Proposed Model for Creating Data Repository Using Facial Recognition for Better Attendance Management

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Abstract

Attendance is an integral part of any institution whether educational or workplace. Attendance is a traditional process used to record the presence of someone at a particular time. It also denotes the commitment of the individual in maintaining the obligation to be present at the required time at the institution or the agency. Usually, attendance has been recorded manually and is called by names alphabetically. But in today's digital world, this requires to be changed so as to accelerate and speed up the process to make it more seamless and efficient. The facial recognition technology can be used to record the attendance of everyone present in a given place at a given time instantly without any human intervention. Technologies like machine learning and deep learning have been utilized alongside algorithms to record images and recognize images from a pre-trained dataset. The proposed model can automatically record attendance by capturing the image of the participant and recording the attendance of the person without any delay.

Keywords

facial recognition, machine learning, LBP, attendance management

1. Introduction

Facial recognition is a pioneering technology that is used to recognize or detect a person's face by using the technology of digital masking from a definite video or image. The technology of facial recognition uses biometrics to map a face from the image or video which is then posited against a face to reveal the personal identity. In today's world, this has gained prominence in many sectors like corporate, civil, government and many more. Facial recognition has gained importance in the work segment since it is very useful in verifying attendance without any flaws. But even though this technology is available, it has not been used widely in workplaces even though it will speed up the process both on the front- and back-end. The technology has also shown promising results in past years and new approaches are discovered often.

This particular research is undertaken to create a facial recognition student attendance system. In workplaces and classrooms alike, the attendance may be skipped at times or may face technical difficulties resulting in multiple attendances. This can create problems in the final recording of data which is why a comprehensive system will allow the universities or the workplaces to access accurate data. It will also disallow individuals from cheating the system and placing attendance for missed days. The present research is presented for classrooms in universities but can be used alike for workplaces too. For this particular research, no funding was received so freely available servers were used to create a database for testing the proposed model. In addition, it is required that the databases from the European General Data Protection Regulation (RGPD) are integrated with the university database so that fair treatment of student data can be overseen and the model be used widely across the university in processes like form filling, distribution and dissemination of exam papers and answers, and much more.

2. Literature Survey

There have been numerous studies conducted over the years that have taken into account different facial recognition technologies used for real-life applications. Mostly the studies consisted of proposing frameworks and models for utilization of the technology. One such study states that the technology can be used for customary level schools. The framework consists of utilizing the mobile application and RFID technology. The RFID technology would be used to record the data at the back-end database and capture the participation of the understudy. The mobile application would be used to provide information to the parents about their child's attendance. The latter is also a backup in case the former fails to send data or does not have enough assets or power [1].

Another study proposed an automated attendance system that tries to address the problem of utilizing a biometric framework for the recognition of faces in varying situations like scaling, light and revolution. The model proposed that the image recorded is undertaken as an input, calculated to recognize it, encoded and imprinted on a spreadsheet to convert it into a PDF record. The images would be easily captured on the smartphone cameras and the image when sent to the database would record the attendance [2].

A model was proposed which is advanced in utilizing the Local Binary Pattern (LBP) along with advanced image processing processes to address the issues in facial recognition faced due to lack of image data. These processes included Histogram Equalization, Contrast Adjustment, Image Blending, and Bilateral Filter which could improve the LBP codes and in turn, improve the accuracy in recognition pattern of the system. The testing and implementation of the system showcased that the system was exceptionally precise and accurate in recognizing faces

which is why it can be utilized without any doubt in real-life environments and a computed attendance system [3]. A similar study involving LBP had suggested utilizing Ada-Boost, picture contrasts, Haar-like highlights, and integral pictures for better accuracy in recognizing the faces. This model, however, suggested that the captured images of the students be compared with the university's student image database for better identification. This framework had achieved better results as it also took into consideration the changes in facial features over a time span [5].

