An Analytical Research on Face Recognition Attendance System for Employees using Machine Learning

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Abstract-
The primary goal of this paper is to develop a facial recognition-based attendance monitoring system for educational institutions in order to improve and modernise the existing system and make it more effective and efficient than it was in the past. Numerous ambiguities in the previous, outdated approach led to imprecise and ineffective attendance recording. When the authority is unable to enforce the regulations that were in place under the previous system, several issues occur. The facial recognition system will be the technology underlying this. One of the natural characteristics that may be used to identify a person specifically is their face. Since there is little chance of a face deviating or being replicated, it is utilised to trace identification. Face databases will be developed in this study in order to provide information into the recognizer algorithm. Then, in order to determine identification, faces will be compared to the database during the attendance-taking session. Upon identification, the attendance of that person will be automatically recorded, with the relevant data being stored in an Excel spreadsheet.

Keywords— *Face Recognition, Attendance System, Employees Using Python, Facial Recognition-Based Attendance Monitoring System For Educational Institutions, RFID (Radio Frequency Identification) Card System.*
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INTRODUCTION

For both teachers and students at an educational institution, attendance is crucial. Thus, maintaining a record of attendance is crucial. When we consider the conventional method of recording attendance in a classroom, the issue appears. Inquiring about a student's attendance by calling their name or roll number requires energy in addition to time. Thus, every issue listed above may be resolved with an automated attendance system. There are some automatic attendances making system which are currently used by much institution. One of such system is biometric technique and RFID system. Although it is automatic and a step ahead of traditional method, it fails to meet the time constraint. The student has to wait in queue for giving attendance, which is time taking. This paper introduces an involuntary attendance marking system, devoid of any kind of interference with the normal teaching procedure. The system can be also implemented during exam sessions or in other teaching activities where attendance is highly essential. This system eliminates classical student identification such as calling name of the student, or checking respective identification cards of the student, which can not only interfere with the ongoing teaching process, but also can be stressful for students during examination sessions. In addition, the students have to register in the database to be recognized. The enrolment can be done on the spot through the user-friendly interface. Face recognition is crucial in daily life in order to identify family, friends or someone we are familiar with. We might not perceive that several steps have actually

taken in order to identify human faces. Human intelligence allows us to receive information and interpret the information in the recognition process. We receive information through the image projected into our eyes, by specifically retina in the form of light. Light is a form of electromagnetic waves which are radiated from a source onto an object and projected to human vision. Robinson-Riegler, G., & Robinson-Riegler, B. (2008) mentioned that after visual processing done by the human visual system, we actually classify shape, size, contour and the texture of the object in order to analyze the information. The analyzed information will be compared to other representations of objects or face that exist in our memory to recognize. In fact, it is a hard challenge to build an automated system to have the same capability as a human to recognize faces. However, we need large memory to recognize different faces, for example, in the Universities, there are a lot of students with different race and
gender, it is impossible to remember every face of the individual without making mistakes. In order to overcome human limitations, computers with almost limitless memory, high processing speed and power are used in face recognition systems. The human face is a unique representation of individual identity. Thus,
face recognition is defined as a biometric method in which identification of an individual is performed by comparing real-time capture image with stored images in the database of that person (Margaret Rouse, 2012). Nowadays, face recognition system is prevalent due to its simplicity and awesome performance. For instance, airport protection systems and FBI use face recognition for criminal investigations by tracking suspects, missing children and drug activities (Robert Silk, 2017). Apart from that, Facebook which is a popular social networking website implement face recognition to allow the users to tag their friends in the photo for entertainment purposes (Sidney Fussell, 2018). Furthermore, Intel Company allows the users to use face recognition to get access to their online account (Reichert, C., 2017). Apple allows the users to unlock their mobile phone, iPhone X by using face recognition (deAgonia, M., 2017). The work on face recognition began in 1960. Woody Bledsoe, Helen Chan Wolf and Charles Bisson had introduced a system which required the administrator to locate eyes, ears, nose and mouth from images. The distance and ratios between the located features and the common reference points are then calculated and compared. The studies are further enhanced by Goldstein, Harmon, and Lesk in 1970 by using other features such as hair colour and lip thickness to automate the recognition. In 1988, Kirby and Sirovich first suggested principle component analysis (PCA) to solve face recognition problem. Many studies on face recognition were then conducted continuously until today (Ashley DuVal, 2012).

