in Metrics

A production-ready CNN is usually trained on millions of photos. Evidently, these millions of It is not possible to update the CNN knobs simultaneously with photos. Iterative training is carried out with a single, little batch of photos at a time. We refer to this tiny batch as a mini batch. To get the CNN output to be a point in this 128-dimensional space, we must define a new loss function, as was indicated in the preceding section. A small batch's loss function is defined over all image pairs.

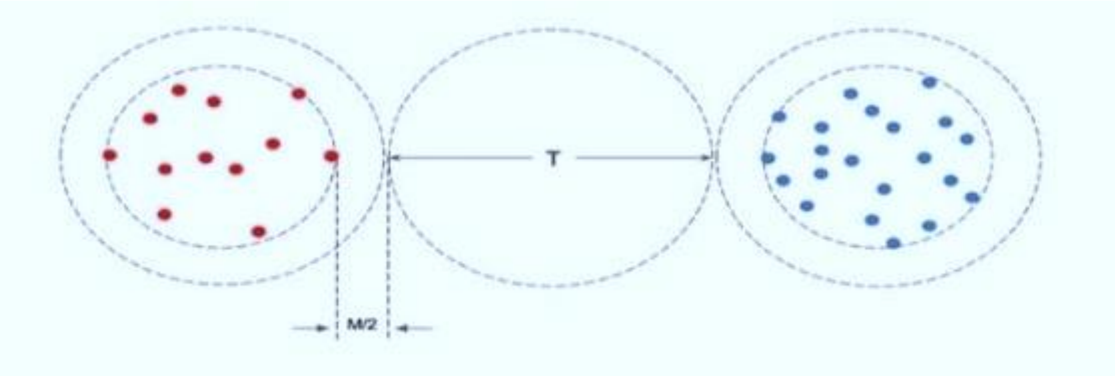

Figure 9: metric loss defined by Dlib's Face Recogniser

The idea is presented in two dimensions for simplicity. Two parameters are used to define the loss: 1) Threshold (T) and 2) Margin. Two distinct classes are represented by the red and blue dots, respectively. The minimum distance between any two points of different classes should be (T + M), and the maximum distance between any two points of the same class should be (T - M) for the metric loss to be 0. Let p1 and p2 be the points in the 128-dimensional space that correspond to pictures l1 and l2. When two images are in the same class, the loss can be expressed as max (0, ||p1-p2||-T+M).

However, if l1 and l2 have two distinct class labels, then max (0, T- ||p1-p2||+M) is how much of a contribution they make to the loss function.

Figure 9 illustrates how this loss function favors embedding, in which photos belonging to the same class are grouped together while photographs belonging to different classes are spaced widely apart.

3) Mining with a Hard Negative

More non-matching pairings (pictures from different classes) than matching pairs (photos from the same class) exist in a tiny batch. When computing the metric loss function, it is crucial to consider this imbalance. The approach only includes the N worst non-matching pairings in the loss computation if there are N matching pairs in a micro batch that share the same class. Put differently, selects the worst non-matching pairings in order to carry out hard negative mining on the micro batch.

A. Enrolment

We define a smaller ResNet neural network for enrollment. This network was also used for training. The photographs of the people we will be enrolling are organized as follows: There will be subfolders with pictures of a single person in each. This mapping of the photos to their labels will be saved for use in subsequent testing. Then, as Dlib utilizes RGB as its default format, we process enrollment photos one by one, converting each one from BGR to RGB format. Then, since the neural network module does not recognize Dlib's cv_image format, convert the OpenCV BGR image to Dlib's cv_image and then Dlib's cv_image to Dlib's matrix format. Identify faces in the photograph. We recognize facial landmarks and generate a normalized and warped patch for each observed face. Create a face description using facial landmarks. This is a 128-dimensional vector representing a face. Next, save the labels and names, as well as the face descriptors and labels.

B. Face Detection and Recognition.

To confirm if a new image of a person is the same, we measure the distance between the enrolled faces and the new face in 128-dimensional space. Retrieve name-label mappings and descriptors from disk. Convert the query picture, which depicts a classroom with several kids, from BGR to RGB. Dlib utilizes RGB as the default format. Convert the OpenCV RGB image to Dlib's cv_image, then to the matrix format. The neural network module does not recognize Dlib's cv_image format. Detect faces in the query image. Recognize facial landmarks for each individual. Create a warped patch of 150x150 for each face. Compute face descriptors for each face. We now calculate the Euclidean distance between face descriptors in query photographs and enrolled images. Find the enrolled face with the shortest distance. According to Dlib, if two face descriptor vectors have a Euclidean distance smaller than 0.6, they belong to the same person.

