Automated Attendance Using Raspberry Pi

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Abstract

Attendance for the students is an important task in class. When done manually it generally wastes a lot of productive time of the class. As it is repetitive, student authentication can be automated using various methods available in the market like biometric attendance. This proposed solution for the current problem is through automation of attendance system using face recognition. Face is the primary identification for any human. This project describes the method of detecting and recognizing the face in real-time. Raspberry Pi 2 model B is used for computation in the detection and recognition modules. This project describes an efficient algorithm using open source image processing framework known as OpenCV.

This system is build by five modules – Face Detection, Face Preprocessing, Face Training, Face Recognition and Attendance Database. The face database is collected to recognize the faces of the students. The system is initially trained with the students faces which is collectively known as student database. The system uses user friendly User interface to maximize the user experience while both training and testing which are collecting student images and taking attendance with the system.

This project can be used for many other applications where face recognition can be used for authentication. Raspberry Pi usage helps in minimizing the cost of the product and the usability as it can be connected to any device to take the attendance. This project uses modified algorithm of haar’s cascades proposed by viola-jones for face detection and uses Eigen faces, fisher faces with LBP histograms for face recognition and uses MySQL to update the database. The system will automatically update the student’s presence in the class to the student’s database.

Keywords: Raspberry Pi, Detection, Preprocessing, Training, Recognition, Database.
1. Introduction and Literature survey

The present day attendance system is manual. It wastes a considerable amount of time both for teachers and students. The waiting time of the students is increased if attendance is taken manually. There are still chances for proxies in the class when attendance is taken manually. Manual attendance always a have a cost of human error.

Face is the essential recognizable proof for any human. So automating the attendance process will increase the productivity of the class. To make it available for every platform we have chosen the Raspberry pi 2 model B for face recognition. Webcam is associated with the Raspberry Pi module. Face identification separates faces from non-faces and those countenances that can be perceived. This module can be utilized for different applications where face acknowledgment can be utilized for validation. In this proposed system we take the attendance using face recognition which recognizes the face of each student in front of it while entering the class.

In this paper, Face Recognition-based Lecture Attendance System [2], the system marks attendance using face recognition by taking pictures of whole class. As it will be difficult to estimate the attendance accurately using individual results of the face recognition system as the rate of face detection is usually low. Here the system proposes a method of estimation using the results of the face recognition system by continuous training. Continuous training improves the performance of the system. This system uses a capturing camera to capture and monitor the class continuously which sends the data to the face recognition module. This system considers the seating arrangement of the class is unaltered so that the positions of the seats is used to fetch student faces for marking attendance.

In Student Monitoring by Face Recognition [4] the camera is fixed at a position where the entry and exit of the class room is clear and is used to capture the image of the entering student and leaving student. 3D Face recognition algorithm is used in the system. Detected student faces are stored as the test images in the database and compares the existing student images using Eigen faces technique. If any entering student is matched with any image in the student database attendance is marked for that particular student for that day.

In Class Room Attendance System Using Facial Recognition System [5] tries to take attendance in the real-time. It takes the snapshot of the class which includes all the students present in the class. Then face detection algorithm is applied to the snapshot to detect the faces in the image. Images are subjected to face segmentation and then face recognition is done using the test image stored which tries to match with the student’s database images and if match is
found attendance is updated to the attendance database and the report is finally generated for the attendance of that particular day. This way this paper proposes the system for the automated attendance system with the help of facial recognition system.

In this **Real time Face recognition system for time and attendance applications**[6] they proposed the use of automated face recognition system for time application and attendance applications using OpenCV library. The proposed system used the viola jones algorithm for the face detection which comprises of the haar’s cascades and the detected face is resized for the favorable size and this is further processed. The processing is done using the linear stretch enhancement and recognition is done using PCA [7]. When the recognition of the student is completed the attendance is automatically updated to the excel sheet which serves as an alternative to the database with both the name, data and time. A web application is used for viewing the status of the same which shows the attendance report of the class on a particular date. This model also considers possible threats like spoofing for the system and this is avoided by using the eye blink detector algorithm to recognize the viewer avoiding security threats. This way the model used real-time face recognition system for the time and attendance.

This **Face recognition based attendance marking system**[8] proposes automated attendance system using face recognition as the metric. This system uses a camera which will be positioned in the room to capture images of the classroom with an adjusted frequency. These captured images are subjected to the enhancement where histogram normalization is used for the image enhancement. For removing noise in the image median filter is used. Skin classification technique is used to avoid false detection which classifies the skin and then retains only skin pixels and all remaining pixels are set to max which is color black. This result image is used for face recognition and recognition and this model used MATLAB software for this. An automated attendance management system aims to solve the issues of manual methods which are not met by the existing systems. All the systems use the facials feature to recognize the identity to implement the system for attendance updation of student. Almost all the existing models tries to do the same with different technologies and different environments. The whole system can be classified into different modules like detection, collection, recognition and updation. In the detection phase all existing models tried to capture the image of the whole classroom to take the input for the system which is the image for detection. In general, the classrooms are not so suitable to take a clear photograph which may result in noise which leads to the failure in detection of student faces.
If the environment is bad with shadows on faces that will lead to failure of the algorithm which takes the image from such long distance to detect the student face in the image. A clear image is required for the techniques proposed in the above systems. Hence it is advised to take single photo at a time. Which may increase the waiting time but still increase the efficiency of the system and also the accuracy of the attendance system. The proposed systems require a computer to evaluate and consumes great amount of power to use webcam all the time and for the computer when required. We also have some premium software which may improve the efficiency but will increase the cost exponentially. One of the models used OpenCV which is an open source rather than using MATLAB which requires licensing and include that cost for the product. So OpenCV is preferable to MATLAB in such case of optimization. Cost optimization and power minimization is required and favorable to every condition and environment which can be manufactured as a generalized product for every environment. Efficiency of the algorithm should not be compromised. There is still a lot of room for improvement of the existing models as they fail to detect and recognize every student present in the class. Speed of the recognition is also a subject to question with the existing models.