LITERATURE REVIEW

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Arun Katara et al. (2017) mentioned disadvantages of RFID (Radio Frequency Identification) card system, fingerprint system and iris recognition system. RFID card system is implemented due to its simplicity. However, the user tends to help their friends to check in as long as they have their friend's ID card. The fingerprint system is indeed effective but not efficient because it takes time for the verification process so the user has to line up and perform the verification one by one. However for face recognition, the human face is always exposed and contain less information compared to iris. Iris recognition system which contains more detail might invade the privacy of the user. Voice recognition is available, but it is less accurate compared to other methods. Hence, face recognition system is suggested to be implemented in the student attendance system.

MODEL IMPLEMENTATION AND SYSTEM DESIGN

(i) Python IDE- There are lots of IDEs for python. Some of them are PyCharm, Thonny, Ninja, Spyder etc. Ninja and Spyder both are very excellent and free but we used Spyder as it feature- rich than ninja. Spyder is a little bit heavier than ninja but still much lighter than PyCharm. You can run them in pi and get GUI on your PC through ssh-Y. We installed Spyder through the command line below.

1. sudo apt-get install spyder

(ii) OpenCV- We used OpenCV 3 dependency for python 3. OpenCV is library where there are lots of image processing functions are available. This is very useful library for image processing. Even one can get expected outcome without writing a single code. The library is cross-platform and free for use under the open-source BSD license. Example of some supported functions are given bellow:

a) Derivation: Gradient/Laplacian computing, contours delimitation
b) Hough transforms: lines, segments, circles, and geometrical shapes Detection
c) (c)Segmentation: thresholding, distance transform, foreground/background detection, watershed segmentation
d) Filtering: linear and nonlinear filters, morphological operations
e) Cascade detectors: detection of face, eye, car plates
f) Interest points: detection and matching
g) Video processing: optical flow, background subtraction, camshaft (object tracking)
h) Photography: panoramas realization, high definition imaging (HDR), image in painting
i) Histograms: computing, equalization, and object localization with back projection algorithm

(iii) "3.2.2 NumPy"- NumPy is a package that defines a multi-dimensional array object and associated fast math functions that operate on it. It also provides simple routines for linear algebra and fft and sophisticated random-number generation. NumPy replaces both Numeric and Numarray.
Example demonstrating NumPy:

```
from numpy import*
from PIL import Image
ar = ones ((100,100), float32)
ar=ar  * 100
for  i  in range(0,100):
ar[i,:] = 100 + (i * 1.5)
im = Image.fromarray(ar,"F")
```

The numpy namespace includes all names under the numpy.core and numpy.lib namespaces as well. Thus, import numpy will also import the names from numpy.core and numpy.lib. This is the recommended way to use numpy.

SOFTWARE DEVELOPMENT

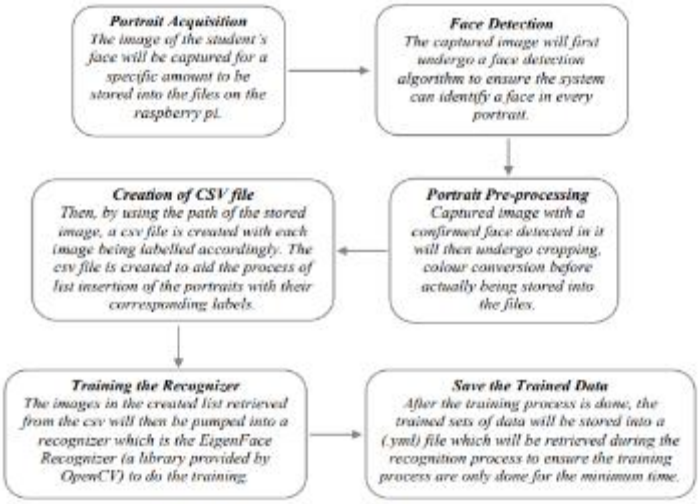
There are two major system flows in the software development section as shown below:

1. The creation of the face database

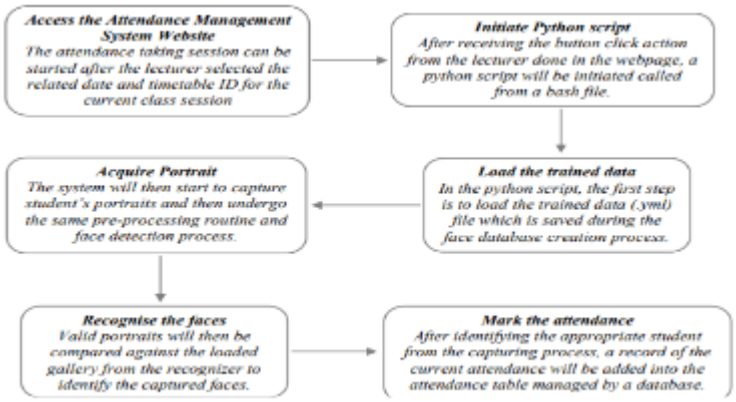
2. The process of attendance taking

Both processes mentioned above are essential because they made up the backbone of the attendance management system. In this section, the process of both flows will be briefly described. Meanwhile, their full functionality, specific requirements and also the methods/approach to accomplish.

