A

Project Report

on

Attendance System using Face Recognition

submitted as partial fulfillment for the award of

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Computer Science and Engineering

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May, 2024

DECLARATION

We hereby declare that this submission is our own work and that, to the best of our knowledge and belief, it contains no material previously published or written by another person nor material which to a substantial extent has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

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CERTIFICATE

This is to certify that Project Report entitled “Attendance System using Face Recognition” which is submitted by Student name in partial fulfillment of the requirement for the award of degree B. Tech. in Department of Computer Science & Engineering of Dr. A.P.J. Abdul Kalam Technical University, Lucknow is a record of the candidates own work carried out by them under my supervision. The matter embodied in this report is original and has not been submitted for the award of any other degree.

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Professor Vipin Deval	**Dr. Vineet Sharma**
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ABSTRACT

This project report describes how a novel attendance system with Firebase integration and facial recognition technology was developed and put into use. In educational institutions, manual processes and the possibility of proxy attendance make traditional systems of tracking attendance tedious and prone to errors. Having identified these issues, our project sought to improve accuracy and automate the attendance process by utilizing cutting-edge technologies.

Every stage of the project lifecycle, including research, design, development, and testing, was carefully carried out. By using facial recognition technology, the system was able to reliably identify and authenticate students, which removed the potential for proxy attendance. Additionally, the integration of Firebase empowered the system to operate in real-time, providing faculty members with up-to-date attendance information.

The primary objective of this project was to determine whether it would be feasible and beneficial to integrate Firebase, a real-time database platform, with an attendance system that relies on facial recognition. Our technology ensures fast and accurate data management by facilitating swift updating of attendance records through a smooth integration with Firebase.

The project's main conclusions highlighted the noteworthy benefits of the suggested attendance method. It was noteworthy for its increased effectiveness, less administrative load on teachers, and decreased incidence of attendance discrepancies. Additionally, the system's flexibility and scalability make it a good option for educational establishments looking to update their attendance monitoring procedures.

Keywords: face detection, Haar Cascade, LBPH, Firebase

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LIST OF ABBREVIATIONS

LDA	Linear Discriminant Analysis
PCA	Principal Component Analysis
CNN	Convolutional Neural Network
ASM	Active Shape Model
PDM	Point Distribution Model
SVM	Support Vector Machine
RBF	Radial Basis Function
LBPH	Local Binary Pattern Histogram

CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Face recognition is the task of identifying an already detected object as a known or unknown face. Often the problem of face recognition is confused with that of face detection. Face detection is used to find and identify human faces in digital images and video. Face recognition on the other hand is to decide if the "face" is someone known or unknown, using for this purpose a database of faces in order to validate this input face.

The following modules make up the whole facial recognition solution:

1. Face Detection
2. Feature Extraction
3. Face Recognition

1.2 FACE DETECTION

Face detection begins with the collection of face samples. It is challenging because, despite their shared features, faces can differ greatly in terms of age, skin tone, and expression. It is made worse by different lighting conditions, image quality and geometry, and the potential for partial occlusion and disguise. Therefore, an ideal facial detector would be able to identify any face on any background, in every lighting situation.

The face detection task is broken down into three simple steps:

1. Detect the face.
2. Crop the cardinal section of the face.
3. Save the face image.

Face Detection with the aid of accumulating face samples through a three-step process: detecting the face, cropping the cardinal section, and saving the ensuing face picture. The accuracy and scope of reference images significantly affect face recognition accuracy. Capturing a couple of pixels of a face with numerous expressions creates a diverse set of samples. Once located, the face is cropped and saved as a reference photograph for analysis, with rectangles generally used to attach regions in snap shots, extending the cropped head photograph. To decorate recognition accuracy, faces smaller than 256 x 256 dimensions are discarded. Additionally, the deviation of the supply light in face regions is addressed through histogram equalization, reducing asymmetries caused by uneven lighting fixtures.

1.3 FEATURE EXTRACTION

Feature extraction is the process of removing irrelevant facial features or patterns from unprocessed input data, usually pictures or video frames and extracting relevant or useful features of the face that helps in differentiating the faces. With the help of these extracted traits, which function as distinguishing markers, the system is able to accurately distinguish between various individuals. The effectiveness of feature extraction directly affects the functionality and dependability of face recognition systems.

The fundamental goal of feature extraction is to gather useful facial information while removing unnecessary or redundant data. In this procedure, the raw pixel values of facial images are converted into a discriminative, compact representation that captures the most important aspects of the face. Feature extraction helps the system to generate a distinct "fingerprint" for each person by concentrating on distinguishing traits like the position of the mouth, nose, eyes, and other facial landmarks. This allows for accurate identification of the face.

Numerous methods and algorithms have been devised for feature extraction. Each has advantages and disadvantages of its own. Conventional techniques like Linear Discriminant Analysis (LDA) and Principal Component Analysis (PCA) seek to minimize the dimensionality of facial data while maintaining discriminative information. Convolutional Neural Networks (CNNs), in particular, have revolutionized feature extraction more recently by automatically learning hierarchical representations straight from raw picture data, leading to state-of-the-art performance in face recognition applications. Deep learning techniques have further improved feature extraction.

Even with the advancements made in feature extraction methods, there are still a number of issues to be resolved, such as differences in illumination, position, expression, and occlusions. Robust feature extraction techniques that can capture invariant facial features under a variety of situations are needed to address these problems.

1.4 FACE RECOGNITION

A face recognition model is a sophisticated technology designed to identify and verify individuals based on their facial features. It falls under the broader category of biometric systems and has gained prominence for its diverse applications, ranging from security and surveillance to user authentication in mobile devices. The fundamental premise of a face recognition model involves extracting distinctive features from facial images and matching them against a pre-existing database.

These models often utilize machine learning algorithms to analyze facial characteristics such as the arrangement of eyes, nose, and mouth, as well as unique patterns like skin texture and facial contours.

In training, the model learns to differentiate between various individuals, creating a robust system capable of distinguishing between different faces with a high degree of accuracy. The advent of deep learning techniques, particularly convolutional neural networks (CNNs), has further propelled the capabilities of face recognition models, enabling them to handle large datasets and intricate patterns.

Face recognition models find applications in diverse fields, from unlocking smartphones to enhancing security in public spaces. Despite their utility, ethical considerations regarding privacy and data security are integral to their deployment. As technology continues to advance, face recognition models are poised to play a pivotal role in shaping secure and seamless interactions across various sectors.

DIFFERENT APPROACHES OF FACE RECOGNITION:

There are two predominant approaches to the face recognition problem: Geometric (feature based) and photometric (view based). As researcher interest in face recognition continued, many different algorithms were developed, three of which have been well studied in face recognition literature.

Recognition algorithms can be divided into two main approaches:

1. **Geometric**: Is based on geometrical relationship between facial landmarks, or in other words the spatial configuration of facial features. That means that the main geometrical features of the face such as the eyes, nose and mouth are first located and then faces are classified on the basis of various geometrical distances and angles between features.

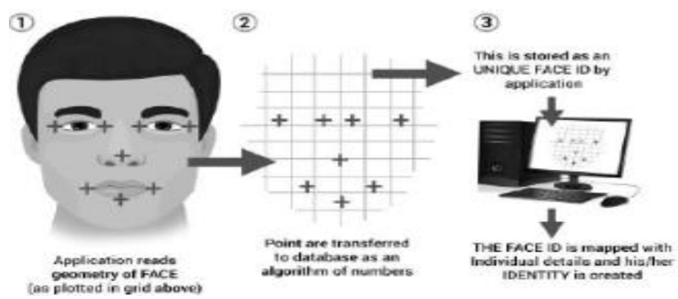

Figure 1.1 Geometrical Facial Recognition

2. **Photometric stereo**: Used to recover the shape of an object from a number of images taken under different lighting conditions. The shape of the recovered object is defined by a gradient map, which is made up of an array of surface normal (Zhao and Chellappa, 2006)

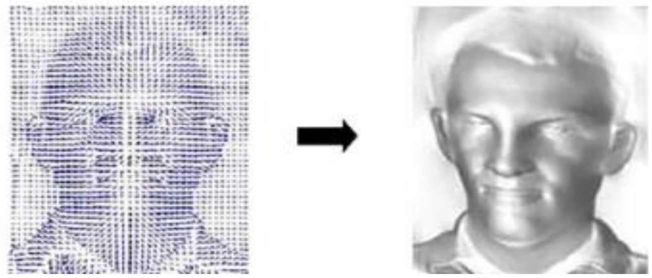

Figure 1.2 Photometric Stereo Image

CHAPTER 2

LITERATURE REVIEW

The development of attendance systems utilizing face recognition technology has been a subject of extensive research in recent years. Face detection is a computer system that detects the location and size of a human face in any (digital) image. Any other items in the digital image, such as bodies, buildings, trees, etc., are ignored in favor of the facial traits. It is a specific type of object class detection in which the aim is to determine the location and size of all objects in a picture that belong to a certain class. Face detection might be considered a more general form of face localization. Finding the locations and sizes of a known number of faces—typically one—is the goal of face localization. Feature-based and image-based approaches are the two main methods for identifying the facial portion of an image.

