Facial Recognition Based Attendance System

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***Abstract*— Mainstream attendance management system used these days are time taking, clunky and/or can be abused. Most of these systems out there are either fool-proof or cost effective but rarely both. This academic paper proposes the idea of Facial Recognition Based Attendance System that hopes to achieve both. Facial Recognition Based Attendance System uses a machine learning to train a model and associate it to a name. Our system comprises of 4 stages- database creation, face detection, face recognition, attendance updating. A database is created of the images of the students in class. Facial detection and recognition are done by Haar-Cascade classifier and Local Binary Pattern Histogram algorithm respectively. This is achieved with the help of computer vision module called OpenCV in python. This system also has a UI component which uses the Tkinter UI module. Hardware like small cameras and a compute unit will be required for the whole system. The accuracy of the system is high making it quite feasible. Once the model is trained to recognize a person, the system only requires one step, that is, a photo capture of a person. This proposed product offers a faster, fool-proof, and a cost-effective alternative the mainstream attendance system due to its unique facial recognition-based ML approach.**

Keyw ords—biometric; recognition system; Face Recognition; Haar-Cascade classifier; Deep Learning; Python; OpenCV; Local Binary Pattern Histogram; Machine learning; computer vision; management system; attendance system

I. INTRODUCTION

Traditional method of attendance marking can be a tedious task for many schools and colleges. Especially for teacher who do roll calls by calling out names. And it takes a lot of time, more than 10 mins. There is also risk of proxy attendance. Therefore, many institutions use some sort of automated attendance system. For example, RFID system, Iris recognitions, fingerprint censor etc. However, many of them require -based systems are relatively oblivious to varied face expressions. Face recognition system consists of two categories: face verification and face identification. Face verification is an one to one matching process, it compares face image against the saved facial images and whereas is an one to many problems that compares a query facial images.

The purpose of this system is to create an attendance system which utilizes a facial recognition techniques. Here, face of an individual will be detected for registering attendance. In recent times, facial recognition is increasing in popularity and is being widely used. In our paper, we propose a system which detects the faces of subjects from a video steam of classroom and attendance will be registered if the detected face is found in the database. This new system consumes less time compared to traditional methods.

II. LITERATURE REVIEWS/COMPARATIVE STUDY

There has been a lot of research in the computer vision field that has helped in pushing this technology forward. Modules like OpenCV are premade modules that have ML models which are optimised for computer vision and hence, facial recognition. We can use this to make a facial recognition-based attendance system. Even though there are many research and product idea using facial recognition there aren't any that uses it in this specific way.

In the current market, there are many attendance systems that are being used. Some of them are smart card-based attendance system, Iris based, fingerprint based, Punch card based. Most of them are clunky, old and/or can be abused. Most of these systems out there are either fool-proof or cost effective but rarely both. This paper proposes the idea of Facial Recognition Based Attendance System that hopes to achieve both.

III. PROBLEM FORMULATION

Traditional Attendance systems are slow, costly and/or can be fooled easily or have other problems. There are few types of attendance system in the market like fingerprint, iris, smart card, punch card etc. Fingerprint, iris and smartcard can take a lot of memory in storing copies of fingerprints and iris and comparison take a fair amount of computing power. These systems are usually very costly. And only a single it, he/she won't be able to get the attendance for the day even if he/she is present. Not to mention the cost of making the smart card are high. Punch card systems are getting old and can be fooled easily.Our aim is to solve these problems by making robust attendance management system powered by ML.

IV. REQUIRED TOOL

This system is going to be built in python as it is faster and easier to work is this language. Since, this is a facial recognition-based system, it'll need some sort of ML based computer vison approach. And for this we are going to use a computer vision python module called OpenCV.

We will also be implementing a UI component. And for that well be using Tkinter as it is quick, easy, portable and stable.

V. FEASIBILITY ANALYSIS

Industry needs a quick and efficient system for attendance management. Compared to other attendance systems like a punch card or a finger or a smartcard system, this system is both cost effective and fool proof. Because facial recognition is already widely implemented in variety of places, it is already technically feasible. It can detect multiple faces at once, makes this system quite fast. A system like this only requires to be trained once and can then detect faces with high accuracy. In the hardware side it only requires a small inexpensive camera, a compute unit and an internet connection making it cheap.

VI. MERITS

Our system offers many different merits that goes beyond what normal mainstream attendance system offers.

Compared to others, our system offers a high degree of automation. A system like this automatically captures, detects and record attendance in a CSV file for later use. This system can also be extended or integrated with online attendance portal for a complete automation. The automation cut down on time taken to take the attendance so that the teachers can spend more time teaching.

Since this system has a GUI, the ease of use factor is very high. The faculty only needs to press a few buttons to record the attendance. This system can also detect multiple faces at once making it quite fast.

A topic of discussion may arise regarding the feasibility of the system in terms of its ability to reliably detect faces. This topic can be discarded because our system uses a ML model, a Haar-Cascade Classifier, making it quite reliable. Because we have established that this system is highly reliable, we can also establish that marking proxy attendance will be near impossible. Our system can also incorporate a depth sensing camera to detect depth and hence decern photos.

Lastly, comes the concern of cost effectiveness. Our system has three main parts: display for the GUI, camera to capture faces and a compute unit to train. These components individually are already very cheap making it fairly cheaper than any other biometric attendance system. Our system can also use an IOT approach where the camera and display are connected to a centralized computing unit making this system even cheaper.

