

Face Recognition for Classroom Attendance Based on Convolutional Neural Network

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Abstract: Marking the attendance of every student manually is a very inconvenient and time consuming task. Our system is based on deep learning architecture to prevent these issues. The automatic attendance system is based on image processing and consists of face recognition, automatically marking a student's attendance. Face recognition is well studied in computer vision, but it remains unsolved because of pose changes, varying light conditions, and occlusions. Also, teachers spend more time marking each student's attendance manually. The criteria of minimum time for students in the classroom will be set by the instructor. Our system will monitor the attendance of students through face recognition. As per the timetable's time and minimum time set by the instructor, student attendance will be marked and stored in the database which will be accessible to the admin.

Keywords: Face Recognition, Classroom Attendance, Image Processing

1. Introduction

Recognition of face is an active issue nowadays for authentication and security purpose and also in the area of attendance systems. The current attendance systems are based on RFID cards, IRIS, Fingerprints, and even notebooks. These systems require human interaction with the device. In current attendance systems, each student must have to wait until the previous student marks the attendance. And also controlling the crowded queue for attendance is essential. The Attendance system using face recognition is the process of recognizing students' faces based on computer technologies. Our current system is the digitization of the traditional attendance system which uses pen and paper. Face recognition purposes, this needs large data sets and complex features to identify the different faces by manipulating different obstacles like illumination, pose, and aging. In during few years, better improvement has been made in facial recognition systems

A. Context

The auto-attendance system helps us to mark attendance without wasting much time using face recognition. It reduces the time and workload of humans taking attendance manually. Our system uses face recognition which can use for improving the management of student attendance and absentees across multiple schools and colleges. To counter multiple issues our system keeps track of students who are present in the class and clicks some pictures of each student and by matching those images with the images stored in the database, it will mark the attendance of students.

B. Background

As the time allocated to a faculty for teaching is less, their time gets wasted in marking each student's attendance on paper. As per the observed knowledge, the time for every faculty to interact with students is very less. So our system will help teachers invest more time interacting with the students. Also tracking attendance manually will lead to proxy attendance.

2. Related Work

This section describes the various websites, books, papers, articles from literature, and existing systems studied for understanding various concepts, proposed methods, algorithms and identifying the research gap.

Existing Systems

The systems related to the proposed system found during the literature survey are as follows:

1)RFID: Radio Frequency Identification (RFID) [8] is an electronic device that includes a small antenna and a chip. This device is used for transmitting information between the reader and the RFID tag. Here in this process, each student is provided with a unique RFID tag.

Drawbacks:

- This technology is a bit expensive because a lot of technology goes into making it.
- If there are a large number of students then purchasing the RFID tags will be costly.
- Sometimes it is not secure so it will go to manipulation.

2)Biometric attendance: Biometric attendance system [9] is the software is an attendance management system that

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keeps track of each student's or faculty's attendance by authenticating fingerprints in real-time.

Drawbacks:

- Sometimes there will be issues with the recognition of damaged fingerprints
- Deployment can be expensive
- Fingerprint data can get stolen
- Environmental challenges may affect sometimes.

3. Literature Survey

Face Recognition based Attendance Management System: Samuel Lukas et al. in [1] proposed the HFR technique. HFR is a human face recognition system that is the issue of today's era. The HFR is used for many applications such as surveillance systems, and monitoring systems. Here they have used two approaches for face recognition I.e. feature-based and brightness based. They have used a technique that is a combination of DWT (Discrete wavelet transforms), and RBF (Radial basis function) the system accuracy increased by working more on feature extraction. The accuracy is about 82 percent.

Class Room Attendance System Using Facial Recognition System: Abhishek Jha in [2] creates a new face recognition method. This White his paper contains the steps to develop a facial recognition system. In this Paper, They explained how facial recognition technology, a type of biometric authentication system, works. In this paper, the stages of face detection, face alignment, feature extraction, and face matching were discussed. A complete attendance system is implemented in his MATLAB.

Face Recognition Based Attendance Record System: Weidong Kuang et al. [3] proposed a presence management system based on face recognition. Using his four components such as his webcam for face capture, image database for students, attendance sheets for recording, and face recognition. First, they used 10 images of her in our database to recognize her face. They used his built-in webcam for facial recognition. Attendance is therefore recorded in an Excel spreadsheet.

