

AUTOMATED ATTENDANCE SYSTEM WITH FACE RECOGNITION

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Abstract: Face is the representation of one's identity. So, we have prepared an automated student attendance system based on face recognition. This system is very useful in daily life applications especially in security and surveillance systems. The security systems on airport uses face recognition to identify suspects and the CBI (Central Bureau of Investigation) and FBI (Federal Bureau of Investigation) uses face recognition for criminal investigations. In our project also video framing is performed by accessing the camera through user friendly interface. The Face is detected and segmented from the video frame by using HOG (Histogram of Oriented Gradient) algorithm.

In the first step or we can say in pre-processing stage, scaling of the size of the image is performed in order to prevent or reduce the loss of information.

Then in next step, the 'median filtering' is applied to remove noise followed by the conversion of colour image into grayscale image.

After that, CLAHE (Contrast Limited Adaptive Histogram Equation) is applied on the images to enhance the contrast of the image.

Overall, we have created a program in python that take the image from the database and make all the necessary conversions for recognition and then verifies the image in the videos or in the real time by accessing the camera through user friendly interface. After the successful match is found then it marks the name and time of the person in attendance sheet.

Keywords: Face Detection, Face Recognition, Attendance automation.

I. INTRODUCTION

There are various software's or technologies are so advanced that even blurred images are sometimes rendered enough and investigated to know the personality of the individual.

What is Face Recognition?

Facial recognition technology is a framework or software which is capable enough to verify the identity of an individual by analysing a picture or video footage.

The main objective of this project is to make face recognition based automated attendance system. In order to obtain better performance, the test images and training images of this project is limited to frontal and upright facial images which consists of single face only.

Both the test and the training images have to be captured through the same device to ensure no quality difference or if possible, the owner or the person having the rights to access the database can add the images of high quality captured from high quality camera and later on add that image to the database, but as I have mentioned only the administrator or the person having the rights to access database can only enrol or remove the students or faculty data from it.

In addition, the students have to register in the database to be recognised. The registration can be done by the IT cellor from the admission office.

II. REAL TIME IMPLEMENTATION:

The human face is a unique representation of individual's identity. Thus, the face recognition is a type of biometric method through which identification of an individual is performed by comparing the real time captured image with the stored images of that person in the database.

Currently, Facial Recognition System is widely spread due to its simplicity and fast performance. Some examples that represent implementation of this system are, the airport protection system and the FBI that uses face recognition system for criminal investigations by tracking suspects, missing children's etc. On the other side, Facebook a popular social media site implements face recognition that allows the users to tag their friends in the photos for entertainment purpose. Apple allows users to unlock their mobile phones by face recognition.

III. PROBLEM STATEMENT:

1.1. Existing Attendance System:

Currently manual student attendance marking technique is often facing a lot issues and a very slow process. Teacher's or faculty calling names of student from their data sheet and student responding to them. But this existing process becomes very complex in large classes that consists so many students. Many times, students also mark proxies by responding to fake name. This makes disturbance in class and distracts the students during the exam times.

Also, verifying the total students present by counting them after attendance, which takes a lot of time consuming. Apart from calling names attendance sheet is passed around classroom during lectures especially the classes consisting large number of students might find it hard to have attendance sheet being passed around the class.

Douglas Ahlers, Bernie DiDario, Michael Dobson, in 2006 gave the concept of attendance tracking system. This framework consists of identity tags, with wireless communication capabilities, for each attendee and the scanners for detecting the attendee's tags as they enter in that allocated room.

O.A. Idowu and O. Shoewu: Development of Attendance Management System by using Biometrics. Attendance is taken with the help of a finger print device and the records of attendance are stored in the database. Attendance is marked after successful identification.

1.2. Proposed Automated Attendance System:

The face recognition student attendance system emphasizes its simplicity by removing classical attendance marking technique such as calling the students name or checking their respective ID Cards.

Thus, attendance system through facial recognition is proposed in order to replace the manual marking of student's attendance.

Furthermore, the automated attendance system based on face recognition is able to overcome the problems of fraudulent approach and faculty does not have to count the number of students several time to verify the presence of students.