(i) The creation of the face database- Completing the face database is a crucial prerequisite for initiating any further processes. This is due to the fact that the face database serves as a benchmark for the identification procedure, which is covered in a later section. A csv file is produced in the above procedure to help with picture labelling since each student will have many portraits recorded; labels are used to separate the photos so they may be grouped together under the same person's name. Following that, a recognizer will use those photos to begin its training process. Since the training process is very time consuming as the face database grew larger, the training is only done right after there is a batch of new addition of student‟s portraits to ensure the training is done as minimum as possible.



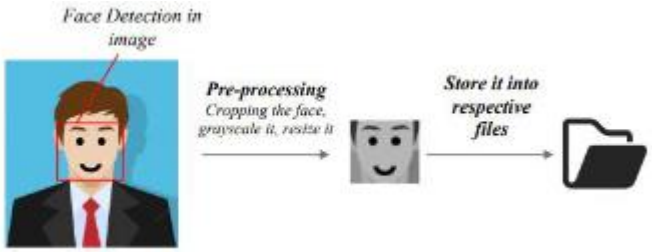
(ii) The process of attendance taking-



METHODOLOGY

A fundamental set of data must be entered into the attendance management system before it can function. These data primarily comprise the individual's ID and face. The initial step in acquiring a portrait can be completed by taking a picture of the subject's face with a camera. In this procedure, the system will first look for a face in the image that was taken. If a face is not found, the system will ask the user to take their picture again until the needed number of portraits 10 for each student in this paper is met. The choice to save only 10 portraits per student was made in light of the Raspberry Pi's limited storage capacity and the university's comparatively large student body. In order to utilise the

Eigen Faces Recognizer, the photos must first go through a number of pre-processing steps in order to create a grayscale image and cropped faces of equal sized images. This figure below shows both of the above-mentioned procedures.



(i) Image Acquisition and Pre-processing procedures- Following processing, the photos are organised hierarchically into a file. All of the faces in this article will be kept under the "database" folder in a hierarchical fashion. As you navigate around the database folder, you'll see a number of sub-folders that, when expanded, will each represent a different individual and hold a collection of that person's face portraits. Each individual's subfolder will be titled according to their unique ID number, which is exclusive to each and every person inside the organisation.

(ii) Hierarchy manner of the face database- After a successful retrieval of facial images into the respective folder, a CSV files created to aid the next process of pumping the faces into the recognizer for the training process. The creation of the CSV file will be done based on a script named create_csv.p.

(iii) Structure of the content in the csv file- Once the database has a sufficient number of photographs, the images will be added to a training process. OpenCV 3.4 typically offers three distinct training mechanism types: EigenFaces, FisherFaces, and Local Binary Patterns Histograms (LBPH). The EigenFaces recognizer is the one on which this research will concentrate. The idea behind EigenFaces is straightforward: it detects a specific face by identifying the greatest variance in a face and then converts those differences into data that can be compared when a new face appears. The path to each picture will be obtained during the training phase by reading the CSV file, after which the labels and images will be put into a list variable. After then, the list will be sent to the training function, where it will take a certain amount of time to complete the training. The time required to train those photos will increase with the size of the face database.

CONCLUSION

Prior to the creation of this project. Many of the institutions had difficulties due to the numerous flaws in the previous way of taking attendance. Thus, the facial recognition function built into the attendance monitoring system may guarantee correct attendance taking in addition to removing the shortcomings of the prior method. By giving all of the difficult tasks to the machine, employing technology to solve flaws not only saves money but also minimises the need for human intervention throughout the process. The sole expense associated with this method is having enough room in the database storage to hold all of the faces. Thankfully, mini SD cards exist that are capable of compensating for data capacity. The face database is successfully constructed in this project. Aside from that, the facial recognition technology is operating effectively.

Ultimately, the solution not only fixes issues with the previous model but also makes it easier for the user to get the data that was gathered by mailing the attendance sheet to the esteemed professors.

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