Smart Attendance Record System using surveillance camera: Ketan N. Mahajan et al. [4] proposed a presence control device for use with digital surveillance cameras. Two levels are used. The first segment is the training

segment and the second segment is the rehearsal segment. Inside the training segment, face recognition and feature extraction are used. Facial Recognition uses digital surveillance cameras to record video for student enrollment methods and uses Viola Jonesys facial recognition algorithms to trip faces in the video. After detecting the face video, they used PCA to extract the features and reduce the dimensionality. During the trial phase, the input photo can be compared with the photos in the database and the presence of the student can be taken into account.

4. Methodology

A.Dataset

The algorithm learns from data, finds relationships, develops understanding, makes decisions, and uses training data to assess confidence. The quality of our training data is a critical factor in the success of our project. Data records play a decisive role in correct classification. Our system took 100 photos of each person in a 4-5 second long video. System recorded a video from webcam so that the system works on different devices. All images are converted to 200x200 pixels.



Fig 1: Sample images from training dataset for Subject 1

B.Database Design

The database design of our work is depicted in Figure 2. Figure 2 is an ER diagram of the Attendance Management system. The system is designed with help of various technologies, where a database is a collection of data, where a database is a collection of data, where the data is stored and structured. A database is controlled by a database management system i.e DBMS. As shown in Figure 2, Entity Relationship (ER) diagram illustrates the database design, where it also shows a relationship between entities.

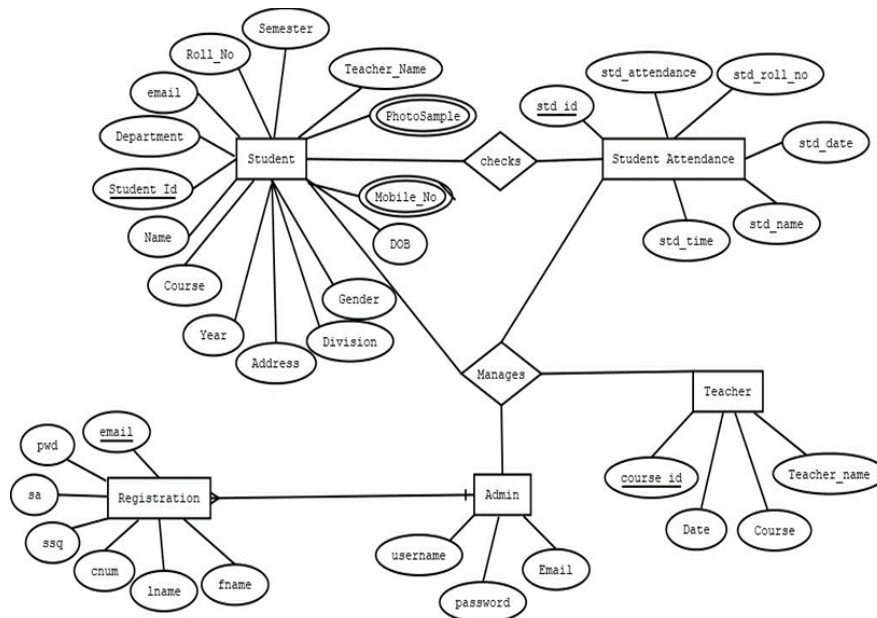


Fig 2: ER Diagram of Attendance System

The figure illustrates the Entity Relationship representation of the attendance Management System using Face Recognition. There are many entities represented with rectangles. An Entity is nothing but an object. Here, there is a student entity with attributes like Name, Course, Year, Address, Division, Gender, DOB, Mobile No, PhotoSample, Teacher Name, Semester, Roll No, email, and Department. Student id is the primary key, a unique key, which will remain unique for each other. Another entity is the Student Attendance which has attributes as std id (Student id), std attendance, std roll no, std date, std name, std time. Std id is the primary key here. Students can check the student's attendance so there is a relation between that. Another entity is Teacher which has the attributes course id, Date, Course, and Teacher name in which course id is the primary key. The next entity is Registration which contains attributes such as email, pwd(Password), name(first name), name(last name), ssq(select security question), sa(select security answer), cnum(contact number) in which the email is the primary key which will be unique for each. And the final entity is Admin which contains the attributes such as username, password, and email. There is a relationship between Admin and Student attendance are that Admin manages the student attendance. Also, there is a relationship between Admin and the teacher that is Admin manages the Teacher entity. And Admin an also manage the registration process.

C. System Architecture

Our system will implement the identification system using deep learning concepts such as Convolution Neural Networks (CNN), where identification is the system that compares the given individual to all the other individuals in the database and recognizes that person.