The proposed framework uses OpenCV library. It is an Open-Source Computer Vision Library that is free for both scholastic and business use. It has python, and PyQt interfaces and supports various platforms like Windows, Linux, MacOS. It has a strong focus on real time application. The library has more than 2500 improved algorithms, these algorithms can be utilized to detect and recognize faces, objects, and so forth OpenCV has a FaceRecognizer class library for face recognition. This recognizes and controls faces

from Python or from the command line. It is a basic library constructed using dlib's cutting edge face recognition built with deep learning. The Dlib is a cross-stage open-source software library that is executed on various computing platform. The model has a precision of 99.38%. This provides a basic face recognition tool that allows you to perform face recognition on folder of pictures from the command line.

IV. AIMS AND OBJECTIVES:

The objective of this project is to design an automated attendance system based on face recognition. Some expected steps in order to fulfill the objectives are as follows:

- To identify the face segment from the video frame.
- To extract the useful features from the identified face.
- To classify the features in order to recognize the identified face.
- To record the attendance of the identified students.

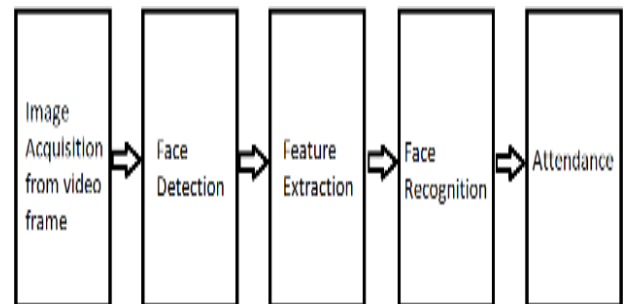


Figure: Block Diagram of the General Framework

V. LITERATURE REVIEW:

1.3. Student Attendance System with face recognition:

Face recognition-based attendance system proposes that the system is based on face detection and recognition algorithms, which automatically detects and recognizes the face and when student enters the class. There are various algorithms which have been made to detect the human face. When it is compared to existing attendance marking technique this system is much accurate and less time consuming.

There are various biometric systems developed for various cause. Some of them are Radio frequency Identification (RFID) card system, Fingerprint system, iris recognition system, Voice recognition system.

RFID card system is used due to its simplicity. However, it can be used for attendance system because it has a silicon



microchip in which the student data is stored. It can be encapsulated within any object. The user tends to check in as long as they have their friend's ID card.

Fingerprint System is truly effective but not much efficient as it's more time consuming for verification process due to which everyone has to line up and check in for verification one by one.

Iris recognition system which stores more detail might capture the privacy of the user.

Voice recognition is also available, but its less accurate compared to other techniques.

Hence, Face recognition system should be implemented for the student attendance system.

Let's compare various biometric systems and to know their advantages and disadvantages.

6.2. Non- Functional Requirements:

Non-functional requirements are qualities or traits of the framework that can pass judgment on its activity. The following point explains them:

- **Accuracy and Precision:** the framework should perform its process in accuracy and Precision in order to avoid problems.
- **Security:** For saving the student's privacy, the framework should be secure as data privacy plays important role in software development.
- **Modifiability:** the system should be easy to modify, in case any attendance or any record contains wrong or incorrect data can be easily corrected.
- **Usability:** the framework should be easy to deal with and simple to understand.
- **Speed and Responsiveness:** the execution of operations must be fast.

| Biometric Type | Advantages | Disadvantage |
|---|------------|----------------------------------|
| Radio Frequency Identification (RFID) card system | Simple | Fraudulent Usage |
| Iris recognition system | Accurate | Privacy Invasion |
| Fingerprint recognition system | Accurate | Time Consuming |
| Voice recognition System | - | Less accurate compared to others |

Table: Advantages and disadvantages of various biometric system.

VI. REQUIREMENTS:

The prerequisites are the descriptions of the system services and limitations.

1.4. Functional Requirements:

The system functional requirement describes activities and services that must provide:

- Tracking and marking student attendance by facial recognition in specific time.
- Allowing the faculty to modify the student absent or late arrivals.
- Showing the names of students with the exact time stamp i.e., exact time of entering the class.