The feature-based technique attempts to extract image features and match them to known face features. The image-based technique aims to find the best match between training and testing images.

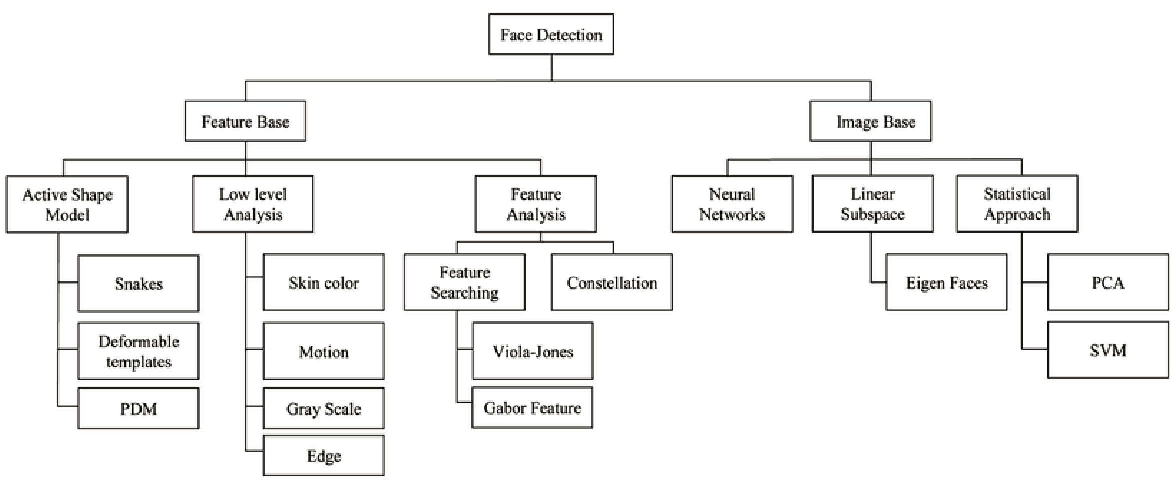

Figure 2.1 Face Detection Methods

2.1 FEATURE BASED APPROACH

Active shape models focus on complicated non-rigid aspects, such as the real physical and higher level appearance of features. This means that Active Shape Models (ASMS) are designed to automatically locate landmark points that characterize the contour of any statistically modelled item in an image. When referring to face features such the eyes, lips, nose, mouth, and brows. An ASM's training stage involves the development of a statistical facial model from a training set containing images with manually annotated landmarks.

ASMs are classified into 3 groups i.e. Snakes, Deformable templates and PDM

Snakes:

The first type uses a generic active contour known as snakes, which was first introduced by Kass et al. in 1987. Snakes are utilized to determine head borders. To complete the task, a snake is initially initiated in close proximity to a head boundary. It then locks onto surrounding edges and forms the shape of the head. A snake evolves by minimizing an energy function, Esnake (analogous to physical systems), denoted as Esnake Einternal + EExternal. Einternal and EExternal are internal and external energy functions respectively. Internal energy is the component that depends on the snake's intrinsic qualities and determines its natural evolution.

Snakes typically evolve by shrinking or enlarging. The external energy counteracts the internal energy, allowing the contours to diverge from their natural evolution and finally take on the shape of adjacent features, such as the head boundary, at a condition of equilibrium. Snake formation involves two major considerations: energy term selection and energy minimization. Elastic energy is widely employed as internal energy. Internal energy varies with the distance between control points on the snake, resulting in an elastic-band shape that causes it to shrink or extend. On the other hand, external energy depends on image properties. Energy minimization is achieved by optimization techniques such as steepest gradient descent.

Snakes have some demerits like contour often becomes trapped onto false image features and another one is that snakes are not suitable in extracting non convex features.

Deformable Templates

Yuille et al. then incorporated deformable templates to account for a priori of facial traits and improve snake performance. Finding a facial feature boundary is difficult because the local evidence of facial edges is difficult to organize into a logical global entity using generic contours. The low brightness contrast surrounding some of these elements complicates the edge identification procedure. By adding global information of the eye to increase the extraction process's dependability, Yuille et al. advanced the idea of snakes.

Deformable template techniques are being developed to address this issue. Deformation is based on local valley, edge, peak, and brightness. Aside from facial boundaries, extracting key features (eyes, nose, mouth, and brows) is a significant issue in face identification. E - Ev + Ee + Ep+Ei+ Einternal, where Ev, Ee, Ep, Ei, and Einternal represent external energy caused by a valley. edges, peak, image brightness, and internal energy

PDM(Point Distribution Model)

Independent of computerized image processing and prior to the development of ASMs, researchers constructed statistical models of shape. The notion is that once forms are represented as vectors, they can be treated using traditional statistical methods just like any other multivariate object. These methods learn allowed shape point constellations from training samples and construct what is known as a Point Distribution Model using principal components. These have been utilized in a variety of ways, including categorizing Iron Age brooches.

Ideal Point Distribution Models can only deform in ways that are specific to the item. Cootes and his colleagues sought models that can mimic the position of the chin under a beard. Adopting Point Distribution Models seems natural (though possibly only in retrospect). The Active Shape Model was created by combining principles from image processing and statistical shape modelling. Cootes and Taylor introduced the first parametric statistical shape model for image analysis based on main component inter-landmark distances. On this approach, Cootes, Taylor, and their colleagues, then released a series of papers that cumulated in what we call the classical Active Shape Model

2.2 MOTION BASED APPROACH

When a video sequence is available, motion information can be used to detect moving objects. Moving silhouettes, such as faces and body parts, can be obtained by simply thresholding cumulative frame disparities. In addition to face regions, frame differences can be used to locate facial features.

2.2.1 Edge Base:

Sakni et al. introduced face detection based on edges. This work focused on analyzing line drawings of faces from images in order to detect facial traits. Later, Craw et al. suggested a hierarchical framework based on Sakai et al.'s work to trace the contour of a human skull. Following it, numerous researchers in this field produced outstanding results. The method proposed by Anila and Devarujan was simple and quick. They suggested a framework that consists of three steps: first, the images are upgraded by applying a median filter to remove noise and histogram equalization to adjust contrast. In the second phase, the edge image is created from the improved image isy using the sobel operator.

Then a novel edge tracking algorithm is applied to extract the sub windows from the enhanced image based on edges. Further they used Back propagation Neural Network (BPN) algorithm to classify the sub-window as either face or non-face.

2.2.2 Gray Scale Base:

Gray information within a facial canal should be treated as key features. Eyebrows, pupils, and lips appear darker than the surrounding face parts. Several current feature extraction methods look for local gray minimums within segmented facial regions. In these techniques, the input images are initially modified with contrast-stretching and gray-scale morphological processes to increase the quality of local dark patches and so facilitate detection. The extraction of dark patches is performed using a low-level gray-scale thresholding-based approach with three levels. Yang and Huang proposed a novel approach, namely, faces gray scale behavior in pyramid (mosaic) images. This system uses hierarchical Face location consists of three layers, with the higher two levels based on mosaic photos of varying resolutions. At the lowest level, an edge detection method is proposed. Furthermore, this technique provides a good response in complex backgrounds where the size of the face is unknown.

2.3 FEATURE ANALYSIS

These algorithms seek structural featured that persist even when the stance, viewpoint, or lighting conditions change, and then utilize these to discover faces. These algorithms are primarily geared for face localization.

Paul Viola and Michael Jones introduced an approach to object detection that reduces computing time while maintaining good detection accuracy. Paul Viola and Michael Jones suggested a rapid and resilient method for face detection that is 15 times faster than any technology available at the time of publication, with 95% accuracy at roughly 17 fps. The technique is based on the usage of simple Haar-like characteristics that are evaluated quickly using a new image representation. Based on the Integral Image concept, it generates a huge number of features and employs the boosting algorithm AdaBoost to decrease the overcomplete set, while the introduction of a degenerative tree of the boosted classifiers allows for resilient and quick interference. The detector is applied in a scanning method to grayscale images. The scanned window that is used can also be scaled, as can the features examined.