1) Attendance Recorder: The auto attendance is based on

face recognition system in which face data of every student will be saved in the system and during the specific time interval [7] image of whole class will be captured and face will be recognized.

Figure depicts the overview of our system.

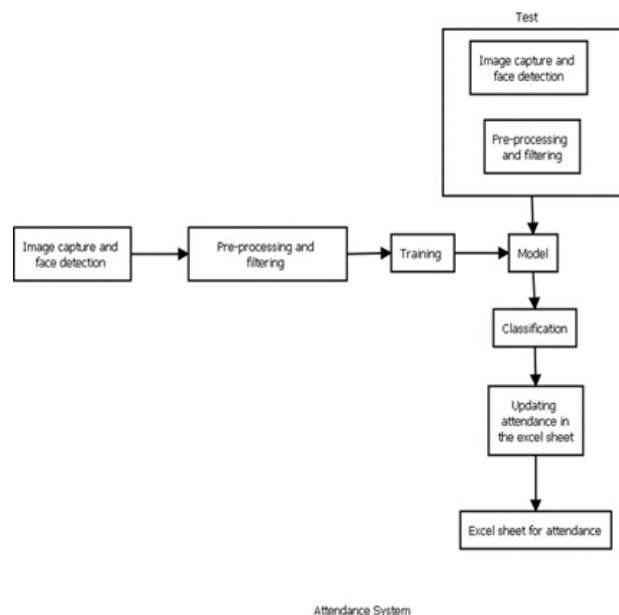


Fig. 3. Attendance system

The various steps are listed under:

- First the data is gathered in the form of images or videos to create the dataset.
- Then using Haar Cascade provided by OpenCV, only the face will be detected from captured image or video.
- The feature dataset with annotations will be used for training, using CNN.
- As shown in Fig, Image data will be taken and converting

it into grayscale, training process will be done on those images using feature extraction. –

- The test image will be provided to the system. After undergoing all the steps mentioned till feature extraction, the model will recognize the face with proper class.
- After testing with several images performance of the system in terms of accuracy will be computed.

5. Experimental Setup and Results

This section describes about the required experimental setup, implementation of the project and snapshots of the work done.

A.Experimental Setup

For our system following measures must be considered. The camera should be placed on the front wall of class at the middle position above the blackboard. The classroom area should be well lit and there should not be any direct light on camera.

B.Experimental Results

- Data Collection:

An attendance management system that uses facial recognition can bring multiple benefits to a business or educational institution. Face recognition-based clock systems are highly accurate at recognizing the presence or absence of individuals, are less error-prone than traditional methods, and can be affected by an officer's presence or clock. Using facial recognition technology eliminates the need for manual time and attendance registration, which can be time-consuming, especially for larger organizations. With the facial recognition system, attendance records can be generated automatically, saving time and reducing administrative burden. The system ensures that only authorized personnel have access to restricted areas, preventing unauthorized access, theft or any other breach of security. In our system, a dataset of student faces is created by taking 100 photos of each student in 4-5 seconds during registration. Train the model using the collected images.

- Data processing:

Facial recognition technology is scalable, which means it can be used in organizations large and small. It can be easily integrated with other systems such as payroll and human resources to automate attendance tracking and other related tasks. In the long run, using an attendance management system based on facial recognition technology is cost effective compared to traditional methods of attendance tracking. This reduces the cost of paper-based systems and eliminates the need for manual data entry. In this system, data collected from students is fed into a CNN classifier. The classifier will classify the images and the system will report the presence of students in the Excel sheet.

- Face Detection:

In Figure 4, we can see that system can detect faces of student.

- Face Recognition:

In the Figure 5, we can see that system can recognize the faces of students correctly.

