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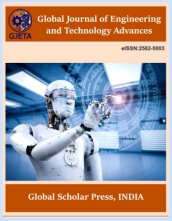

(RESEARCH ARTICLE)

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Face-App: A real-time face recognition e-attendance system for digital learning

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Abstract

Attendance is essential for every organization e.g., schools, colleges, universities, and companies. It is exhausting taking attendance in every period. General attendance management system in any organization is a very long process as well as time-consuming, which can piss students/staff off. Nowadays, biometric attendance systems are also accessible. This system may offer various advantages to enterprises, however also has many drawbacks; time-consuming, costs, data breaches, false positives and inaccuracy, no remote access, and many more. This paper deals with the process of taking the attendance using a face recorded camera and Face-App software tool will be complete the further attendance makes the process for staffs and students in an easy and simple manner within a short time. This proposed system (Face-App) uses face detection for the identification of faces from objects (e.g., students and staff), and a face recognizer for matching the faces from stored database images (authentication), and marks attendance according to the matched face images. Face-App system, which can be, controlled using mobile or computer according to requirements. Automated systems help to reduce the need for manual labor and can correct errors on attendance sheets.

Keywords: E-attendance; Face detection; Face recognition

1. Introduction

In the modern era, we know that everything is based on cutting-edge technology. The attendance system is one of the essential things that we need to convert into a technology-based system. These days, taking attendance is a necessary task to ensure the passing of knowledge across various fields and to maintain records of learners, tutors, and workers. It can be a challenge to manage student attendance in schools, colleges, or universities, especially in classrooms with many students by the lecturer.

There are mainly two kinds of student attendance framework, i.e. Manual Attendance System (MAS) and Automated Attendance System (AAS). Practically in MAS, the staff may have trouble in both approving and keeping up every student's record in a classroom all the time [1]. . Students were traditionally required to fill out a notebook attendance at the end of class. We observed that the techniques were used very time-consuming and even many demerits have been observed by us such as wastage of paper, interruption in the classroom, etc. Automated Attendance System (AAS) may decrease the managerial work of its staff. Especially, for Human Face Recognition, it normally includes the students' facial images captured at the time he/she is entering the classroom, or when everyone is seated in the classroom to mark the attendance [1]. . Our proposed system Face-App aims to reduce the time of preparation by cutting down on paper and making sure attendances in an automatic way with high security, less time-consuming in every organization e.g., schools, colleges, universities. Face-App system capture images from the live frame then use face detection for identification of faces from objects (e.g., students and staff), and face recognizer for matching the faces from stored database images (authentication), and marks attendance according to the matched face images. In reality, it is common for students to sign their friends into classes without being there themselves. However, using our e-attendance software

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(Face-App) can give the management team the ability to validate and record who truly attended. The installation of this system has to be carried out in accordance with some techniques namely face detection and face recognition. Face detection and face recognition are much upgraded in terms of computer authentication technology [1, 2, 3, 4, 5].

There are many different computerized time attendance systems. They all focus on how to change the traditional and manual paper sheets mechanisms that are currently used in schools, colleges, and universities circumstances. A real-time attendance system that uses smartphones to detect employees in their current location not only based on geographic data, but also by scanning fingerprints. GPS tracking need for the further reached time of users at the office, such as with fingerprint authentication [6]. . Using RFID technology proposed time attendance [7]. . Another proposed time attendance system that uses a student's smartphone to record their reached time. One concern with this idea is the desire of some students to help their friends in school by carrying their phones [8]. . This can be a big problem for teachers because it allows the student to register their attendance and leave, which means they could skip class. Other research has indicated in literature such as, video surveillance camera [9]. . QR codes [10]. . Android application [11, 12]. .

However, the purpose of this research is that attendance system should be both affordable and sustainable; it should combine both cheap and efficient/secure ideas that is the primary concern of our system (Face-App), which focus on Face detection and Face recognition with python.

1.1. Purpose

Proper attendance recording and management has becoming more important in today's world. Attendance is one of the work ethics valued by students. Most of the educational institutions and government organizations in developing countries still use paper based attendance method for maintaining the attendance records. RFID-based attendance system, general attendance, time attendee systems, cellphone application takes the same time and proxy attendance can possible. Then, we decided to research the automatic attendance system, which will more effective, safer, less time-consuming, and user-friendly. We proposed a system (Face-App) that takes test images of users and then compares these test images with our trained images. If live captured and trained images are matched after processing then our system Face-App automatically makes attendance with the exact name, date, and time, also generate same values in excel sheet.

2. Background

2.1. Related Works

2.1.1. Paper based attendance

There are various disadvantages to this approach such as data is not available for analysis because paper based registers are not uploaded to a centralized system, time taken for data collection reduces the effective lecture time and fake attendance by students.

2.1.2. RFID based attendance system

The conventional method of taking attendance by calling names or signing on paper is very time consuming and insecure, hence inefficient. Radio Frequency Identification (RFID) based attendance system is one of the solutions to address this problem. This system can be used to take attendance for student in school, college, and university. Its ability to uniquely identify each person based on their RFID tag type of ID card make the process of taking the attendance easier, faster and secure as compared to conventional method. Students or workers only need to place their ID card on the reader and their attendance will be taken immediately. With real time clock capability of the system, attendance taken will be more accurate since the time for the attendance taken will be recorded. The system can be connected to the computer through RS232 or USB port and store the attendance taken inside database [7].