Another attendance system was proposed to improve the confrontational orderly framework which could drastically change the dynamics and mechanics of the system. The testing of the research showed that by integrating the Android Face Recognition with Deep Learning, the programme could recognize faces with a 97% accuracy. The dataset created would be stored in the cloud and integrated with the Attendance Management System web worker. Also, the system would verify the data by instantly presenting the data on-screen for students to improve the reliability of the data [4].

Unlike other frameworks suggesting using smartphone cameras to record or capture the images, this study had proposed that a high-resolution digital camera be placed at the door or the gate which will record the images of the students in real-time and feed the data to a database that already has student images record. This framework aimed at recording attendance within the classroom when a class was being held and utilizing the pattern recognition technology so as to completely negate the conventional manual systems of recording attendance [6].

Another study proposed to use the skin-color model which is a novel and dynamic method of facial recognition in relation to an indistinct neural network that can record new faces and detect already recorded faces. A hybrid algorithm was proposed which could reduce the number of false positives and increase precision by utilizing speed processing and skin shading model through the fuzzy neural network [7].

Another system proposed using the Yale University database for creating a training dataset using facial recognition technology. The Create Training Dataset involves using the face detection algorithm for selected images from a database and using database storage. The workflow proposed for the model includes detecting faces by uploading images from the Yale database, applying RGB to grey transformation and then using histogram equalization. The identified and detected faces are stored in the training data set using the Haar classifier. After the first stage is completed, the following stages include recognizing the face using PCA strategies. The Euclidean distance classifier is further used to match facial features from the training database. If the faces match attendance is recorded [8].

Few researchers [9] had proposed a model for an automated attendance system that included a Radio Frequency Identification (RFID) system that could detect the faces of the students whenever they went in or out of the classroom. The system recorded authentic data that was stored as an attendance log and could be recovered at any time providing all the necessary data. In [10], the authors had proposed a very interesting attendance system that utilized iris biometrics. The participants were asked to register themselves with all details and their unique iris template. When recording attendance, the system would read the iris image of every attendee and attendance would be recorded accordingly by comparing previous data from the database. The proposed model was web-based for easier integration and usage. Other studies have utilized the PCA algorithm [11], Viola-Jones and Histogram of Oriented Gradients (HOG) along with Support Vector Machine (SVM) [12-16], and Discrete Wavelet Transforms (DWT) and Discrete Cosine Transform (DCT) [17] to create frameworks which superseded with quality and efficiency in each model. The current study takes into consideration all such previous models and frameworks to propose a model that can address all the fallacies in the previous models to work with better accuracy[19].

3. Methodology

The methodology proposed for this research is simple and precise. The aim was to create a facial recognition system that would require the least amount of input images so that lesser training data is required. This would mean that the supervisor could upload only one or two pictures of a student and successfully recognize faces rather than having to upload huge datasets containing multiple images of students[20]. The study compared two face classification models namely pre-trained CNNs and PCA dimensionality reduction. The following steps were undertaken to perform the facial recognition:

- Using images with multiple faces to detect all.
- Using a facial recognition algorithm to accurately compare recorded and uploaded images of lecturers and students.

$$LBP(x_c, y_c) = \sum_{p=0}^{P-1} 2^p s(i_p - i_c)$$

- Creating and providing a file of all recognized participants.

The process can be simplified as:

1. Face detection.
2. Decomposition of the face.
3. Extracting facial features.
4. Identifying matches in the database.
5. Recording attendance for the person.

The first step is to capture the image of a user and store it in the database using the firebase. If the system finds a match the attendance is recorded or else terminated. The lighting in the background is a prerequisite for capturing the image and the detection of faces utilizes the harassed algorithm.

Applying the LBP:
The LBPH initially utilizes the initial computational method of creating an intermediate mage that has better highlighted facial features than the original image. This is done by using a sliding window algorithm dependent on the parameter's neighbours and radius.

1. There is a 1X1 comparison of the input image and the fed image for authentication.
2. The next step also conducts a similar search but to match the image with a user from the database.
3. The LBP operator is defined using 3X3 and is used for all regions.