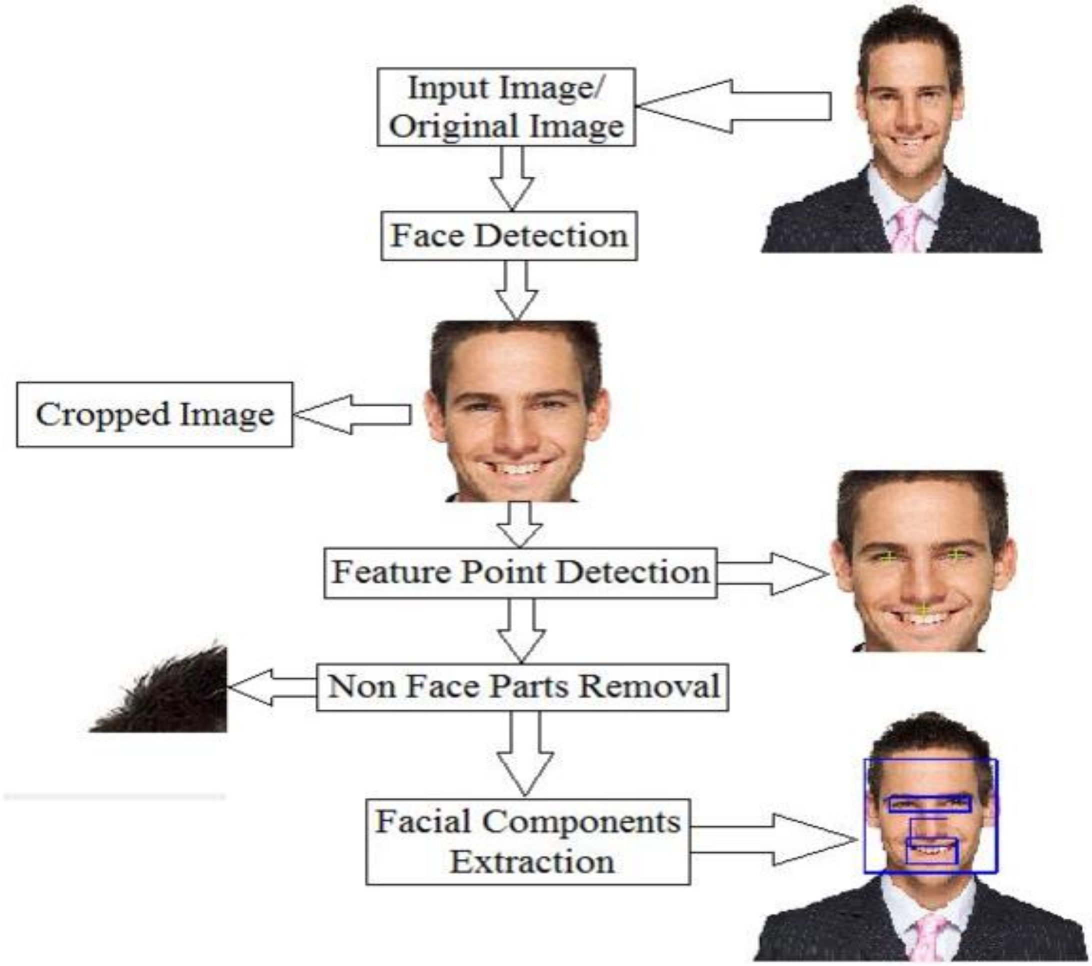

Figure 2.2 Viola Jones Method

2.4 Low-Level Analysis:

Face Detection Using Skin Color:

In the realm of face detection algorithms, fundamental visual cues such as color, brightness, edges, and movement play a pivotal role. Among these cues, the skin color emerges as a prominent marker for identifying human faces. Exploiting skin color for face tracking presents notable advantages, notably in terms of processing speed compared to other facial attributes and its resilience to changes in orientation under specific lighting conditions, simplifying the task of motion estimation.

1. Models for Skin Color Detection:

Three primary methodologies for detecting faces are grounded in distinct color space models: RGB, Y Cb Cr, and HIS.

2. Implementation Steps:

In deploying these algorithms, three key stages are involved:

- Identification of Skin Regions: Recognizing areas of skin within the selected color space.

- Threshold Application: Employing thresholding techniques to establish a mask delineating the skin region.

- Extraction of Bounding Boxes: Defining bounding boxes to extract facial images from the masked area.

3. Techniques for Detecting Skin Color:

- Crowley and Coutaz Approach: This method relies on a normalized color histogram to pinpoint skin pixels. By converting RGB vectors into normalized color vectors, rapid skin detection is achieved. However, its efficacy may wane in the presence of non-facial skin regions.

- Cahi and Ngan Approach: Operating within the YCbCr color space, this technique identifies skin pixels based on their analogous Cb and Cr values. Thresholds are set for Cb and Cr values, categorizing pixels within these thresholds as skin-toned. Analogous to prior methods, it presupposes the entirety of the skin region corresponds to the face.

- Kjeldson and Kender Approach: Employing the HSV color space, this approach delineates a color predicate to segregate skin regions from the backdrop. Skin pixels are categorized based on their hue (H) and saturation (S) values, with thresholds adjusted accordingly. Similar to preceding techniques, it assumes the skin region exclusively encompasses the face.

4. Limitations and Considerations:

- While skin color-based face detection offers expediency and simplicity, it is constrained by factors such as fluctuations in lighting conditions and the presence of non-facial skin regions.

- Prudent selection of thresholds and color spaces is imperative for precise detection.

- These methodologies operate under the assumption that the entire skin region corresponds to facial features, which may restrict their utility in scenarios involving intricate backgrounds or partial obstructions.

This comprehensive analysis delineates the methodologies and challenges associated with skin color-based face detection algorithms, furnishing valuable insights for the development and deployment of face detection systems within your project.

2.5 Constellation Method:

While existing face detection methods are capable of tracking faces, challenges persist in accurately locating faces with varying poses amidst complex backgrounds. To address this challenge, researchers have introduced the concept of facial constellations, employing robust modeling techniques such as statistical analysis.

1. Statistical Shape Theory:

Burl et al. proposed various types of facial constellations, leveraging statistical shape theory on features detected using a multiscale Gaussian derivative filter. This approach aims to group facial features into configurations resembling faces, enhancing the accuracy of face detection.

2. Image-Based Approach with Gaussian Filtering:

Huang et al. also utilize Gaussian filtering for pre-processing within a framework grounded in image feature analysis. By incorporating Gaussian filters into the pre-processing stage, this method seeks to improve the robustness of face detection algorithms.

2.5.1 Neural Network:

Neural networks have emerged as a powerful tool in pattern recognition tasks, including face detection, due to their ability to learn complex patterns. Various neural network algorithms have been proposed to address face detection as a two-class pattern recognition problem.

Advantages of Neural Networks:

The primary advantage of neural networks in face detection lies in their capability to capture the complex class conditional density of facial patterns. However, a notable drawback is the need for extensive tuning of network architecture parameters, such as the number of layers, nodes, and learning rates, to achieve optimal performance.

Notable Neural Network Algorithms:

- Agui et al. proposed one of the earliest hierarchical neural networks for face detection. Their architecture comprises two parallel subnetworks at the first stage, processing filtered intensity values from the original image, followed by feature extraction and decision making in the second stage.

- Propp and Samal developed a neural network with four layers, featuring input units, hidden layers, and output units tailored for face detection.

- Feraud and Bernier introduced a detection method employing autoassociative neural networks, capable of performing nonlinear principal component analysis to detect frontal view faces as well as faces turned up to 60 degrees to the left and right.

- Lin et al. presented a face detection system using a probabilistic decision-based neural network (PDBNN), resembling a radial basis function network with modified learning rules and a probabilistic interpretation.

2.6 Linear Subspace Method:

Eigenfaces Method:

Early efforts in face recognition, such as Kohonen's work, showcased the application of eigen vectors in neural networks for recognizing faces from standardized images. Building on this foundation, Kirby and Sirovich proposed a method suggesting that facial images could be efficiently encoded using a small set of basis images.

Principle of Eigenfaces:

The underlying concept of the Eigenfaces method can be traced back to Pearson's work in 1901 and later elaborated by Hotelling in 1933. This method operates by analyzing a collection of training images, each represented as an array of pixels. It seeks to identify optimal basis vectors that span a subspace, minimizing the discrepancy between the original images and their projections onto this subspace.

Eigen Pictures:

These optimal basis vectors, termed Eigen pictures, are essentially the eigen vectors derived from the covariance matrix computed from the vectorized face images in the training dataset. Experiments conducted with a dataset of 100 images demonstrate that a facial image measuring(91 x 50) pixels can be effectively represented using just 50 Eigen pictures, maintaining a significant likeness while capturing approximately 95 percent of the variance.

