Automated Attendance System Using Video Surveillance

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***Abstract*—** Attendance System is essential in all learning institutes for checking the performance of students. In most learning organizations, student attendances are physically taken by the utilization of attendance sheets issued by the institution heads as a component of regulation. This technique is repetitive, tedious. The main purpose of the automated attendance system is to record the present number of people inside the organization. The automated attendance system is used to reduce the manual attendance work and time used for maintaining attendance records. The high resolution surveillance camera is used to capture the video in a classroom. By using this video, the attendance of students is marked. This is useful in generating the attendance reports as need of academics. The success of automated attendance management system using surveillance camera mainly depends on how efficiently face detection and face recognition algorithms are implemented.

***Keywords*— surveillance camera, face recognition, face detection, accuracy, Attendance management system**

1. INTRODUCTION

Face recognition is as old as computer vision, both because of the practical importance of the topic and theoretical interest from cognitive scientists. Despite the fact that other methods of identification (such as fingerprints, or iris scans) can be more accurate, face recognition has always remains a major focus of research because of its non-invasive nature and because it is people's primary method of person identification. Face recognition technology is gradually evolving to a universal biometric solution since it requires virtually zero effort from the user end while compared with other biometric options .The remainder of this paper is organized as follows: Section II reviews evolution of different attendance systems. The methodology is presented in Section III. IV section explains the algorithm used in detail and section V provides all the experimental details, results and their analysis. The last section contains conclusion and summarizes the paper.

2. EVOLUTION OF ATTENDANCE SYSTEMS

Student's attendances are taken manually by using attendance sheet given by the faculty members in class, which is a time consuming event. Moreover, it is very difficult to verify one by one student in a large classroom environment with distributed branches whether the authenticated students are actually responding or not.

Addressing this issue, innovations have ended up at wide-ranging use of the biometrics. Attendance Management through biometrics had awkward cost of extra effort and personal time at the user end. After the outbreak of face recognition as a useful method, techniques were evolved to incorporate it in attendance management systems.

Another approach is a fingerprint based attendance system in which a portable device capable of taking students fingerprint is moved inside the classroom. The advantage of this approach is that attendance we will take at lecture time without the instructor's intervention and this system guarantees the marking of full proof attendance. But the problem with the approach is that if we pass the device during lecture time, then there may be distracting of attention of both teacher and student and student interaction required to have attended

Another approach developed is RFID (Radio Frequency Identification) based attendance management system in which each student will have one unique identity card. That card will be swapped in a machine to put attendance. Swap machine is directly connected to a system that stores attendance related details. The limitation of the above approach is that unauthorized person also can put the attendance.

However, face recognition can be done automatically from video of classroom. Face Recognition System hasn't required active participation from students to put the attendance. With the help of the camera when we capture a face that face will be stored in a device with minimum dimensions, hence the space required for storage is also less. There are many developments going on to increase the accuracy of face recognition system as they dominate the future.

3. METHODOLOGY

The automated attendance system helps to mark attendance of the students when the faces are recognized using the surveillance camera. The proposed attendance system consists of face recognition and face detection. Viola and Jones algorithm is used for face detection. Where it is used in both creating database and face recognition process where in case creating database it takes input image through a web camera continuously. Captured image undergoes face detection. Detected face will be cropped and stored in database where in case of face recognition if there is any movement video surveillance will be used to detect the moving object. The captured image undergoes face detection and further processed later by face recognition.
After taking the attendance, details of the students who are present are stored in excel sheet and also weekly and monthly attendance reports are automatically generated.
The pseudo code of proposed system is as follows.