2. Proposed Method:

The total system is divided into five modules namely Face Detection, Face Preprocessing, Face Training, Face Recognition and Attendance Database. This proposed system uses viola jones algorithm [1] for face detection which uses modified haar cascades for detection. Current face detection systems are quite reliable but face recognition systems are less accurate compared when we use them in real-life applications. OpenCV has preinstalled cascade classifiers. In this project we use three cascades in which one is face cascade and other two are for eyes in which one is for eyes with glasses. For reducing cost we have used Raspberry Pi 2 model B in our project. The architecture of the project is as shown in the below figure 2.1

![Haar Cascades](image)

**Fig 2.1.** Haar Cascades.
Raspberry Pi is the main component in the project. We will be using USB webcam to capture photos. We can access Raspberry Pi’s console either by using SSH in laptop or by using Keyboard and mouse with the display device like TV connected to Pi.

Face detection is done using Viola Jones algorithm using haar cascades as classifier. Firstly, the algorithm needs a lot of positive images and negative images to train the haar cascades classifier. Positive images are images with clear faces where negative images are those without any faces. Haar cascades are similar to convolutional kernel which are shown below in fig 3.1.

![Haar Cascades](image)

**Fig 3.1. Haar Cascades.**

Each feature is represented as a single value obtained from the difference of the sums of pixels in white rectangle from the sum of all pixels in the black rectangle. All different possible sizes and locations of classifier is used for calculating of plenty of features. As the number of classifiers increase the arithmetic computations seems to take a long time. To avoid this, we use the concept of Integral Image. In Image Processing Integral image is a data structure which is a summed area table and algorithm for quickly and efficiently generating sum of values in a rectangular grid subset. Integral image is derived by using the formula and denoted using the fig 3.2 below

\[
I_{\Sigma}(x,y) = \sum_{x' \leq x} \sum_{y' \leq y} i(x', y')
\]

![Integral Image](image)

**Fig 3.2. Integral Image.**
To solve the complexity of the number of classifiers applied for calculation we use Adaboost machine learning algorithm to eliminate the redundancy of the classifiers. Any classifier which has a probability of 50% or more in detection is treated as weak classifier. The Sum of all weak classifier gives a strong classifier which makes the decision about detection.

Although it is very vague to classify with one strong classifier we use the cascade of classifiers. Classification takes place in stages, If the selected region fails in the first stage, we discard it. We don’t use the classifiers on that region which is discarded. The region which passes all the stages i.e. all strong classifiers is treated as the detected face.

Detected Faces are passed to the Face recognition phase. In this phase we use Local Binary Patterns algorithm for face recognition. Local binary patterns are simple at the same time very efficient texture operator which assigns the pixels of the image by comparing with the adjacent pixels as threshold and which results in a binary result. The detected integral image is subjected to this Local binary pattern which results in decimals is represented as histogram for every integral image. Face recognition is extremely vulnerable to the environment changes like brightness, facial expressions and position. Face preprocessing is the module which reduces the problems that makes the picture unclear to recognize the face such as less brightness and contrast problems and noise in the image and make sure the facial features always be in a constant position. In this project we use histogram equalization for face preprocessing. For efficiency we use separate preprocessing which is histogram equalization for left and right face. So histogram equalization is done three times, firstly for the whole face and the other two for side faces. The project uses a MySQL for database queries. The queries are automatically executed after face recognition of the student. The attendance status can be verified in the database dbAttendance which includes the name of the students who are present and the time at which the attendance is taken with the date of the attendance.
Conclusion

We come to realize that there are extensive variety of methods, for example, biometric, RFID based and so on which are tedious and non-productive. So to defeat this above framework is the better and solid arrangement from each keen of time and security. Hence we have accomplished to build up a solid and productive participation framework to actualize an image handling algorithm to identify faces in classroom and to perceive the confronts precisely to check the attendance.

Scope for Future Work

The same project can be utilized for several security applications where authentication is needed to access the privileges of the respective system. It can be used in recognizing guilty parties involving in unauthorized business. Face recognition algorithm can be improved with respect to the utilization of resources so that the project can recognize more number of faces at a time which can make the system far better. Many variants of the project can be developed and utilized for home security and personal or organizational benefits.

References


3. OpenCV Documentation [ www.docs.opencv.org ].


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