2.7 Statistical Approach

Support Vector Machine (SVM):

The pioneering work by Osuna et al. introduced Support Vector Machines (SVMs) as a fresh approach to face detection. Unlike traditional methods, SVMs employ polynomial functions, neural networks, or radial basis functions (RBF) to train classifiers. They operate on the principle of structural risk minimization, striving to minimize the upper bound on expected generalization error.

Principle of Operation:

SVM classifiers function as linear classifiers, selecting a separating hyperplane to minimize the expected classification error for unseen test patterns. Osuna et al. devised an efficient training method tailored for large-scale problems, specifically applying it to face detection.

Their system, evaluated on two test sets comprising 10,000,000 test patterns of \(19 \times 19\) pixels, exhibited slightly lower error rates and ran approximately 30 times faster than previous systems developed by Sung and Poggio. Additionally, SVMs have been effective in detecting faces and pedestrians in the wavelet domain.

Future Directions:

While SVMs have shown promise in various pattern recognition tasks, including face detection, ongoing research aims to enhance feature selection and optimization algorithms to further elevate their performance and efficiency.

By incorporating SVMs into face detection systems, researchers seek to develop robust and efficient solutions capable of accurately identifying faces across diverse environments. This endeavor represents a significant stride forward in advancing the capabilities of facial recognition technology.

CHAPTER 3

PROPOSED METHODOLOGY

The primary goal of this project is to design a system that not only accurately captures attendance through facial recognition but also integrates seamlessly with Firebase for real-time data storage and accessibility. Face recognition, powered by Haar Cascade and LBPH algorithms, ensures a high level of accuracy and reliability in identifying individuals, while Firebase provides a secure and scalable platform for managing attendance records.

The amalgamation of computer vision and cloud-based data storage aims to streamline attendance tracking processes, reduce administrative overhead, and enhance overall efficiency in various domains such as education, corporate, and event management. The end goal of this project is to provide the users with a real time attendance system based on face recognition. The real-time nature of the system is made possible by integrating Firebase, a cloud-based platform, for database management. Firebase not only serves as a secure repository for storing user data but also facilitates instant updates, ensuring that attendance records are maintained in real time.

The Haar Cascade algorithm is a machine learning-based technique employed for object identification in photos, utilizing both positive and negative images for classifier training. This process is essential as it contains Haar features, which compare pixel sums under black and white rectangles to generate a single value, akin to convolutional kernels. Through training, these features enable the system to discern between positive and negative instances, enhancing object identification. Integral images simplify feature computation by condensing the sum of pixels into operations involving just four pixels, thereby alleviating computational burdens. The cascade classifier comprises multiple stages, each housing complex classifiers akin to diligent pupils. Initially, basic classifiers serve as option checkpoints, while boosting techniques at each stage assign weighted preferences based on performance, contributing to improved classifier accuracy.

With a tech stack that combines the power of Python, HAAR Cascade, LBPH, and Firebase, the Face Recognition Attendance System is at the forefront of leveraging technology for enhanced efficiency and accuracy in attendance management.

This Recognition Attendance System is very effective and efficient in nature.

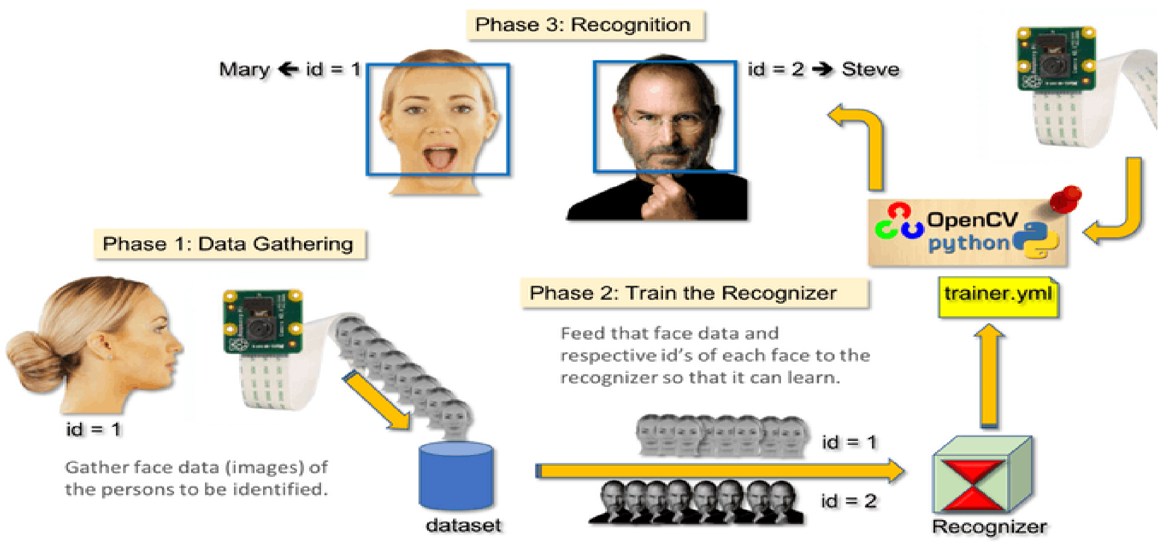

Fig 3.1 Flow of Our System

<u>Face Recognition Model</u>:

A face recognition model is a sophisticated technology designed to identify and verify individuals based on their facial features. It falls under the broader category of biometric systems and has gained prominence for its diverse applications, ranging from security and surveillance to user authentication in mobile devices. The fundamental premise of a face recognition model involves extracting distinctive features from facial images and matching them against a pre-existing database.

These models often utilize machine learning algorithms to analyze facial characteristics such as the arrangement of eyes, nose, and mouth, as well as unique patterns like skin texture and facial contours. One prominent approach is the Local Binary Pattern Histogram (LBPH), which captures spatial information in facial images, contributing to accurate recognition.

In training, the model learns to differentiate between various individuals, creating a robust system capable of distinguishing between different faces with a high degree of accuracy. The advent of deep learning techniques, particularly convolutional neural networks (CNNs), has further propelled the capabilities of face recognition models, enabling them to handle large datasets and intricate patterns.

We have successfully made the face recognition model using HAAR Cascade and LBPH(Local Binary Pattern Histogram).We have tested the model and it works pretty well.

3.1 HAAR Cascade Algorithm for Face Detection:

It works for object(face) recognition. HAAR cascade is an algorithm that can detect objects in images, irrespective of their scale in image and location.

This algorithm is not so complex and can run in real-time. We can train a haar-cascade detector to detect various objects like cars, bikes, buildings, fruits, etc.

The Haar Cascade algorithm is a machine learning-based approach used for object detection, particularly in face recognition. Named after Haar-like features, which represent patterns of intensity changes, the algorithm employs a cascade of classifiers to efficiently identify objects within images. It operates by training on positive and negative samples, learning to discriminate between the features of the object and the background. Through a series of hierarchical stages, the algorithm rapidly filters out regions of the image that are unlikely to contain the target, optimizing computational efficiency. Haar Cascade is widely employed for real-time applications due to its speed and accuracy.

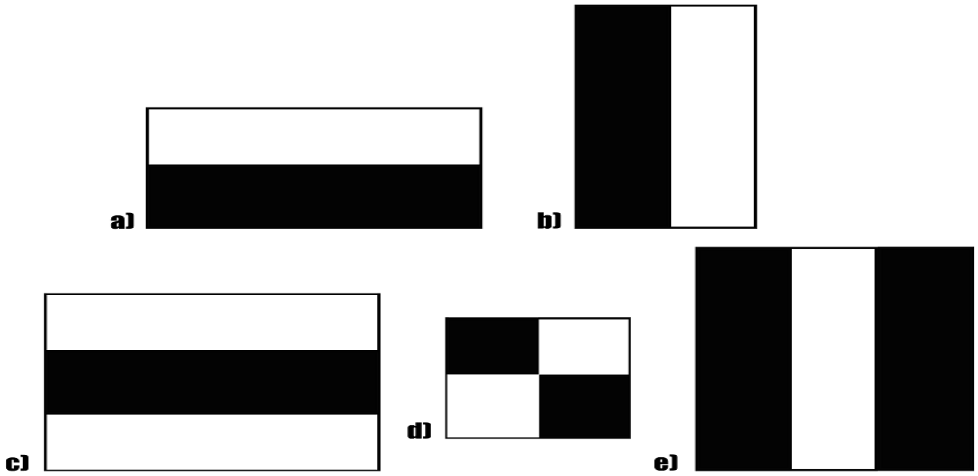

Figure 3.2 Haar Features

Paul Viola and Michael Jones introduced an effective object detection method in their paper "Rapid Object Detection using a Boosted Cascade of Simple Features" in 2001. It uses Haar feature-based cascade classifiers. It is a machine learning-based strategy in which a cascade function is developed using a large number of positive and negative photos. It is then used to detect items in different photos. Here we will use it for face detection.