6.3. System Requirement:

There are specific prerequisites for each platform that run applications based on the Face Verification. Minimum requirements that the clients must have in order to run this program and acquire great outcomes are as follows:

➤ **Hardware Specification:**

Processor: - 7th generation
i5. RAM: - Minimum 4 GB.

Hard Disk: - Minimum 500 GB. Camera: - High quality.

➤ **Software Specification:**

Platform: - Windows 8 or 10,
Linux
Language Used: - Python
Frontend tools: - PyCharm IDE, or Visual Studio
Backend: - Database Directory, Attendance Excel Sheet.

VII. IMPLEMENTATION:

1.5. Front End:

For frontend development, we have used the python language and some of its famous libraries and toolkits that are explained below:

➤ **Python:**

Python is an interpreted, high level and general-purpose programming language used all over the world.

I have chosen python language to design this project because of its simplicity and code readability. Whereas, there are various other modules which make it easier for any programmer to develop a software using this

language.

➤ **OpenCV:**

Open-Source Computer Vision Library (OpenCV) is a library of python binding which is designed to solve computer vision problems.

➤ **PyQt:**

PyQt is a GUI widgets toolkit. It is a Python interface for Qt, which is one of the most powerful, secure and popular cross-platform GUI libraries. PyQt is a combination of Python programming language and Qt library.

➤ **User Interface after execution of code:**

After execution of program user will have a simple and clean user interface. That contain two buttons, one for initiating face detection and recognition and another button to stop the program.



Figure: User Interface

➤ **After starting facial recognition:**

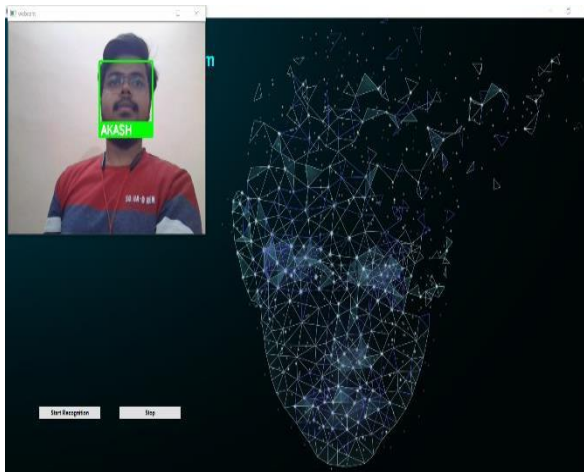
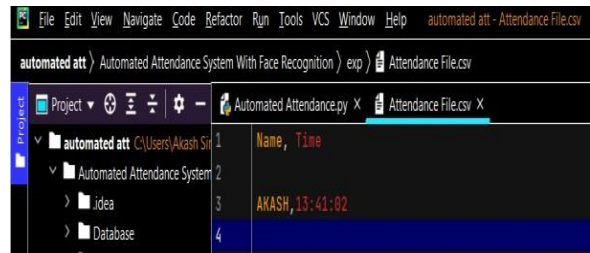


Figure: Face Detection

➤ **Attendance sheet after successful recognition of**



face:

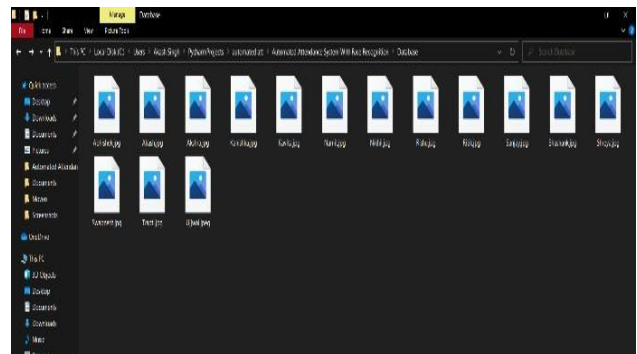
Figure: Attendance Sheet

1.6. Back End:

Moving further, for backend development i.e., for data storage and attendance marking we have used a folder and an excel sheet whose functions are explained below:

➤ **Dataset:**

Image dataset: Dataset includes pictures or recordings for tasks like face acknowledgment, object detection and so on. So, in the image dataset we have stored the image of the students with their



names who are currently enrolled in that particular subject and section. See below figure.