4. Proposed model

The proposed model can be divided into four primary stages described as follows:

a. Creation of the dataset

The images of the participants are recorded using a web camera. High-quality images are captured using a good camera from three sides so get all the angles of one face. Then the images undergo pre-processing. Region of Interest (ROI) is created by cropping the image to the required size according to the defined pixel position. The images are then converted from

RGB to greyscale and stored with the name of the student as the file name.

b. Face detection

The face detection stage is done using the Haar-Cascade classifier with OpenCV. The Haar Classifier requires to undergo training before it can detect human faces. The training is done using an XML file namely 'haarcascade_frontalface_default'[21]. For the detection process, the MultiScale module from OpenCV is used. It uses three features for creating the rectangle around the faces- scaleFactor, minNeighbors, minSize. scaleFactor is the parameter that defines the scale to which the image needs to be reduced. minNeighbors states the number of neighbours every participant rectangle can handle. The higher the value the less face is detectable but can detect high-quality images. minSize defines the minimum image size which is usually (30,30). For this model scaleFactor is 1.3 and minNeighbors is 5.

c. Face Recognition

There are three steps involved in face recognition namely preparing the training data, training the face recognizer, and prediction. The images of the students are the training dataset which will be assigned an integer label to denote the student it belongs to[22]. This data is used for face recognition. The face recognizer used is the Local Binary pattern Histogram. First, the face is transformed into a list of the LBPs which are then converted into decimal numbers and then converted into a histogram. One histogram is finally created for every individual image. When the recognition process initiates the histogram for the face requiring recognition is calculated and then compared with the already stored histograms of the images to match the face with the best and closest previously stored data.

d. Updating the attendance

When the face recognition stage is completed, the faces will be marked as present in an excel sheet and the rest as absent. The list of absentees will be recorded and auto-mailed to the faculties at the end of the month as an attendance sheet.

5. Implementation process

The process is implemented through the following steps:

- The image of the person is fed into the system.
- The processes of image decomposition, pattern recognition, and feature extraction are used for refining the data in the database and ensuring better facial recognition.
- Image decomposition is used which is one of the most important image processing techniques in computational photography and computer vision. Pattern recognition is used to provide human recognition intelligence to machines. Feature extraction is a process of reducing dimensionality so that the raw data is more manageable and divisible for positing data.
- Identifying a match in the database for the person.
- Recording the attendance.

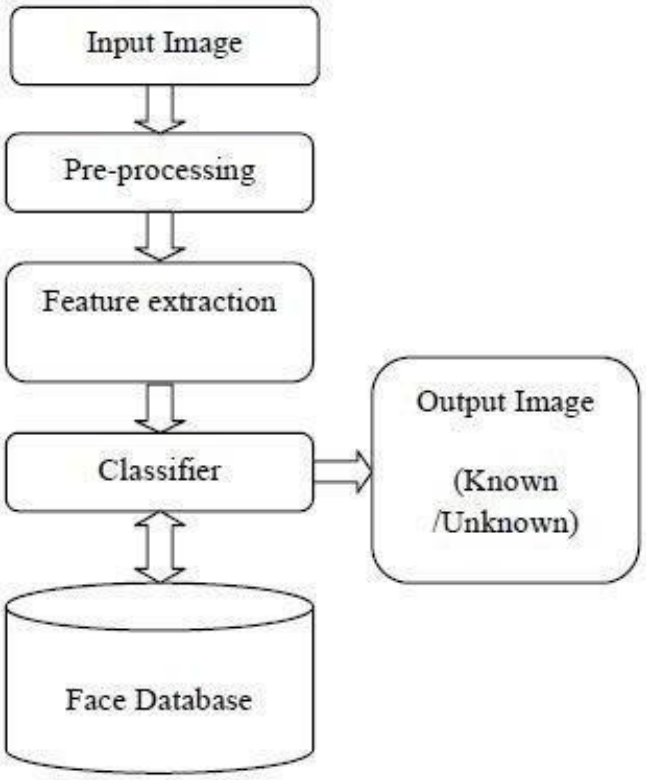

Fig.1 Data Repository Using Face Detection

The front end of the system is created using the PyCharm in Python, OpenCV and Android Studio which recognises the face and records the attendance