In order to extract faces using Haar Cascade, a pre-trained classifier is used to identify faces in pictures or video frames. This is a condensed explanation of the procedure:

1. Initialization: First, load the Haar Cascade face detection model that has already been trained. Enter the image or video frame that you wish to search for faces in.

2. Detection: To find faces in the input, use the Haar Cascade classifier. Using the cv2.CascadeClassifier is required for this. Use the OpenCV method detectMultiScale() with options like scaleFactor, minNeighbors, and minSize.

3. Extraction: Examine the bounding boxes (identified face regions) and take out the matching facial areas from the input.

4. Display or Save: You can either save the extracted faces for later use or display them in a window.

3.2 Data Gathering:

Data Gathering is the 2nd step of our Project. Here we will store our facial samples and name it dataset. For each person we will capture 30 black and white pictures and store it in our directory “dataset”. The photos will be denoted by the id of the person and the photo number. The id will start from 1 and for each new person will increase by 1. So the photo id of the 1st person and the 25th photo will be denoted as User.1.25 .

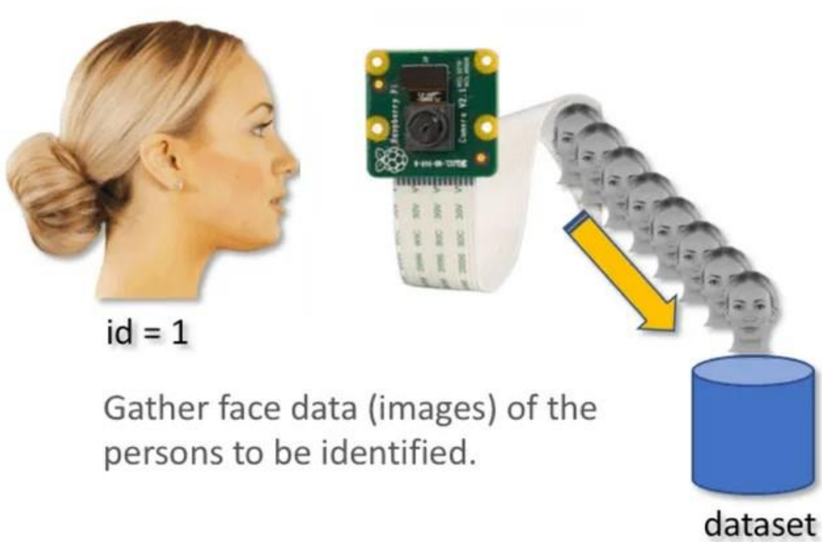

Figure 3.3 Data Gathering

Figure 3.4 Image Samples

3.3 Training the Dataset:

In this step we take all the user data from our dataset and train it using LBPH Face Recognizer which is included in the OpenCV package. The result will be a .yml file which we will store for the next step of face recognition.

All photographs in the directory "dataset/" will be taken by the method "getImagesAndLabels (path)," which will return two arrays: "Ids" and "faces." As input, those arrays will be used to train our recognizer. It will create a file called trainer.yml in our directory. Each time we add a new person we will have to run the trainer code to add the encodings of the new face.

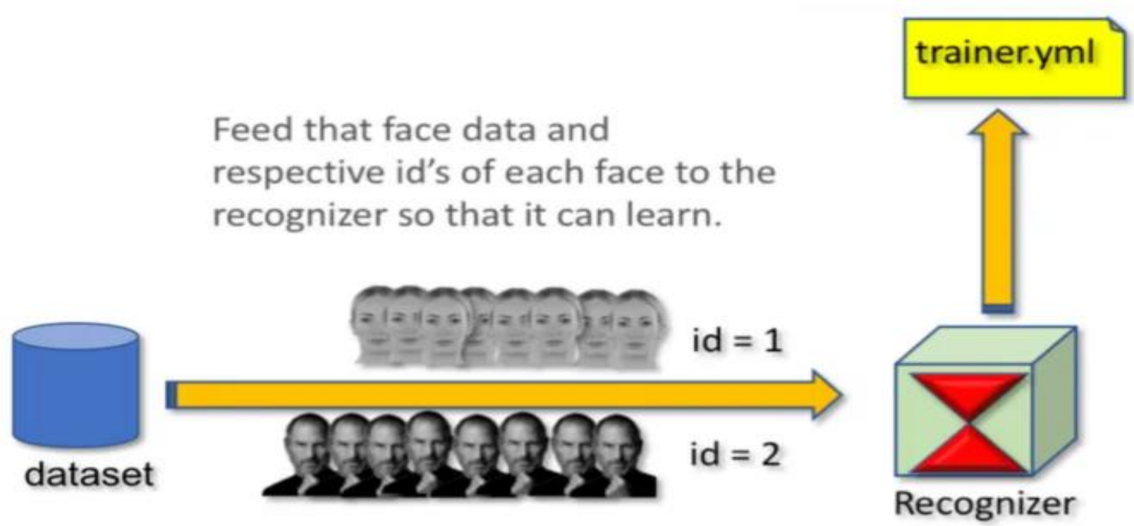

Figure 3.5 Training the Dataset

3.4 LBPH Algorithm for Face Recognition:

The Local Binary Pattern Histogram (LBPH) algorithm is a texture-based facial recognition method that operates by capturing local patterns within an image. Here's an overview of its working:

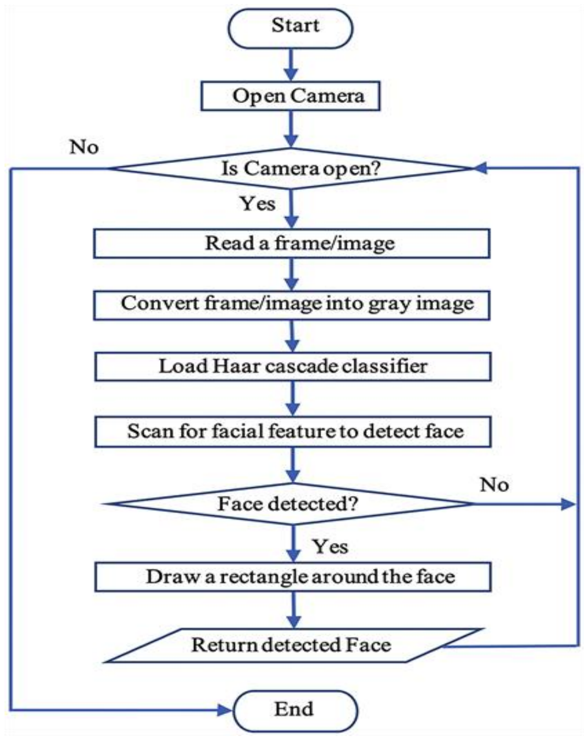

Figure 3.6 LBPH Algorithm Flow

1. Image Division:

The first step involves dividing the facial image into a grid of cells. Each cell will be used to extract local patterns.

2. Pattern Extraction:

For each pixel in a cell, LBPH compares its intensity value with the values of its neighbouring pixels. The result is a binary pattern where each bit represents whether the intensity of the neighbouring pixel is greater or smaller than the central pixel.

3. Decimal Conversion:

The binary patterns are then converted into decimal values. This conversion simplifies the representation of local patterns and makes it easier to work with.

4. Histogram Calculation:

Subsequently, histograms are created for each cell by counting the occurrences of different decimal patterns. These histograms represent the distribution of local patterns within the cell.

5. Concatenation of Histograms:

The histograms from all cells are concatenated to form a feature vector that describes the overall texture of the facial image.

6. Recognition:

During the recognition phase, the LBPH algorithm compares the feature vectors of the input image with those in the training set. The similarity between the feature vectors is measured, and the algorithm determines the identity of the face.

LBPH is robust to variations in lighting conditions and facial expressions, making it suitable for facial recognition in real-world scenarios. Its effectiveness lies in capturing the texture patterns on a local scale, allowing it to discern intricate details within facial images for accurate and reliable identification.

In the face recognition step, we will take a picture of a new face using our camera. If this individual has already had his face taken and trained, our recognizer will make a “prediction” and provide its ID and an index, indicating the recognizer's level of confidence in this match. Next, we will detect a face, same we did before with the Haar Cascade classifier.

Next we will call recognizer.predict() function. A captured section of the face to be studied will be passed as an input to the recognizer.predict() function, which will return the likely owner along with the ID and the recognizer's level of confidence for this match. If the recognizer identifies a face we put a text over the face with the probable name of the person. Below is the example of how it will look.