1. Take Video Surveillance Data from classroom camera
2. Apply viola Jones Algorithm [Face Detection]
3. Extract the detected faces
4. Store images in database (folder)
5. Take live video surveillance data for recognition
6. Apply Haar Cascade classifier [Face Recognition]
7. Extract the features from detected faces
8. Compare Features
9. Put Student's Attendance based on recognized face .
10. Generate daily attendance sheet.
11. Calculate weekly and monthly attendance reports

Face matching system involved 2 stages

(1) First stage is the model registration which is concerned with the storage of an image with computer memory.
(2) Second stage is the process of searching for an extracted face in an image

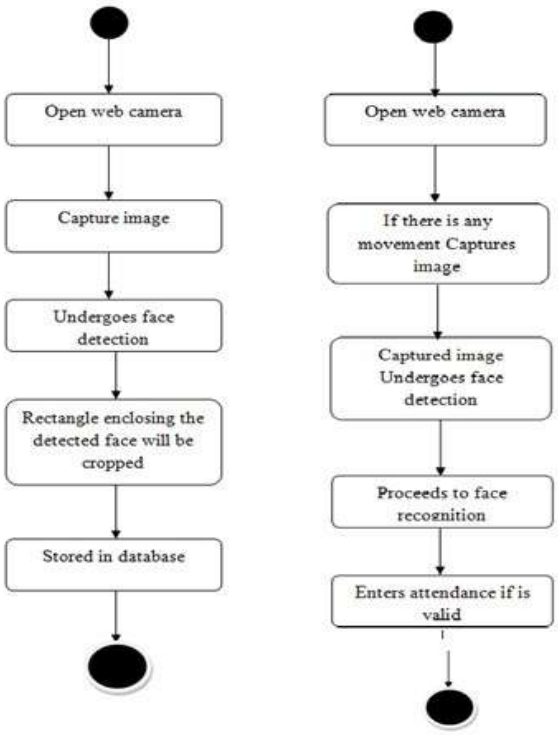

Fig-1 Face detection and recognition

Proposed automated attendance system can be divided into five modules.

1. *Video capture*: Camera will capture the video of the students at the beginning and after capturing the video the next process is to divide the video into the required number of frames and then it goes to the face detection.

2. *Face Detection*: The face detection algorithm will increase the efficiency of the face recognition. There are some of the algorithms proposed for face detection as face geometry-based performances. It is observed that algorithm gives the better output in different conditions to combine the multiple classifiers for better detection rate.

3. *Database Development*: In this phase we consider the video capture to way person as individual features. We extract the face and store the features in the database after identifying.

4. *Feature Extraction*: Feature extraction normally refers to the process of extracting features (informative characteristics) from a frame in a video, independently of past or future frames. It is very similar to extracting features in a static image. There exist methods that use several frames to extract more stable features. It is generally used to recognize the object

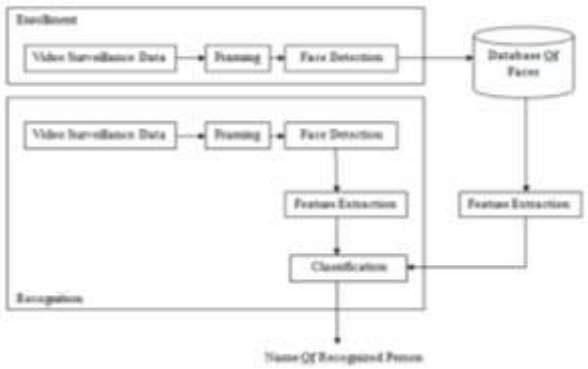

Fig-2 Overview of the system

5. Excel Generation: Excel sheet is generated on daily basis based on the attendance captured by automated attendance system. Weekly and monthly attendance sheets are generated at the end of every week and month respectively.

4. ALGORITHM

Haar Cascade Algorithm: It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images. It is proposed by Paul Viola and Michael Jones. It consists of four main steps.

1. Haar Feature Selection
2. Creating Integral Images
3. Adaboost Training
4. Cascading Classifiers

Haar Feature Selection: First step is to collect the Haar Features. A Haar feature considers adjacent rectangular regions at a specific location in a detection window, sums up the pixel intensities in each region and calculates the difference between these sums**.**

Creating Integral Images: Integral Images are used to make this superfast. For example, consider the image below. Top row shows two good features. The first feature selected seems to focus on the property that the region of the eyes is often darker than the region of the nose and cheeks. The second feature selected relies on the property that the eyes are darker than the bridge of the nose. But the same windows applying on cheeks or any other place is irrelevant.

