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Smart Face Recognition System

Aadithyan V, T Sai Samrat Goud, G Karthik Reddy, P Naga Chaitanya,
V Jaya Surya, Dr K Prabhakara Rao
Department of ECE, B V Raju Institute of Technology, NARSAPUR, Medak District

ABSTRACT:
Automatic face recognition (AFR) technologies have seen exciting advances in performance over the past years, and such they are now extensively used for security and commercial applications. An automated system for human face recognition in a real-time background which can be useful for a wide range of applications ranging from marking attendance of students to identifying criminals/high profile people in a locality. So using real-time face recognition is a real-world solution that comes with day to day activities of handling various activities.
This task, however, is very difficult as real-time background subtraction in an image is still a challenge. To detect human faces in real-time, a simple fast Principal Component Analysis is used to recognize the faces identified with a high accuracy rate. Our system uses the Speeded Up Robust Features (SURF) [1] method to detect human faces and maintains the collection of user facial features as datasets and uses them for verification.
Keywords: *Speeded Up Robust Features (SURF); Image Processing; Automatic Face Recognition (AFR).*

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I. INTRODUCTION

With technology growing every day and means of authentication changing along with it, facial recognition has stood out as a form of authentication. The usage of facial recognition is noticed in a multitude of circumstances. Face recognition consists of two steps, in first step faces are detected in the image and then these detected faces are compared with a database for verification. Several methods have been proposed for face detection such as temple matching [2], the Ada Boost algorithm, the Float Boost algorithm, the S-Ada Boost algorithm, Support Vector Machines (SVM), Speeded Up Robust Features (SURF) and the Bayes classifier. The efficiency of the face recognition algorithm can be increased with a fast face recognition algorithm. In all the above methods SURF is most efficient.

Face recognition techniques can be classified into two types, Appearance-based which uses texture features that are applied to the whole face or some specific Regions, and Feature-based which uses geometric features like mouth, nose, eyes, eyebrows, cheeks, and Relation between them. Statistical tools such as Linear Discriminant Analysis (LDA), Principal Component Analysis (PCA), Kernel Methods, Neural Networks, and Eigen-faces have been used for the construction of face templates.With its wide range of applications, face recognition is being used in our day to day lives from unlocking a smart device such as our phones to detecting intruders in a smart home system.In the case of our project, we have used face recognition to aid in the process of marking the attendance of students attending their classes.

II. LITERATURE SURVEY

[3] There has been more emphasis on developing security systems to ensure the safety of innocent citizens, namely in places like airports and border crossings where the identification process is crucial. This paper proposed a facial recognition system using machine learning, specifically using support vector machines (SVM). The first step is face detection which we accomplish using a widely used method called the Viola-Jones algorithm. The Viola-Jones algorithm is highly desirable due to its high detection rate and fast processing time.

Once the face is detected, feature extraction on the face is performed using histogram of oriented gradients (HOG) which essentially stores the edges of the face as well as the directionality of those edges. HOG is an effective form of feature extraction due to its high performance in normalizing local contrast. Lastly, training and classification of the facial databases are done using a multi-class SVM where each unique face in the facial database is a class.

This paper also discussed the shortcomings of using a global approach to feature extraction, which is that a model trained using a feature vector of the entire face instead of its geometrical

components makes it less robust to angle and orientation changes. However, when the variation in facial orientation is not large, the global-approach is still very accurate and simpler to implement than component-based approaches.

[4] This paper discusses the problems of face detection. It suggests that detecting faces in images is the very first and fundamental step in the face recognition process. Since faces have a high variation in color, pose, and lighting conditions, it is normally difficult to design an automated system to overcome these problems. However, machine learning has shown and proved that it is one of the most successful tools to build high-performance face detection systems.

The above-stated problems could not be overcome entirely in approaches such as template-based and feature-based methods. But using Appearance-based and components-based methods along with machine learning algorithms, we were able to achieve a lot of progress in facial recognition technology.

The paper suggests that Support Vector Machines (SVM) and Hidden Markov Model (HMM) laid the foundation for face recognition. The Neural network and Ada boost took the research to greater levels. Ada boost is the most popular technique and has been used in several image applications recently. As it reduces the computation time and hence the speed of detection is increased. Among existing methods for detecting faces in images, techniques using boosting algorithms are more effective for real-time object detection.