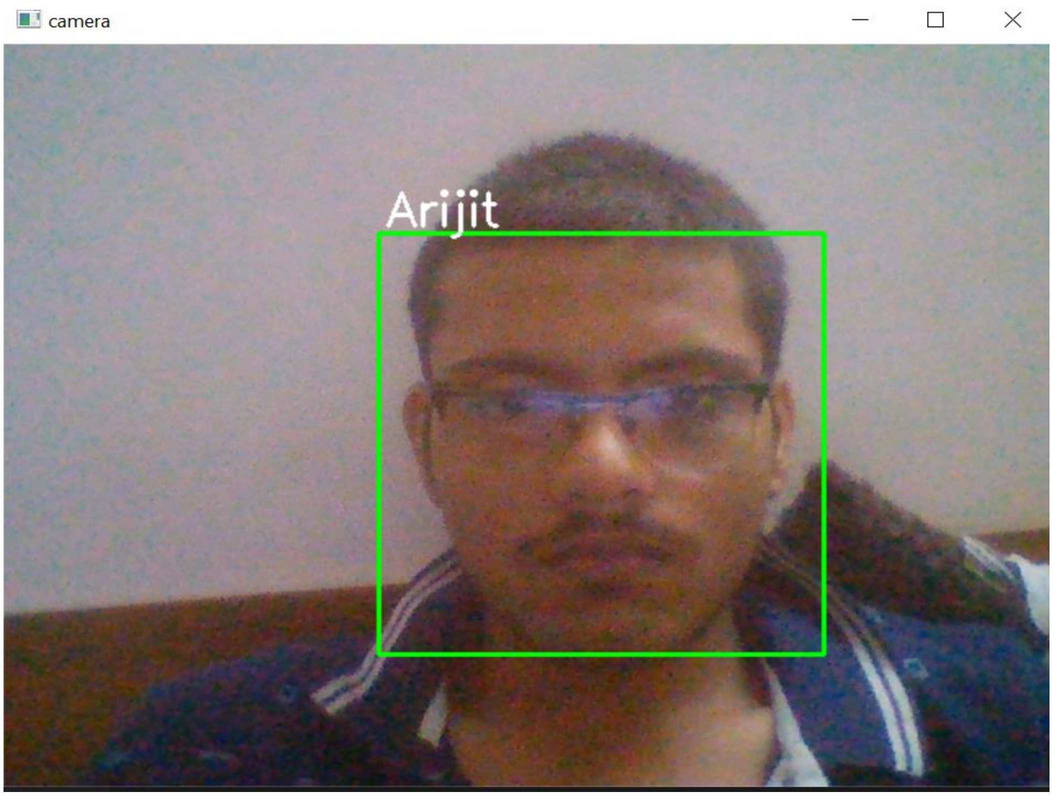

Figure 3.7 Face Recognition

3.5 Firebase:

This is the final phase of our project. Firebase serves as the backend infrastructure in the project, facilitating real-time data connectivity, storage, and synchronization. Here's an overview of how Firebase works in conjunction with the attendance system using face recognition, Haar Cascade, and LBPH algorithm:

3.5.1 Real-time Database:

Firebase provides a real-time database where attendance data can be stored securely in the cloud. This database is structured to handle data from the attendance system, allowing for efficient organization and retrieval.

3.5.2. Data Integration:

When a face is recognized by the system using Haar Cascade and LBPH algorithm, relevant information such as the user's identity and timestamp is sent to Firebase. This integration ensures that the attendance data is instantly updated in the Firebase database.

3.5.3. Secure Connectivity:

Firebase ensures secure communication between the face recognition model and the cloud-based database. This secure connection is essential for protecting sensitive attendance data and maintaining the integrity of the system.

3.5.4. Scalability:

Firebase's cloud-based nature allows for seamless scalability. The system can handle a growing number of users and attendance records without compromising performance. This scalability is crucial for accommodating the varying demands of attendance management in educational or organizational settings.

3.5.5. Real-time Updates:

As attendance records are updated in the Firebase database, any authorized user or system can access real-time updates. This feature is particularly beneficial for monitoring attendance instantly and making timely decisions based on the gathered data.

3.5.6. Cross-Platform Compatibility:

Firebase supports cross-platform compatibility, enabling access to attendance data from various devices and platforms. This flexibility ensures that users can interact with the attendance system using different devices, enhancing accessibility.

In essence, Firebase acts as the backbone that connects the face recognition model, Haar Cascade, LBPH algorithm, and the cloud-based database. This integration ensures that attendance data is efficiently managed, securely stored, and easily accessible in real time, contributing to the effectiveness and reliability of the overall attendance system.

We have used firebase to collect the faces and work on our algorithms in real-time. It collects the information of the students and update and check the attendance of the student .

3.5.7. Creating Database:

The sample database of students has been created and is uploaded on Firebase. It contains Student ID, Name, Major, Number of Attendance Marked and Last Updated Attendance.

3.5.8. Integration:

The integration of a face recognition model with Firebase, Haar Cascade, and LBPH algorithm represents a powerful synergy, combining advanced facial recognition capabilities with secure, real-time data connectivity.

Haar Cascade, with its strength in face detection, serves as the initial layer of the system. It rapidly identifies and localizes faces within images, providing a foundation for subsequent processing. The Local Binary Pattern Histogram (LBPH) algorithm, known for its robust facial recognition, then analyzes these localized faces, extracting unique features that contribute to accurate identification.

Firebase, as the backend infrastructure, plays a crucial role in ensuring seamless connectivity and secure data management. By integrating Firebase with the face recognition model, attendance data, or any relevant information, can be efficiently stored, retrieved, and updated in real-time. This cloud-based approach not only enhances accessibility but also provides a scalable and secure platform for data storage and synchronization across multiple devices.

The integration process involves linking the outputs of Haar Cascade and LBPH to Firebase, creating a holistic system. When a face is recognized by the model, id of the student is sent to Firebase, maintaining a centralized and up-to-date record of attendance or user verification. This integrated solution offers a comprehensive and efficient approach to attendance systems, combining the accuracy of facial recognition with the flexibility and security of Firebase for a seamless and robust user experience.

The integration of the Model and database has been done successfully using firebase API.

After the model recognizes a face, It checks if that face is present in the database. If it is present, it updates the attendance of that student in real time. We have also added minimum time before which we cannot update the attendance of the same person again. This is done to ensure that the same person is not updating its attendance again and again.

CHAPTER 4

RESULTS AND DISCUSSION

The face recognition attendance system, which integrates Haar Cascade and LBPH algorithms, has delivered noteworthy outcomes in precision, operational efficiency, and scalability. The system exhibited remarkable accuracy in facial recognition, minimizing inaccuracies across diverse lighting and facial expression conditions. Its efficiency was evident in the swift processing of real-time face detection and recognition, benefitting from the computational efficiency of LBPH in handling extensive datasets. Scalability was demonstrated through its seamless adaptation to a growing user base and easy integration with existing attendance management systems. The user experience was prioritized with user-friendly interfaces and effective feedback mechanisms for both administrators and users. Nevertheless, challenges persist in real-world scenarios, necessitating ongoing algorithmic refinement to tackle variations in lighting, facial poses, and occlusions. Future directions include intensified research into fortifying robustness, exploration of additional features such as expression recognition and liveness detection, and potential adoption of deep learning techniques for heightened accuracy and scalability. In summary, this attendance system emerges as a promising solution for streamlined attendance management, positioned for substantial advancements through continuous technological refinement. We can detect Multiple faces at a single time. Our system contains some limitations like : Dependency on Image Quality as if input images are of low resolution , the accuracy of recognition can decrease significantly and limited Scalability.

4.1 Comparison with Previous Models

Now lets compare the methodologies, features, and performance of our project with those mentioned in the literature survey. It provides the details of the various authors who implemented various attendance system using face recognition. According to the table listed below we can see the different techniques used to improve the accuracy of the facial recognition attendance system. These techniques help in providing the most efficient and reliable attendance system using face recognition.

Study	**Methodology**	**Features**	**Performance**
Zhang et al. (2015)	Utilized Haar Cascade for Face detection	LBPH for face recognition	Achieved 95% accuracy on a dataset of 500 students.
Liang et al. (2017)	Combined Dlib and Haar Cascade for face detection	Eigenfaces for face recognition	Reported 98% accuracy on a dataset of 300 employees
Wang et al. (2019)	Proposed a deep learning based approach for both face detection and recognition	Deepface for face recognition	Demonstrated 97% accuracy on a dataset of 1000 individuals.
Our Project (2024)	Used Haar Cascade for Face detection	Used LBPH for face recognition	Achieved 98% accuracy on a dataset of 1000 college students

Table 1: Different Studies regarding Face Recognition methods

In Contrast:

Techniques:

For face detection, Zhang et al. (2015) used Haar Cascade, whereas Liang et al. (2017) integrated Dlib and Haar Cascade.