VII. ARCHITECTURE DIAGRAM

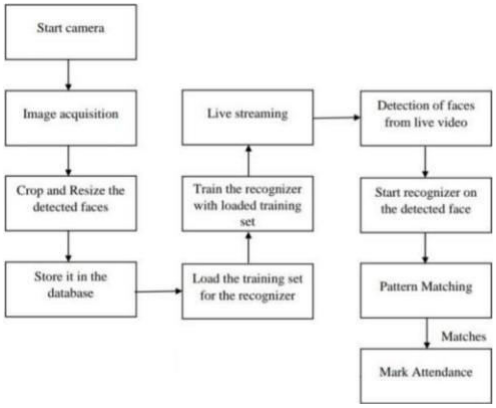

Fig 1. Architecture Diagram

VIII. IMPLEMENTATION

The above architecture diagram describes the process/algorithm of the attendance system.

This process can be split into 4 main phases:

1) Dataset Creation

Images of subjects are captured using a camera. Multiple images of single a subject will be acquired with slightly varying gestures and angles. These images undergo pre-processing. The images are then cropped to obtain the Region of Interest (ROI) which will be further unutilized in facial recognition process. Next step in the process is to resize the cropped images to specific pixel position. Then these images are converted from RGB to gray scale images. These images are then saved as the names of respective student in the folder.

2) Face Detection

Facial detection here is performed using Haar-Cascade Classifier using OpenCV. The Haar Cascade algorithm should be prepared to identify human faces before it can be utilized for facial recognition. This process is called feature extraction. The Haar cascade training data used is an xml filehaarcascade_frontalface_default. The Haar features shown in Fig.2. will be used for feature extraction.

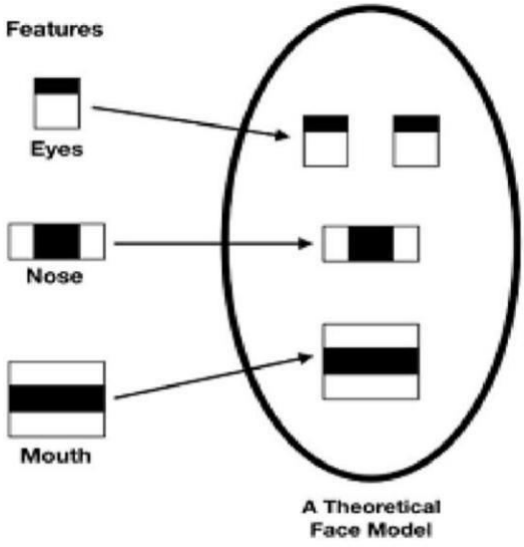

Fig 2. Haar Features.

Here, we are using detectMultiScale module in OpenCV. It is required to create a rectangular area around the faces in an image. It has got 3 parameters to consider- scaleFactor, minNeighbors, minSize. The first, scaleFactor is utilized to show how much an image should be decreased in each image scale. The second, minNeighbors tells how many neighbors each candidate rectangle must have. The third, minSize specifies the minimum size of the object. By default it is (30,30). The parameters that is being utilized by our system is scaleFactor and minNeighbors with the quantities 1.3 and 5 respectively.

3) Face Recognition

The Facial recognition process can be split into three parts: prepare training data, training face recognizer, prediction. Here, the training data will be the images in the dataset. They will be assigned with an integer label of the subject it belongs to. These images are then used for facial recognition. Face recognizer used in our system is Local Binary Pattern Histogram. First, the list of local binary patterns (LBP) of entire face is obtained. These local binary patterns are converted into decimal number and then histograms of each one of those decimal qualities are made. In the end, one histogram will be formed for each image in the training data. Later, during recognition process histogram of the face of the subjects to be recognized is determined and afterwards compared with the already computed histograms. It then returns the best matched label associated with the subject it belongs to.

4) Attendance Updation

After facial recognition process, the recognized faces will be registered as present in the excel sheet.

IX. DESCRIP TION OF PROJECT MODULES

1) Tkinter

Tkinter is the standard GUI library in Python. It is the popular Python interface to the Tk GUI toolkit. Tkinter is comes with standard Microsoft Windows, Linux and MacOS versions of Python. The name Tkinter comes from Tk interface. Tkinter was written by Fredrik Lundh. It is is free program released under the Python license.

Here, the Tkinter module is responsible for rendering the UI for our attendance system. This GUI can be used to interact with the system. Here, the users will be presented with three different options like, student registration, faculty registration, and marking attendance. The students are supposed to enter their required details in the registration form. After clicking on register button, the camera starts and another window pops up and starts detecting faces in the frame. Then it automatically starts capturing photos until 60 images are collected or **"CRTL+Q"** is pressed. Then, these images will be pre-processed and stored.

2) OpenCV

OpenCV or Open Source Computer Vision Library is a python library of programming functions meant for real-time computer vision. It was initially developed by Intel, but was later supported by Willow Garage and then Itseez. It is open source under the open-source BSD licence and is also cross platform.

Facial detection here is performed using Haar-Cascade Classifier with OpenCV. Here, the detectMultiScale module in the OpenCV is being used. This is needed to create a rectangle area around the faces in the captured image. It has got 3 parameters to consider- scaleFactor, minNeighbors, minSize. The first, scaleFactor is utilized to show how much an image should be decreased in each image scale. The second, minNeighbors tells how many neighbors each candidate rectangle must have. The third, minSize specifies the minimum size of the object. By default, it is (30,30). The parameters that are being used in our system is scaleFactor and minNeighbors with the values 1.3 and 5 respectively.

X. CONCLUSION

This system aims to create an effective yet efficient facial recognition-based attendance system using ML. Our system will be able to register the attendance via facial ID. It will detect faces of the subjects via camera and then do a facial recognition. After recognizing, it will register the attendance of the subject and update the attendance on the excel sheet record.