[5] The paper mainly focuses on face recognition used for marking attendance of students. It suggests that by using face recognition for marking attendance of students and employees, the process of marking attendance is more efficient and time-saving. The system developed by them seems to differentiate the actions performed by different user levels i.e. a student or a teacher. The paper implies that they are also trying to make the model recognize faces in much wider coverage and also implement geo-location.

[6] The paper focuses on face recognition used for marking attendance of students with the use of Convolution Neural Networks (CNN). The paper suggests that this particular system can detect and recognize faces only up to 30 degrees and also suggests that poor lighting may affect the process.

[7] This paper lists different types of approaches to face recognition. It mainly explains the following methods the Feed Forward Neural Network, Convolution Neural Network, Deep Convolution Neural Network, Principal component analysis, Linear Discriminant Analysis. It provides a clear picture of all the above-mentioned methods used in face recognition and also provides the applications of Feed Forward Neural Network method.

III. PROPOSED WORK

With massive development in technology, authentication systems are also developing and are moving towards more secure and robust methods, and one such approach is face recognition. There are many different methods and algorithms in face recognition, and they all have their uses. But in this case, we used the Speeded Up Robust Features (SURF) method to detect human faces and maintain the collection of user facial features as datasets and use them for verification. Our model is essentially employed to register the attendance of students/employees.

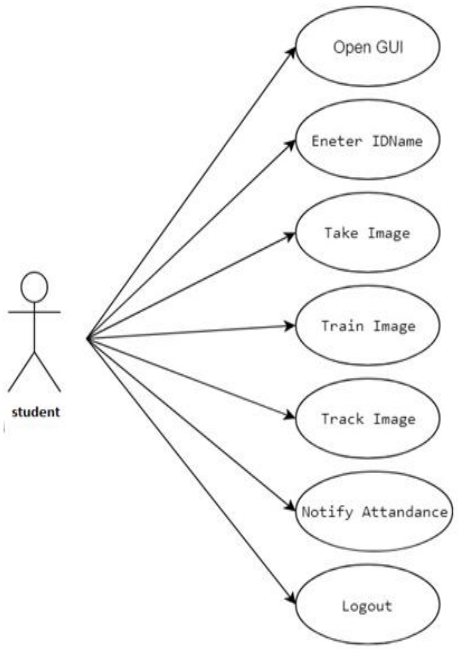

Figure 1.0 Use Case Diagram.