Fig-3 Representation of integral images

We apply each and every feature on all the training images. For each feature, it finds the best threshold which will classify the faces to positive and negative. But obviously, there will be errors or misclassifications. We select the features with minimum error rate, which means they are the features that best classifies the face and non-face images.

Adaboost Training: Adaboost selects the best features and trains the classifiers that use them. This algorithm constructs a "strong" classifier as a linear combination of weighted simple "weak" classifiers.sDuring the detection phase, a window of the target size is moved over the input image, and for each subsection of the image and Haar features are calculated. You can see this in action in the video below. This difference is then compared to a learned threshold that separates non-objects from objects. Because each Haar feature is only a "weak classifier" (its detection quality is slightly better than random guessing) a large number of Haar features are necessary to describe an object with sufficient accuracy and are therefore organized into cascade classifiers to form a strong classifier.

Cascading Classifiers:

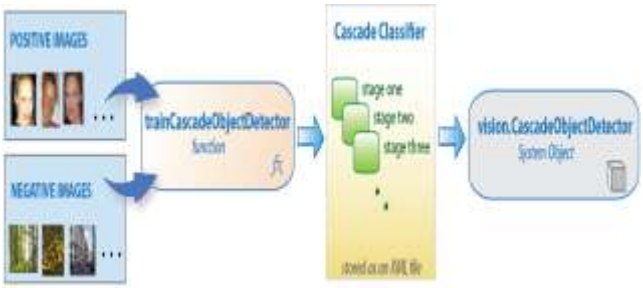

Fig-4 Representation of the cascading classifiers

The cascade classifier consists of a collection of stages, where each stage is an ensemble of weak learners. The weak learners are simple classifiers called decision stumps. Each stage is trained using a technique called boosting. Boosting provides the ability to train a highly accurate classifier by taking a weighted average of the decisions made by the weak learners. Each stage of the classifier labels the region defined by the current location of the sliding window as either positive or negative. Positive indicates that an object was found and negative indicates no objects were found. If the label is negative, the classification of this region is complete, and the detector slides the window to the next location. If the label is positive, the classifier passes the region to the next stage. The detector reports an object found at the current window location when the final stage classifies the region as positive. The stages are designed to reject negative samples as fast as possible. The assumption is that the vast majority of windows do not contain the object of interest.

Conversely, true positives are rare and worth taking the time to verify. A true positive occurs when a positive sample is correctly classified. A false positive occurs when a negative sample is mistakenly classified as positive. A false negative occurs when a positive sample is mistakenly classified as negative. To work well, each stage in the cascade must have a low false negative rate. If a stage incorrectly labels an object as negative, the classification stops, and you cannot correct the mistake. However, each stage can have a high false positive rate. Even if the detector incorrectly labels a non-object as positive, you can correct the mistake in subsequent stages. Adding more stages reduces the overall false positive rate, but it also reduces the overall true positive rate.

Cascade classifier training requires a set of positive samples and a set of negative images. We must provide a set of positive images with regions of interest specified to be used as positive samples. You can use the Image Labeler to label objects of interest with bounding boxes. The Image Labeler outputs a table to use for positive samples. You also must provide a set of negative images from which the function generates negative samples automatically. To achieve acceptable detector accuracy, set the number of stages, feature type, and other function parameters.

Cascade classifiers: Two cascade classifiers are widely used.

1. Haar Cascade Classifier
2. LBP Cascade Classifier

Haar Cascade Classifier:
Advantages:

- High detection accuracy
- Low false positive rate

Disadvantages:

- Computationally complex and slow.
- Longer training time.
- Less accurate on black faces.
- Limitations in difficult lightning conditions.

LBP Cascade Classifier:
Advantages:

- Computationally simple and fast.
- Less training time

Disadvantages:

- Less accurate.
- High false positive rate.