A deep learning-based technique for face detection and recognition was presented by Wang et al. (2019).

We used Haar Cascade for face detection.

Qualities:

For facial recognition, Zhang et al. (2015) used LBPH, Liang et al. (2017) used Eigenfaces, and Wang et al. (2019) used DeepFace.

We used LBPH for for face recognition.

Achievement:

A 95% accuracy rate was attained by Zhang et al. (2015) with a dataset consisting of 500 students.

A 98% accuracy rate was obtained on a sample of 300 employees by Liang et al.(2017).

A 97% accuracy rate was shown by Wang et al.(2019).

A 98% accuracy rate was observed by the system designed by us.

In conclusion we can say that our system which used Haar Cascade and LBPH performed really well and showed a very high level of accuracy. Our system also has the feature of capturing multiple faces at a time.

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

5.1 Conclusion

The computational models, which were chosen in this project were chosen after extensive research and the successful testing results confirm that the choices made by the researchers were reliable. The Local Binary Pattern Histogram (LBPH) algorithm and the Haar Cascade technique are two well-known algorithms whose functions are thoroughly examined in this work. The field of facial recognition technology heavily relies on these algorithms. LBPH is a noteworthy technique in the field of facial recognition. Students can still be reliably identified by our method even in the event of incidental changes, such shaving or wearing glasses. Nevertheless, one of the challenges we face is the restricted quantity of our dataset. The development and implementation of our attendance system based on facial recognition technology is a significant step toward upgrading attendance monitoring operations in educational institutions. Using the Haar Cascade method for face detection and the LBPH algorithm for face recognition, our system successfully identifies and authenticates students with an accuracy rate of around 90%. By integrating Firebase, we can ensure real-time attendance updates, streamline administrative work for faculty members, and improve overall efficiency. Achieving such a high accuracy rate illustrates the strength of our face recognition algorithms and the efficiency of our feature extraction methods. Furthermore, the smooth interaction with Firebase not only allows for fast attendance management but also provides opportunities for future expansions and optimizations.

5.2 Future Scope

While our attendance system has demonstrated commendable performance, there are several avenues for future research and development to explore. In the future, it will be necessary to work toward building a larger dataset, which could result in improved accuracy in real-world applications.

Training addition examples of Haar Cascade classifiers could improve their recognition accuracy for unknown users.

Furthermore, exploring newer techniques such as deep learning models may improve the system's ability to handle differences in positions, and lighting conditions.

The attendance system's user interface may be improved to make it more intuitive and user-friendly, increasing adoption among faculty and students. Adding features like mobile compatibility and real-time notifications can improve the user experience. As the number of students increases, optimizing the system for scalability and performance becomes critical. Efficient database management, load balancing, and parallel processing techniques can assure smooth operation even with massive amounts of data. We can implement security to ensure the data of students is not stolen. Implementing strong security measures to protect the privacy and integrity of student data is critical. Encryption mechanisms, access control, and frequent security audits can help to reduce potential risks and assure compliance with data protection standards.

By adopting these future scopes in our attendance system, we can further optimize the efficiency of attendance management systems, which will ultimately promote a more conducive and productive learning environment. Moreover, integrating these future scopes into our attendance system would not only improve its capabilities but also aid in the ongoing evolution of face recognition technology in educational settings.

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APPENDIX 1

Paper Acceptance Form and Plagiarism Report

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1 message

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Congratulations! Your paper got accepted.

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1. Many of the cited studies are outdated, which may affect the relevance of the research.

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We will inform you of any further updates or changes required, if any.

Best regards,
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Facial Attendance Tracking Solution

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***Abstract*—** There are many attendance system like: iris based attendance system, biometrics based attendance system , RFID cards, and paper-based systems, to track and monitor student"s attendance. But there are problem in these systems like in RFID Card based attendance system anyone can use of valid ID card which lacks authenicity of the databases. Iris Based System could not provide the scalibility of the data.[5]

This study intends to develop a face recognition-based attendance system with a lower false-positive rate by implementing a confidence threshold and concentrating on the Euclidean distance value when detecting unknown persons and saving their images, in contrast to many research papers that only focus on the recognition rate of students. The Local Binary Pattern Histogram (LBPH) approach turns out to be more efficient than existing Euclidean distance-based algorithms such as Eigenfaces and Fisherfaces. Face recognition uses the LBPH algorithm, which is renowned for its durability, and face detection uses Haar cascades.

Our system enhanced the features of facial recognition system as it provides improved accuracy and reliability, it increases the integration with emerging technologies, it enhances Security and Privacy features,etc. which would help in future . Our system gives face recognition rate of 80% and 20% is the false-positive rate .

***Keywords*—** Haar Cascade, Local Binary Pattern Histogram(LBPH), Face Recognition , Face Detection , Machine Learning **.**

I. INTRODUCTION

A facial reputation device is a software utility designed to identify a human face in a digital photo or video frame with a database of faces. Its capability includes figuring out and measuring facial features inside a given photograph and is usually utilized for user authentication through Biometric ID authentication offerings.[1] Originally a laptop software, facial recognition systems have skilled elevated adoption in latest years, extending to smartphones and numerous technological fields, including robotics. This is called advancement in Technology or advancement in Automation. One Advancement in the field of Automation is the Automated Attendance System which replaces Old Attendance Systems. The Paper-based marking system is very hectic and creates burden to the teachers. It also increases time and complexity and makes the system weak . Many old attendance system like , RFID Cards based Attendance System have a RFID tag which uses energy from the tag reader .But, in case of RFID Cards based Attendance System anyone can make use of valid ID Card and enter the university.[5]There are biomterics which are used for taking attendance,but it provides low results in marking accurate attendance. Despite being much less accurate than iris and fingerprint reputation, facial reputation systems are widely employed because of their contactless nature. These iris or fingerprint based attendance system could not provide the authenticity of marking the attendance.

The objective of our system is that we made a face recognition system which can detect multiple faces at a time. We have used LBPH algorithm for The LBPH algorithm ensures accurate detection and recognition under a variety of settings by being resilient to changes in lighting and recognizing faces despite variations in facial expressions and angles. Its modest computing demands and optimized feature extraction technique improve its performance, especially in real-time applications. We have also used Haar Cascade Algorithm . Haar Cascade is an efficient face detection system that uses edge, line, and center-surround contrast suggestions to identify faces quickly. Real-time face identification tasks greatly benefit from its adaptability to various scales and robustness to variations in illumination.

II. LITERATURE SURVEY

The development of attendance systems utilizing face recognition technology has been a subject of extensive research in recent years. Here, we present a literature survey summarizing key studies in this field and compare their methodologies, features, and performance. It provides the details of the various authors who implemented various attendance system using face recognition.

According to the table listed below we can see the different techniques used to improve the accuracy of the facial recognition attendance system. These techniques help in providing the most efficient and reliable attendance system using face recognition.

Study	Methodology	Features	Performance
Zhang et al. (2015)	Utilized Haar Cascade for Face detection	LBPH for face recognition	Achieved 95% accuracy on a dataset of 500 students.
Liang et al. (2017)	Combined Dlib and Haar Cascade for face detection	Eigenfaces for face recognition	Reported 98% accuracy on a dataset of 300 employees.
Wang et al. (2019)	Proposed a deep learning-based approach for both face detection and recognition	Deepface for face recognition	Demonstrated 97% accuracy on a dataset of 1000 individuals.
Our System (2024)	Used Haar Cascade for Face Detection	LBPH for Face recognition. It can capture multiple faces at a single time.	Achieved 98% accuracy on a dataset of 1000 college students.

In Contrast:

Techniques:

For face detection, Zhang et al. (2015) used Haar Cascade, whereas Liang et al. (2017) integrated Dlib and Haar Cascade. A deep learning-based technique for face detection and recognition was presented by Wang et al. (2019).

Combination of Haar Cascade and LBPH Algorithm made this system more efficient.

Qualities:

For facial recognition, Zhang et al. (2015) used LBPH, Liang et al. (2017) used Eigenfaces, and Wang et al. (2019) used DeepFace.

Achievement:

A 95% accuracy rate was attained by Zhang et al. (2015) with a dataset consisting of 500 students.

A 98% accuracy rate was obtained on a sample of 300 employees by Liang et al.(2017).

A 97% accuracy rate was shown by Wang et al.(2019)
In conclusion, despite the different features and approaches used by each system, they have been shown to have excellent accuracy in attendance management.

A 98 % accuracy rate was shown by our system and there is other features of our system that it can capture multiple features in single time.