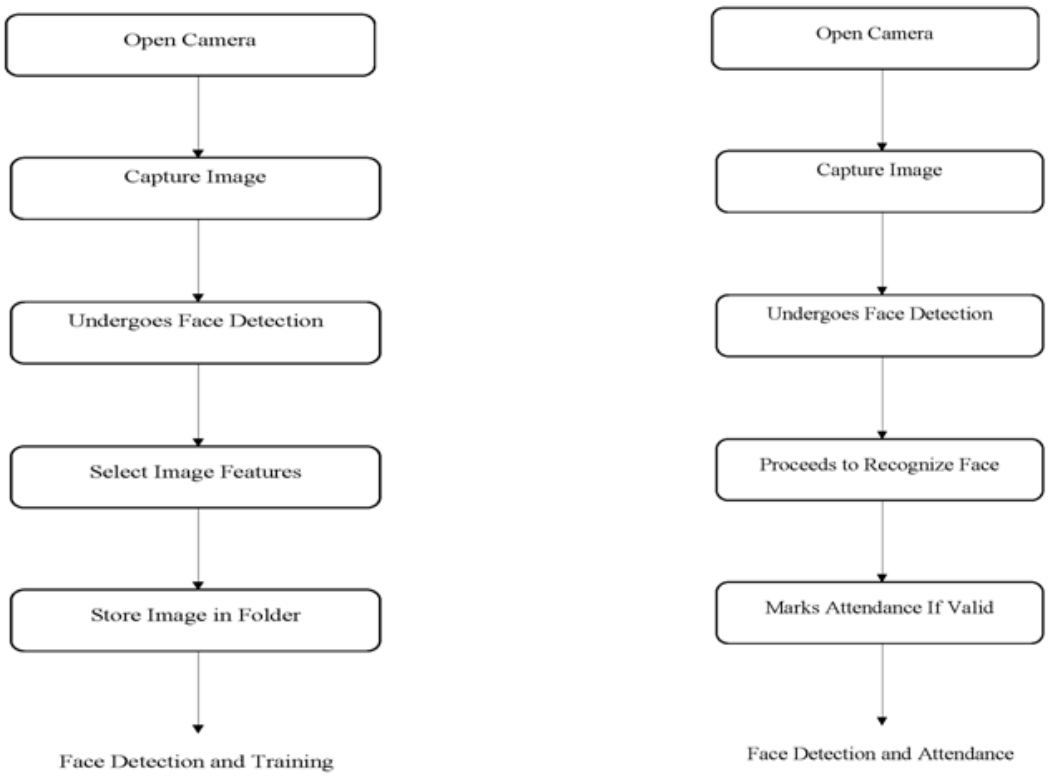

Figure 2.0 Activity Diagram.

As the diagram suggests, a User Interface (UI) is first opened up and an "IDName" is entered, this is a unique string that is different for everyone using the UI. Once the IDName is entered, a photo of the person is taken by the device. This photo is then used to train the device, to identify the person. Once the training is done, the image is stored as a data set and the attendance is recorded.

The first half of the activity diagram showcases the training portion of the process, i.e. taking pictures of people and training the device to identify them. The picture of each individual is taken in multiple angles and lighting conditions to increase the accuracy of the device in the identification process.

The second half of the activity diagram showcases the attendance marking portion of the process. The device, once trained and has the images stored as datasets, is ready to identify the person in front of it.It scans the person's face and matches it with the datasets. If it detects a match with the dataset, then it performs the desired operation which in our case is to mark the attendance of a student.

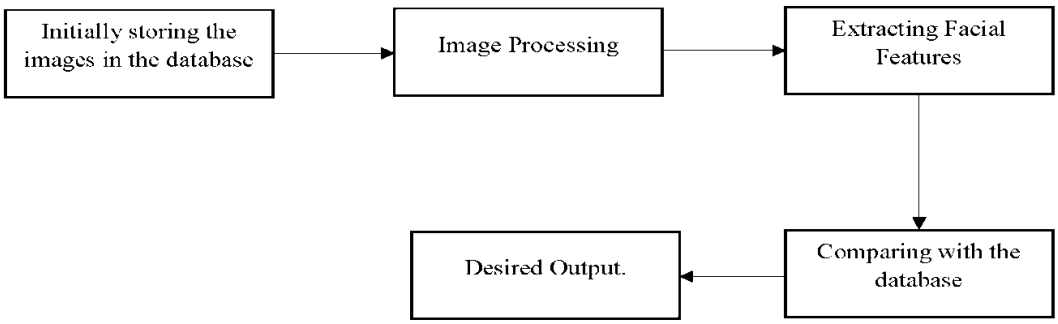

Figure 3.0: Block Diagram of the Entire Process.

Every face has at least 80 distinguishable parts called Nodal points. Few of them are:

- Distance between the eyes
- Width of the nose
- Depth of the eye sockets
- Structure of cheek bone

A general face recognition conducts a comparison of these parameters with the images in the database. We use this information to extract the face from the image and save it. We first take the photo from the camera and create a face detector object.

Once that is done, the captured images are converted into grayscale and are sent to the image detector. From the detector, we get the position, width, and height of the face. Once we get these values, we compare it with the data base present in the system.

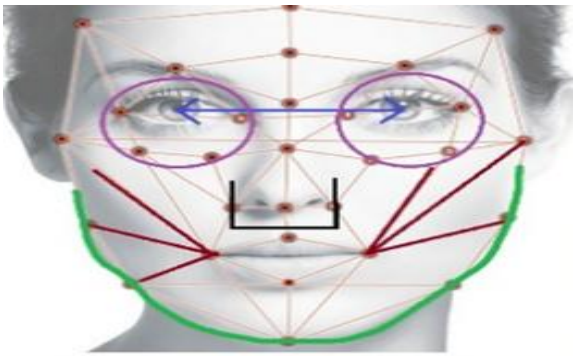

Figure 4.0: Example of nodal points in a face.