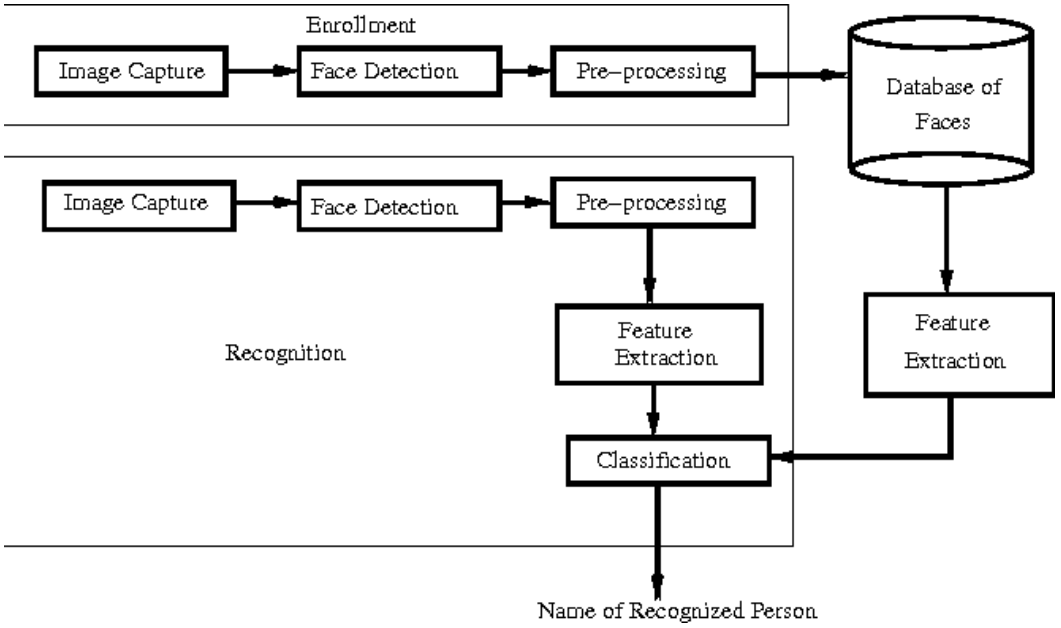

Fig.2 System Architecture Diagram

6. Experimental Results

1. The username and the password are entered as login credentials.

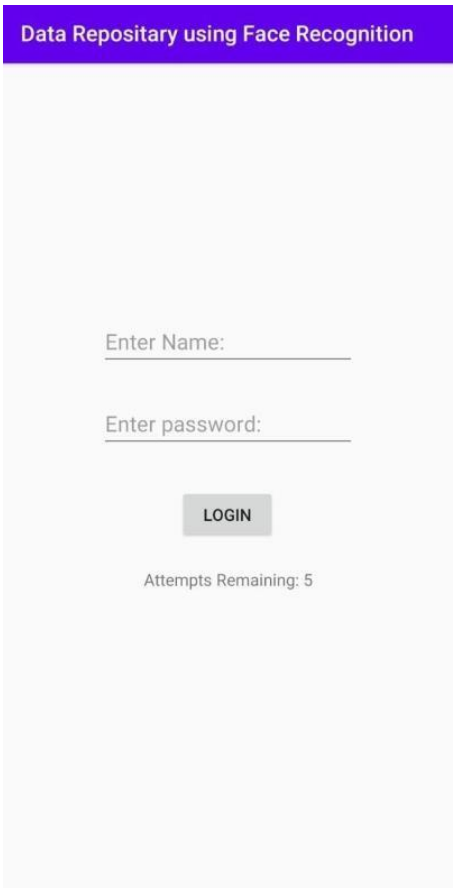

Figure 3: Login Page

The user can enter their login id and password which is authenticated by the system for log in to the system. If the password is wrongly entered then the system will ask to verify the credentials entered by the user.