Otherwise, they are from distinct persons. The threshold varies based on the number of enrolled photographs and differences (e.g., lighting, camera quality) between them and the query image. We apply a criterion of 0.5. If the minimum distance is smaller than the threshold, get the person's name from the index. Otherwise, the person in the query image is unknown.

C. Attendance Marking

When a face is discovered and matched to an enrolled face, attendance is recorded in the database under the matching USN. The database stores student names, as well as attendance dates and times.

IV. Results And Discussions

A GUI enables users to interact with the system. Users will have three options: student registration, teacher registration, and attendance marking. Students must fill out the registration form entirely. Fig. 10 shows the camera and window that appear immediately after registering. The character arrives and begins to recognize the faces in the frame. When 60 samples are acquired or CRTL+Q is pressed, the camera will automatically begin capturing photos. The pre-processed shots will be saved to the training pictures folder. Faculty members must fill out the registration form with their course codes and email addresses. This is vital since the faculty will receive a list of missing classes via email.

Figure 10: Face Detection

Each session, faculty members must input the course code. After entering the course code, the camera will activate automatically. Figure 11 shows a facial recognition window that identifies two registered students. If the individuals were not registered, the window would display "unknown."

To quit the window, use CTRL+Q. You can also amend attendance information in the excel spreadsheet and email missing students' names to the appropriate faculty.

Figure 11: Face Recognition

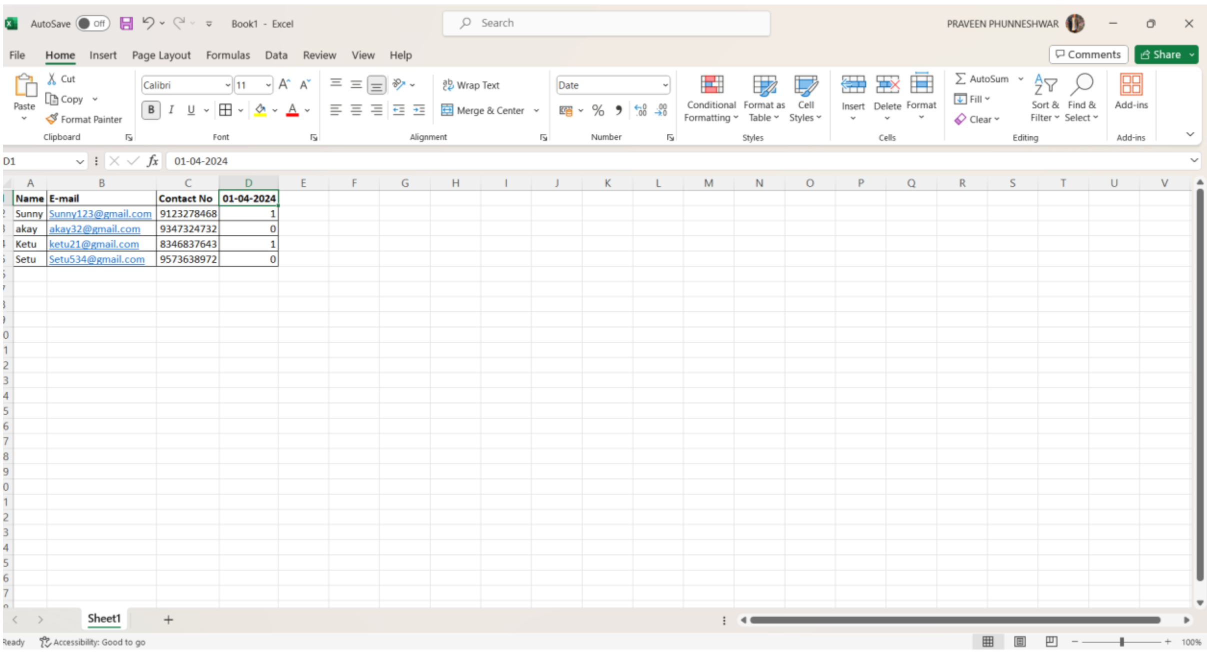

Figure 12: Attendance sheet

Figure 12 shows an updated attendance sheet following the recognition procedure. Absent pupils are listed as "0," whereas recognized students are denoted as "1." The faculty member's email address will get a letter including the list of absentees.

V. Conclusion

The technique aims to create a robust face recognition-based class attendance system. The proposed system uses face ID to track attendance. The system will recognize and identify faces using a camera. After recognition, the attendance record will be updated to reflect the student's attendance.

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