IV. SEQUENCE OF OPERATION

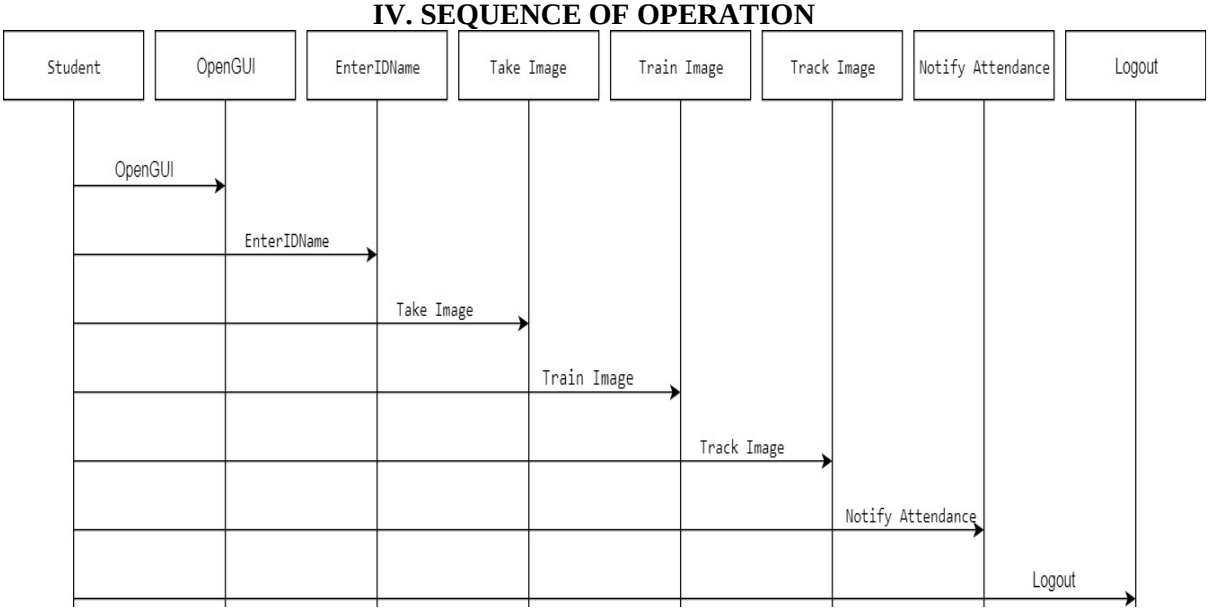

Figure 5.0 Sequence Diagram.

STEP 1: The student opens the Graphical User Interface (GUI).
STEP 2: Once the GUI is opened, the student enters an "IDName" this is a unique ID for every student/employee.
STEP 3: After filling out the "IDName", the device then proceeds to take a picture of the person.
STEP 4: The picture is then used to train the device and stores the picture as a data set.
STEP 5: Once the device is trained, when a person comes under the view finder of the device, it identifies the face and runs it through the data sets.
STEP 6: If a match is found, then in our project it marks the attendance. But this can easily be repurposed to perform a number of other operations.

This system while mainly designed to record the attendance of students/employees is not confined to just that. It can easily be repurposed to work as a security alert system in a private commodity by letting off a buzzer/alarm when an unrecognized person is identified instead of recording the attendance. This system can also be used to identify criminals in different localities by uploading their images to a central server which is connected to multiple devices of the same nature located at various locations.

V. CONCLUSION

Face recognition System has been envisioned to reduce the errors that occur in the conventional (manual) authenticating and identifying systems. The aim is to automate and make a system that is useful to an organization. This method is secure enough, reliable and available for use.There is no need for specialized hardware for installing the system in the office or any other locality. It can be constructed by using a camera and a computer. Once set up, it can be used for a multitude of purposes ranging from marking attendance to identifying criminals all that needs to be done is the device be trained properly.

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