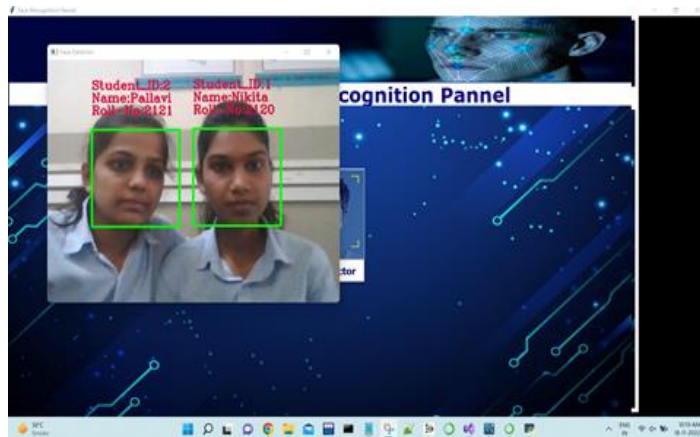


Fig. 4. Face Detection

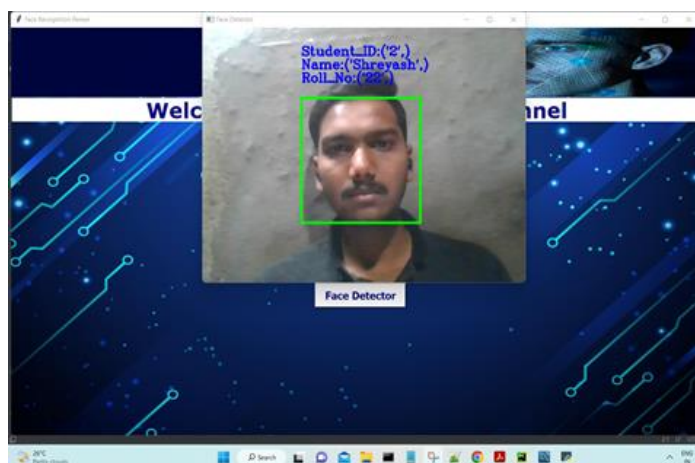


Fig. 5. Face Recognition

The results obtained from the partial implementation of our methodology consider following parameters.

- Network Bandwidth: Network bandwidth plays important role in the performance of application because database is stored in Mysql Workbench.
- RAM: Devices having less free memory may cause application to run slowly. So user need to free up their RAM by closing unwanted application to get faster performance.
- Internet Connection: If the user has slow internet connection then system may respond slowly.

In our system there is a comparison of CNN and SVM algorithms. In comparison between Custom Convolutional Neural Network (CNN) and Support Vector Machine (SVM) from the study conducted on our system's classes, it is observed that CNN gives better accuracy while training and testing in actual conditions. The custom CNN had 10

Convolutional layers with an input image size of 200 X 200 while the SVM also had an input image size of 200 X 200. Convolutional Neural Networks can categorize images. Its built-in convolutional layer reduces the high dimensionality of images without losing their information. And it classifies every student in the class.

In CNN filter is defined which determines how large we are looking at the partial images, and the step length that decides how many pixels we have to continue between the calculation. Using the convolutional layer, pooling layer, fully connected layer feature extraction, and image recognition can be done to predict the images accurately to increase the system's accuracy. In contrast, the SVM classifier finds the maximum margin hyperplane and splits the data accordingly. It only affects the support vectors which are closer to the hyperplane. As a result, the network learned feature representation for a wide range of images from the 3000-image dataset. CNN has recorded percent accuracy while training but testing was affected due to some lightning conditions affecting accuracy. But it was still much better than the SVM model.

Table 1. Accuracy

DB Images	Accuracy
3	70.80%
4	82.70%
5	86.00%
6	90.00%
7	84.20%

The above table shows the detailed description about the accuracy of our system. Here, the number of images in the dataset increases, the accuracy also goes on increasing. It means that the accuracy highly depends on the number of images present in the dataset.

6. Conclusion

We have studied the different algorithms used in face recognition systems and, successfully implemented Attendance Management System using Face Recognition. This system will capture the image of the whole class at one time. The face of a student should be at a minimum distance of 2.5 feet. This is done to avoid accidental face recognition. Our system requires good lighting conditions to accurately classify the images of students. Our system is first trained and then while testing it detects the face and labels the face with his/her name. By implementing the algorithm and technique used to develop a face recognition system, we

analyzed the performance of the developed algorithm. And deploying a system that will generate attendance reports of students. Our does not require any human interference. This is the most beneficial advantage. Also, the time for teachers for taking attendance is used properly so that they can interact with students effectively having more time. Our system will accurately predict the student's faces and accordingly marks the attendance in an excel sheet. In our system we have compared SVM, CNN and LBPH algorithms for accuracy. We can conclude that LBPH (Local Binary Patterns Histogram) algorithm, is the most efficient algorithm for face recognition from images because it gives high accuracy during the training and testing phase.

Author contributions

Suhel Sayyad: Conceptualization, Methodology

Nikta Gote: Data duration, Writing-Original draft preparation, Software, Validation. Field study

Pranita Bhosale: Visualization, Investigation, Writing-Reviewing and Editing.

Pallavi Yadav: Writing-Original draft preparation, Software **Ishika Adsul:** Investigation, Writing-Reviewing and Editing

Conflicts of interest

The authors declare no conflicts of interest.

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