Figure: Image Dataset

➤ **Attendance File:**

This program marks or store the attendance automatically in a file with .csv extension or we can say in excel file. Whenever any student face is recognised, the program marks the attendance of that particular student with proper name, date and time in the excel sheet.

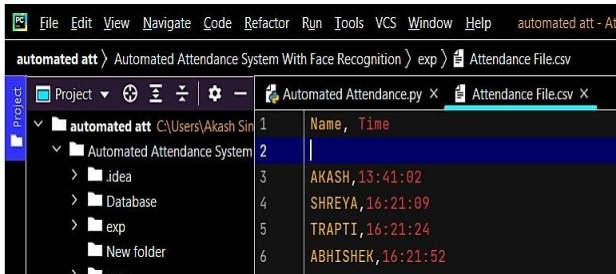


Figure: Attendance File

2. Face Recognition Process:

The following block diagram represents all the processes involved in face recognition.

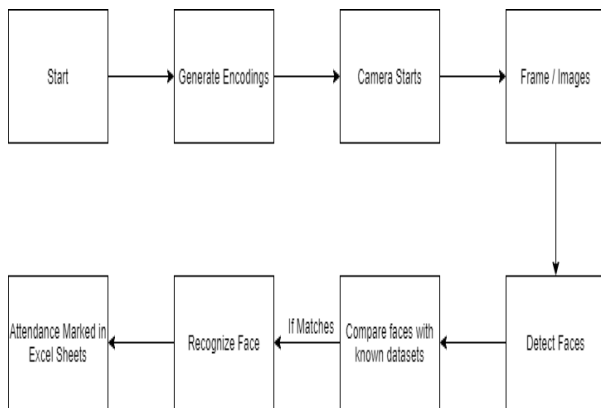


Figure: Block Diagram

- **Face Detection and Extraction:** Face detection is necessary as the image taken through the camera given to the system, face detection algorithm applies to identify the human faces in that image, the number of image processing algorithms are introduced to detect faces in an image and also the location of that detected faces. We have used Histogram of Oriented Gradient method to detect human faces in given image.



Figure: Face Detection

- **Face Positioning:** There are 68 specific locations or we can say there are 68 face landmarks in a human face. The main function performed in this step is to detect landmarks of faces and to position the image. A python script automatically detects the face landmarks and position's the face as much as possible without distorting the picture. Below is our test image to detect landmark of face:



Figure: Test image to detect landmark of face

The basic idea is to detect these 68 specific points (called landmarks) that exist on each face like at the top of the chin, the external edge of each eye, the internal edge of every eyebrow, and so on. At this point we will train our machine learning algorithm to track down these 68 specific points on any face. Here is the output of our test image for which 68 face landmarks are generated as shown in picture below:

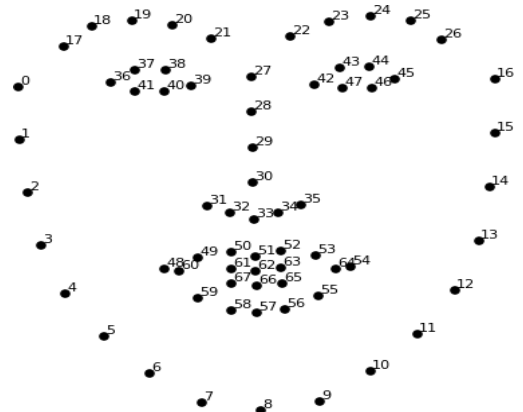


Figure: Landmarks generated for test image

- **Face Encoding:** When the faces are recognized in the given picture, the next stage is to extract the unique identifying facial element for each picture. Fundamentally, at whatever point we get localization of face, the 128 key facial point are extracted for each picture given info which are highly accurate and these 128-d facial points are stored in data file for face acknowledgment. So, all we need to do is to scan our face pictures through their pre-trained network to get the 128-measurement for each face. Here's the estimations for our test picture:

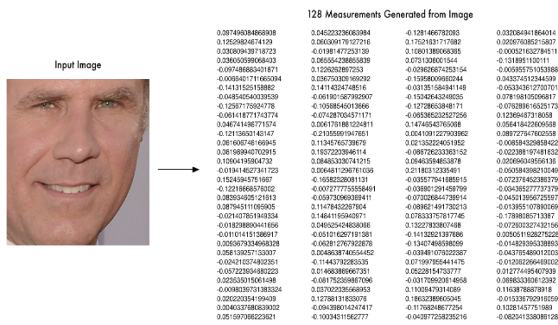
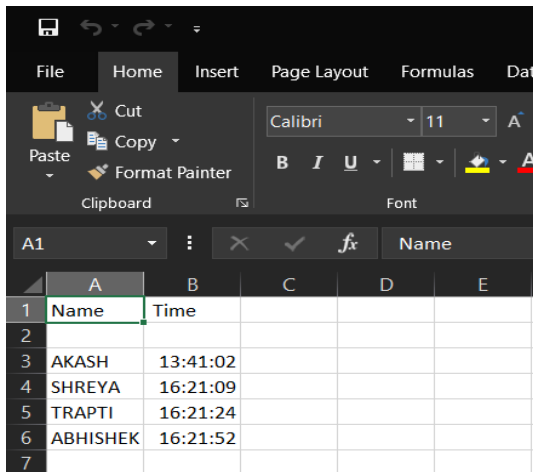


Figure: Encoding our Face Image

- **Face matching:** Our framework ratifies the faces, building the 128-d embedding (ratification) for each. Inside face comparison function is used to calculate the Euclidean distance between face in picture and all appearances in the dataset. If the current image is matched at least 60% with the current dataset, it will move to attendance marking.
- **Attendance Marking:** Once the face is identified with image stored in the database file, python automatically marks the attendance of the students present at that time. When the data is returned the system generates attendance table which includes the name, date, day and time and then the data is stored into the excel sheet automatically.



| | A | B | C | D | E |
|---|----------|----------|---|---|---|
| 1 | Name | Time | | | |
| 2 | | | | | |
| 3 | AKASH | 13:41:02 | | | |
| 4 | SHREYA | 16:21:09 | | | |
| 5 | TRAPTI | 16:21:24 | | | |
| 6 | ABHISHEK | 16:21:52 | | | |
| 7 | | | | | |

Figure: Attendance Sheet

3. System Privilege:

Our system provides various functionalities at organizational level's:

1. **Functionalities at student level:**
 - Students can only view their attendance.
2. **Functionalities at faculty / lecturer's level:**

The following are the privileges of the lecturer:

- Start the attendance.
- View the attendance.
- Retrieve queries.
- Can manually update the attendance sheet.

3. Functionalities at administrator's level: The following are the privileges of administrator:

- View attendance.
- Retrieve queries.
- Register new students.
- Control over the system.
- Access to modify /update the database.

VIII. DISCUSSION AND EXPLANATION:

Under this topic we would see how this project works, requirements of modules, how the data set is created, face being recognised and how the marking of attendance takesplace. As our project is still on going so there can be various issues and bugs. So, keeping that aside let's see what are the process going on in this project.

Hoping that python being installed on the system, first you have to import all the required modules like "cv2" from OpenCV, face recognition module, "os" module, NumPy and Datetime module, let me explain a little bit about these modules.

➤ OpenCV:

It stands for Open-Source Computer Vision library, which was developed by intel. This library is cross platform and is free for use under the open-source Apache 2 license. This library mainly focuses at real time computer vision and features GPU acceleration for the real time operations.

- **CV2:** It was the old interface in old OpenCV versions named as "cv". The OpenCV developers had chosen the name "cv2" when they had created the binding generators.

- **Face Recognition Module:** This module recognizes and manipulate faces through Python or through the command line. It was build using dlib's state of the art face recognition build with deep learning. This model has an accuracy of 99.38% on the "labeled faces in the wild" benchmark. Where the "Labeled Faces in the Wild" is a public benchmark for face verification, also called as pairmatching.

- **"Dlib" library:** It is a general-purpose crossplatform software library developed in C++. It's a cutting-edge toolbox in C++ that incorporates different AI



algorithms and tools for creating complex software programs to solve real world problem.