5. EXPERIMENTAL RESULTS

A set of experiments carried out on surveillance data obtained from cameras on the college campus and also taken from the mobile. The performance evaluation of the system is performed using this dataset. The screenshots of various phases of attendance system are as follows:

Fig-5 Graphical User Interface

Fig-5 represents the graphical user interface of the attendance system where we can choose our respected option of whether to register or get recognized by the system.

Fig-6 Training images

Fig-6 is the registration process carried out in front of the webcam of the laptop. At the time of registration process, students' faces with different orientation are saved inside the database.

Fig-7 Images in database

Fig-7 represents how the frames are generated from the video captured.

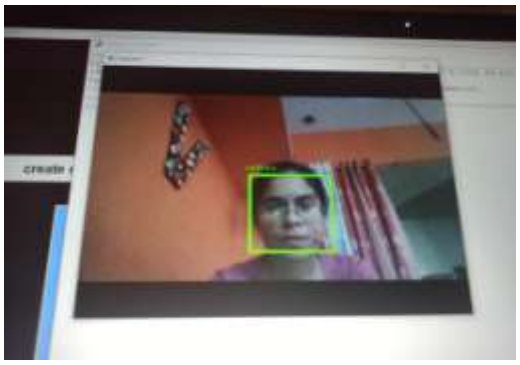

Fig-8 Recognition of student

Fig-8 represents the recognition of student by matching from the database.

Fig-9 Recognition of multiple students

Fig-9 shows the recognized faces at the time of attendance in a class.

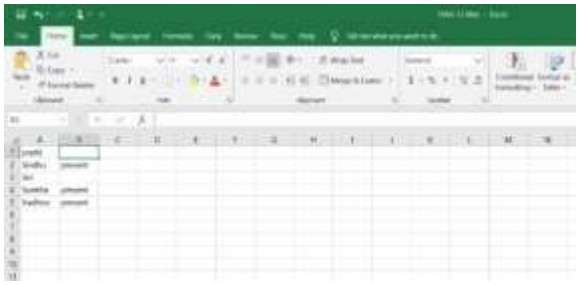

Fig-10 Excel sheet generation

Fig-10 represents the generation of an excel sheet after the class with 'present' marked for the students recognized in the video.

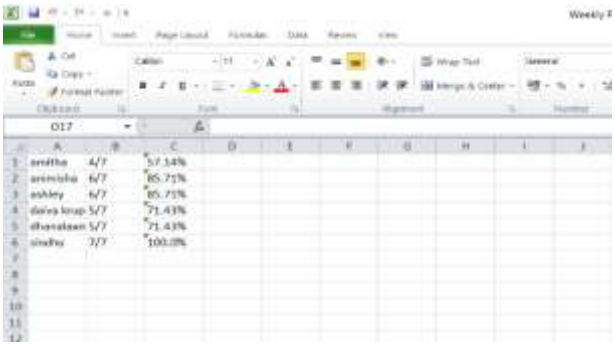

Fig-11 Generation of weekly and monthly reports

Fig-11 represents the generation of weekly and monthly reports based on the daily reports generated from the classes taken.

6. CONCLUSION

The aim of this paper is to capture the video of the students, convert it into frames, and relate it with the database to ensure their presence or absence, mark attendance to the particular student to maintain the record. The Automated Classroom Attendance System helps in increasing the accuracy and speed ultimately achieve the high-precision real-time attendance to meet the need for automatic classroom evaluation. The proposed approach provides a method to identify the individuals by comparing their input image obtained from recording video frame with respect to train image. It is able to detect and localize face from an input facial image, which is obtained from the recording video frame.

It can be concluded from the above discussion that a reliable, secure, fast and an efficient system has been developed replacing a manual and unreliable system. This system can be implemented for better results regarding the management of attendance. This system will save time, reduce the amount of work the administration has to do and will replace the stationery material with electronic apparatus. Hence a system with expected results has been developed but there is still some room for improvement. For future enhancement same method can be implemented for logout, where other face recognition technique preferably on 3d data can also be used for same proposed methodology in order to obtain better accuracy.

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