2. Select the image and save the file with a certain file name.

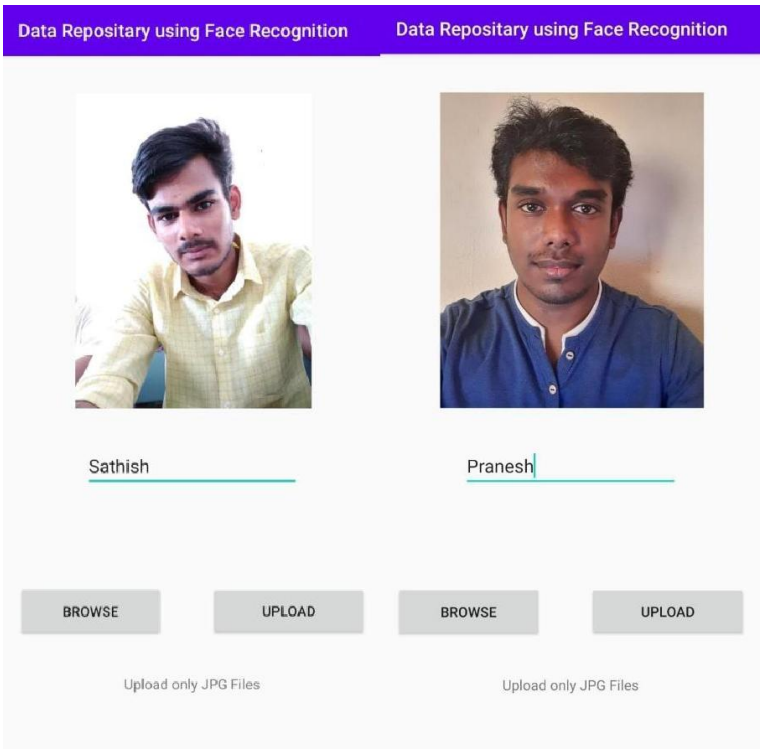

Figure 4: Select Image with file name

3. The image is uploaded in the database for storage.

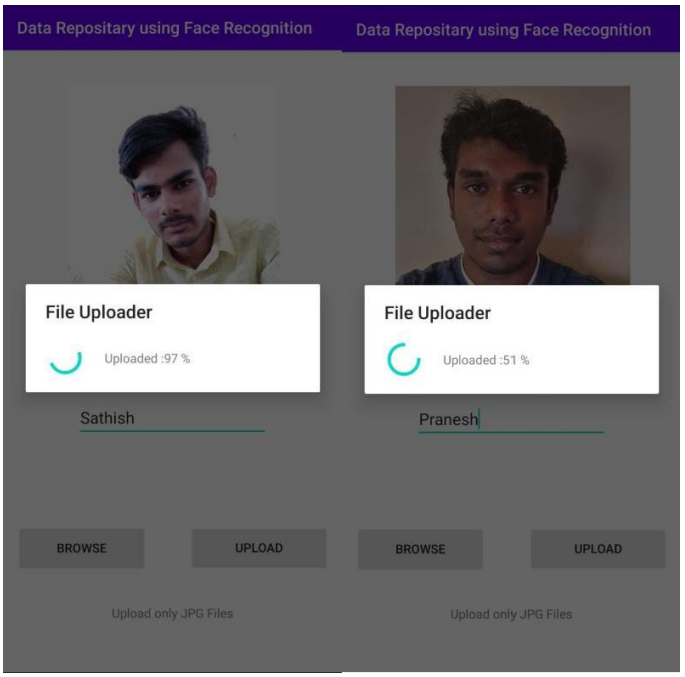

Figure 5: Image Uploaded in the Database

4. Match the person's image with the file name that will record the attendance with the name and time.

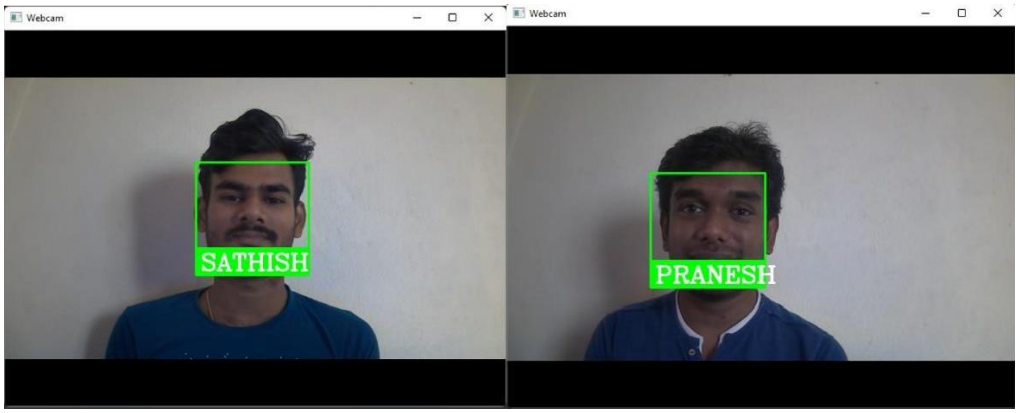

Figure 6 : Matching the image

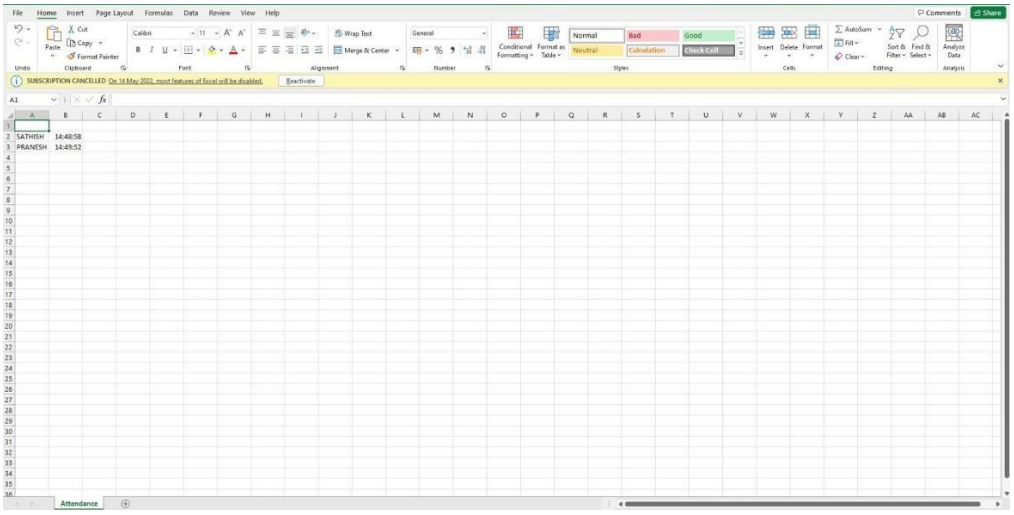

Figure 7: Produce the Result

7. Conclusion

An automated attendance system is very necessary for further the upgradation of classrooms and the learning process. The current manual or semi-manual processes are time-consuming and also require manual intervention at every stage to record the data including calling names in class, marking attendance for the right class and day, or passing the attendance sheet in the class, then recording it at the end of the semester to create a comprehensive attendance of all students. It is a tiring and cumbersome process that is unnecessary considering the available technologies. This model proposes a very simple method for integration of facial recognition technology for better attendance management that will allow better organization and

save time and resources too. Also, the flaws in previously proposed systems that included lighting issues, precision, functionality limitations, and such are aimed to be addressed with this model which makes it a futuristic solution for attendance management at both classrooms and workplaces.

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Conflicts of interest

The authors have no conflicts of interest to declare.

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