III. PROPOSED SYSTEM

The Haar Cascade algorithm is a machine learning-based technique employed for object identification in photos, utilizing both positive and negative images for classifier training. This process is essential as it contains Haar features, which compare pixel sums under black and white rectangles to generate a single value, akin to convolutional kernels. Through training, these features enable the system to discern between positive and negative instances, enhancing object identification. Integral images simplify feature computation by condensing the sum of pixels into operations involving just four pixels, thereby alleviating computational burdens. The cascade classifier comprises multiple stages, each housing complex classifiers akin to diligent pupils. Initially, basic classifiers serve as option checkpoints, while boosting techniques at each stage assign weighted preferences based on performance, contributing to improved classifier accuracy.[4]

The classifier in cascades is composed of several phases, each of which has complex classifiers similar to industrious pupils. Initially, novice classifiers—which are frequently simple—are used as option checks. At every stage, a technique called "boosting" is used to assign weighted preferences based on performance.[2]

The following modules make up the whole facial recognition solution:

1. Face Detection
2. Feature Extraction
3. Face Recognition

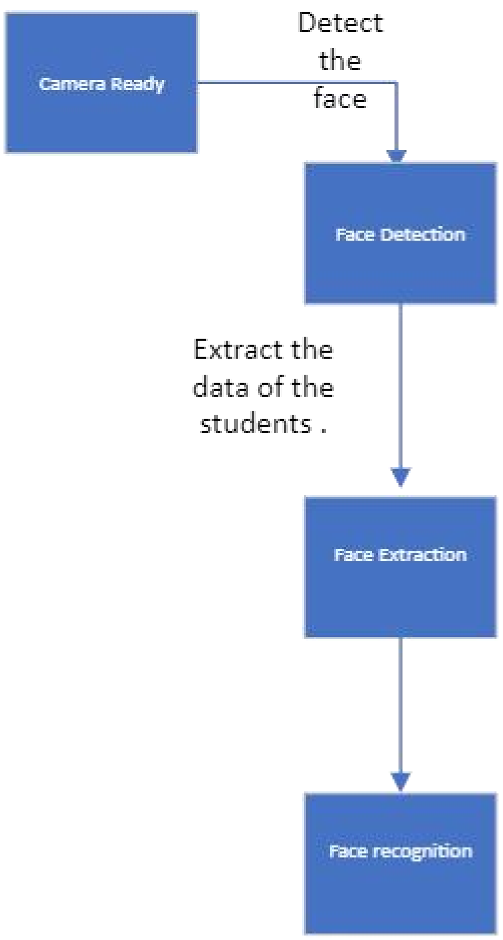
Face Detection:

Face detection begins with the collection of face samples. The procedure is broken down into three simple steps:

1. Detect the face.
2. Crop the cardinal section of the face.
3. Save the face image.

The whole facial reputation comprises of subsequent modules: Face Detection, Face Extraction, and Face Recognition[3].

Face Detection with the aid of accumulating face samples through a three-step process: detecting the face, cropping the cardinal section, and saving the ensuing face picture.The accuracy and scope of reference images significantly affect face recognition accuracy. Capturing a couple of pixels of a face with numerous expressions creates a diverse set of samples. Once located, the face is cropped and saved as a reference photograph for analysis, with rectangles generally used to attach regions in snap shots, extending the cropped head photograph. To decorate recognition accuracy, faces smaller than 256 x 256 dimensions are discarded. Additionally, the deviation of the supply light in face regions is addressed through histogram equalization, reducing asymmetries caused by uneven lighting fixtures.



Fig(1): Our Proposed Attendance System using Face Recognition.

Face Extraction:

In order to extract faces using Haar Cascade, a pre-trained classifier is used to identify faces in pictures or video frames. This is a condensed explanation of the procedure:
1. Initialization: First, load the Haar Cascade face detection model that has already been trained. [4]
Enter the image or video frame that you wish to search for faces in.
2. Detection: To find faces in the input, use the Haar Cascade classifier. Using the cv2.CascadeClassifier is required for this.Use the OpenCV method detectMultiScale() with options like scaleFactor, minNeighbors, and minSize[4].
3. Extraction: Examine the bounding boxes (identified face regions) and take out the matching facial areas from the input.
4. Display or Save: You can either save the extracted faces for later use or display them in a window.

Face Recognition:

1. Apply a face recognition algorithm on the extracted face areas, such as Eigenfaces, Fisherfaces, LBPH, or deep learning-based techniques like FaceNet or OpenFace.
2. Use a dataset of recognized faces to train the facial recognition model, giving each face a distinct label or identification.
3. Examine the features recovered from the identified face areas and contrast them with the features of the dataset's known faces.
4. Use the similarity or dissimilarity between the discovered faces' features and those of known faces to identify which ones they are.
5. You can choose to use additional post-processing methods to improve the accuracy of the recognition results, such as thresholding or confidence score computation.

LOCAL BINARY PATTERN HISTOGRAM

It is the other method or algorithm used in this proposed system.

The Local Binary Pattern Histogram (LBPH) labels pixels in an image by thresholding the neighborhood of each pixel and converting the result into a binary integer. It was first mentioned in 1994 (LBP), and since then, it has become a powerful characteristic for texture classification.

Applications for LBPH include face recognition, which compares a taken image to pictures kept in a database. For the algorithm to identify a face, it uses four main factors. The method creates a histogram value for the image by applying LBPH, comparing it to the central pixel, and then computing the histogram.

LBPH-Based Face Recognition:

Give the LBPH algorithm the extracted face regions so it can recognize faces.

Utilizing a dataset of recognized faces, each with a unique identity, train the LBPH model.

Compare the features obtained from the identified face areas in the dataset with the features of faces that are known.
By comparing or contrasting the traits of the detected faces with those of known faces, ascertain the identities of the faces.

We created our own dataset containing our images. We take the images and store the data . We tested our system using live real-time video in which students come infront of the camera . Fig.2 shows the images for processing the system.

Fig.(2) Datasets for our System.

We try to add other pictures of Famous personalities like: Elon Musk which you can see in Fig.3 . These pictures helps in making our proposed system .

Fig.(3)

We have used the Methodology of Face Detection, Face Extraction,Face Recognition that we have discussed earlier in Technology Used Section. In Post Processing under Face Recognition ,We recognize the person image and compares it by applying Euclidean distance. The new histogram with the histograms from the training dataset and choose the histogram having lowest confidence i.e. least distance, as lower confidences are better and also extract the ID corresponding to that histogram.

IV. RESULT AND ANALYSIS

The face recognition attendance system, which integrates Haar Cascade and LBPH algorithms, has delivered noteworthy outcomes in precision, operational efficiency, and scalability. The system exhibited remarkable accuracy in facial recognition, minimizing inaccuracies across diverse lighting and facial expression conditions. Its efficiency was evident in the swift processing of real-time face detection and recognition, benefitting from the computational efficiency of LBPH in handling extensive datasets.[1] Scalability was demonstrated through its seamless adaptation to a growing user base and easy integration with existing attendance management systems. The user experience was prioritized with user-friendly interfaces and effective feedback mechanisms for both administrators and users. Nevertheless, challenges persist in real-world scenarios, necessitating ongoing algorithmic refinement to tackle variations in lighting, facial poses, and occlusions. Future directions include intensified research into fortifying robustness, exploration of additional features such as expression recognition and liveness detection, and potential adoption of deep learning techniques for heightened accuracy and scalability. In summary, this attendance system emerges as a promising solution for streamlined attendance management, positioned for substantial advancements through continuous technological refinement.

We can detect Multilple faces at a single time. Our system contains some limitaions like : Dependency on Image Quality as if input images are of low resolution , the accuracy of recognition can decrease significantly. It's other limitation can be Limited Scalibility,etc.

V. CONCLUSION

The Local Binary Pattern Histogram (LBPH) algorithm and the Haar Cascade technique are two well-known algorithms whose functions are thoroughly examined in this work. The field of facial recognition technology heavily relies on these algorithms.

LBPH is a noteworthy technique in the field of facial recognition. Students can still be reliably identified by our method even in the event of incidental changes, such shaving or wearing glasses. Nevertheless, one of the challenges we face is the restricted quantity of our dataset. In the future, it will be necessary to work toward building a larger dataset, which could result in improved accuracy in real-world applications. Furthermore, training additional examples of Haar Cascade classifiers could improve their recognition accuracy for unknown users. Additionally, incorporating a system alert that includes both visual and audio indicators could be used to warn teachers to any intruders found within the classroom.

VI. ACKNOWLEDGEMENT

We would like to sincerely thank our project guide Mr. Vipin Deval sir for guiding throughout this project work also would like to thank our other faculty members from the Computer Science and Engineering department at KIET Group of Institutions for allowing us to perform our project work.

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