- **“OS” Module:** The OS module in python provides the facilities to establish a link between the user and the operating system. It has various useful OS functions that are used to perform OS- based tasks and get all the related information about the operating system.
- **NumPy Module:** It’s a python package that stands for “Numerical Python”. NumPy is a library that contains multidimensional array/cluster objects and the records for processing of arrays. Using NumPy a developer can also performs logical and mathematical operations on arrays and many more operations.
- **Datetime Module:** This module supply classes for manipulating dates and time or through this module a user can include current date and time in their program.
- **PyQt5 Module:** This is a complete set of Python bindings for Qt v5. Because of the tools and simplicity provided by this library anyone can design an interactive desktop application with so much ease.

IX. FUTURE SCOPE:

Practically all academic institutions require attendance record of students and maintaining attendance physically can be hectic as well as time consuming task. Hence maintaining attendance automatically with the help of face recognition will be exceptionally useful and less prone to mistakes or errors as compared to manual procedure. This will also reduce the manipulation of attendance record done by students and reduces time consumption too. The future extent of the proposed work can be, catching numerous definite pictures of the students and utilizing any cloud innovation to store these pictures. This framework can be designed and utilized in ATM machines to identify frauds. Also, the framework can be utilized at the time of elections where the voters can be distinguished by perceiving the face.

4. Advantages and drawbacks of facial recognition system:

4.1. Advantages of Facial Recognition System:

- **Easy to manage.**

Since the AI based attendance system is completely automatic, dealing with the records and monitoring everyday activities will turn out to be a lot simpler than the manual system. Everything will be done by the system. Numerous products are customized so that it shows the specific time of how many hours or minutes an individual worked at his/her work area in the day. All activities can be easily monitored to maintain a record.

- **Time and cost saving.**

This framework can be advantageous in saving lots of time and cash for organizations. Since the face recognition framework monitors employees or students working hours and access to different zones in the premise, organizations will not need to utilize an extra labour force to do this work. The automated framework likewise helps in preventing human mistake and monitors exact hours.

- **Easily monitor and detect students.**

Schools, universities and colleges have adapted face recognition both to record attendance and prevent any mischievous activity in premises.

- **Strengthens security measures.**

This framework also helps to improve security and safety measures. Facial recognition has become a regular part of Airport security evaluating since a long time, helping to identify lawbreakers and possible dangers to carriers and travellers.

Banks and different foundations additionally utilize facial recognition to prevent fraud, as the innovation can identify individuals who've been recently accused of wrongdoings and alert the bank or the institution.

- **Automatic and seamless verification process.**

It's not important to wait for your turn like checking fingerprint scanner or other safety efforts, facial recognition for attendance framework offers a speedy, programmed, and consistent verification experience.

- **Reduces interaction or touching of devices during pandemic situations.**

The entire world is experiencing COVID-19 and it's about time that we should offer regard to social distancing. Having a safe distance with others has become a need these days. Conditions such as this can be hazardous if you have manual attendance system, having a Face recognition-based attendance system won't just permit you to register the attendance of an individual but also keep you at a safe distance from them as you can work distantly and still see who all are coming and going. This requires the point that, this entire framework is a lot more secure, efficient, and faster method to record attendance.



4.2. Drawbacks of Facial Recognition System:

pp.300-307.

➤ **Image Quality:**

The resolution of the reference picture plays a significant part in the identification process. If the resolution of any picture is not high or good, then it can cause cameras to be tricked into believing that the person being scanned is not the same as in the photo. A simple arrangement for this issue is to ensure that both the reference pictures and scanning are performed by same cameras.

➤ **Produces data vulnerabilities.**

There is concern about the storage of facial recognition data, as these data sets can possibly be penetrated or breached.

➤ **Performance may vary from system to system.**

This framework requires fast and good quality of processor for smooth and lag free execution of program. Low configuration PC or devices might face lag issues or might face slow data processing.

➤ **Technology might be fooled. (In rare case).**

Some variables might affect this framework's ability to recognize individuals' appearances, including camera angles, lighting levels and picture or video quality. Individuals wearing masks or slightly changing their appearance can throw off facial recognition technology too. But there is very rare probability for occurrence of this issue.

X. CONCLUSION:

The Face Recognition based Automated Attendance System is simple, accurate and works efficiently. This system works automatically once the registration of individual student is created by the administration. There is a need to utilize few algorithms that can perceive the appearances in order to improve the system performance and recognition accuracy.

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