2.1.3. Android Attendee System

The mobile attendance system has been built to eliminate the time and effort wasted in taking attendances in schools and colleges. It helps schools, colleges, universities faculty lecturer, so that they may take student attendance on their phone. The app greatly reduces the amount of paper resources needed in attendance data management [11, 12]. The system is divided into following modules:-

- Student's attendance list creation.
- Attendance marking
- Attendance store.
- Attendance sheet transfer.

2.1.4. Biometrics Attendance System

Fingerprint matching is widely used in forensics for a long time. It can also be used in applications such as identity management and access control. The unique nature of fingerprint makes it ideal for use in attendance systems. Besides being secure, fingerprint-based attendance system will also be environment friendly. This system may offer various advantages to enterprises, however also has many drawbacks; time consuming, costs, data breaches, false positives and inaccuracy, no remote access and many more [13, 14].

However, this system automates attendance system and eliminates the use of paperwork needed for attendance marking and monitoring staffs/students attendance. The system can run only in android platform.

2.2. Comparative Studies Analysis

Table 1 Comparison with Related Attendance Systems

Features	Face-App	RFID System	Paper System	Biometric System	Android System
Time-Saving	✓	✓	×	✓	✓
High Security	✓	×	×	✓	×
Automated Easy Time Tracking	✓	×	×	✓	×
Prevents Loss of Productivity	✓	✓	×	✓	✓
Cost Effective	✓	×	×	×	✓
Touchless Sign In System	✓	×	×	×	×
Easy To Manage	✓	×	×	×	×
Smart Integration	✓	✓	×	✓	✓
No Proxy Attendance	✓	×	×	×	×
Automated and More Accurate	✓	×	×	×	×

3. Proposed System and Methodology

In our system, we almost follow the well-known waterfall models as shown follows

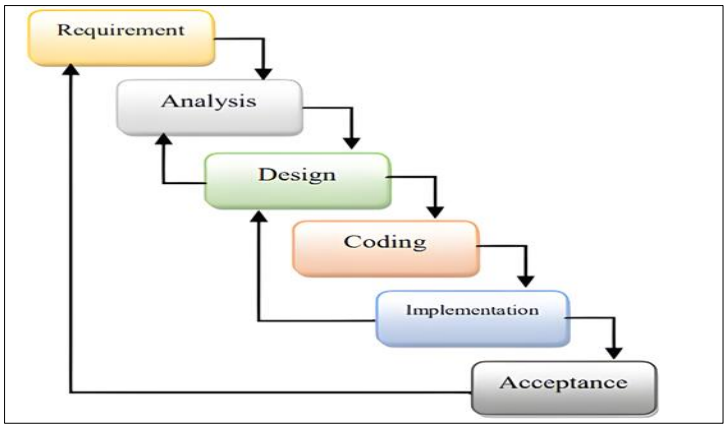

Figure 1 Waterfall Model

3.1. Requirement Specification Phase

Software Requirements Specifications (SRS) is a classification of a package to be developed. It contains all the useful and non-functional specifications. It captures all the specifications and the system performance. SRS reduces the time and energy required by developers to attain the required goal and additionally reduces the event price. It encompasses all the conditions that decrease the event time, value, and additionally cut back the chance.

3.1.1. System Requirements

- Computer.
- 4 GB RAM (Minimum).
- 80 GB HDD.
- Internet (Wi-Fi) Connection
- A high-resolution face camera e.g., 512*512 pixel.
- Dual Core processor.
- Windows XP (Service Pack 2) or higher.

3.1.2. Resources Used to Develop and Improve the System

Used tools and packages is following bellows-

- Python

Python is high level programming language with dynamics semantics. There are several modules two can be import while implementing the code from algorithm. Python is also the scripting language where the application can be developed and can be used for many purposes. Some of python interpreter and the extensive standard library are available without charge.

- OpenCV

OpenCV is a useful tool for working with images and performing computer vision tasks. An open-source library can complete objectives like face detection, object tracking, landmark placing, and more. It supports multiple languages e.g., python, C++

```
pip install opencv-python
```

- Pandas

Pandas is an open source Python package that caters diverse tools for data analysis. The package contains various data structures that can be used for many diverse data manipulation tasks. It also includes a range of methods that can be invoked for data analysis, which becomes feasible when working on data science and machine learning problems in Python.

```
pip install  pandas
```

- Cmake

Cmake is used to control the software compilation process using simple platform and compiler independent configuration files, and generate native make files and workspaces that can be used in the compiler environment of your choice.

```
pip install cmake
```

- Numpy

NumPy, which stands for Numerical Python, is a library consisting of multidimensional array objects and a collection of routines for processing those arrays. Using NumPy, mathematical and logical operations on arrays can be performed. NumPy is a Python package. It stands for 'Numerical Python'.

```
pip install numpy
```

- Face-recognition

Face recognition is an automatic process of identification or verification of people from their pictures. One of the most well-known facial recognition techniques is its reliability and accuracy. One important limitation might be if people have similar faces. There are two main approaches to face recognition. One is primarily based on geometry, and the other is based on features. The recognition process proceeds by comparing the extracted features from the image with the ones previously stored in an extensive database of faces. It can be very difficult to differentiate one person's face from another. There are many ways of doing this, but PCA, LDA and DCT are all effective.

```
pip install face-recognition
```

3.2. Analysis Phase

Our propose system (Face-App) that takes test images of users and then compares these test images with our trained images. If live captured and trained images are match after processing then our system Face-App automatically makes attendance with exact name, date and time, also generate same values in excel sheet. Therefore, in the analysis phase, we have collected images and trained though our systems (Face-App) to make more efficient our system.

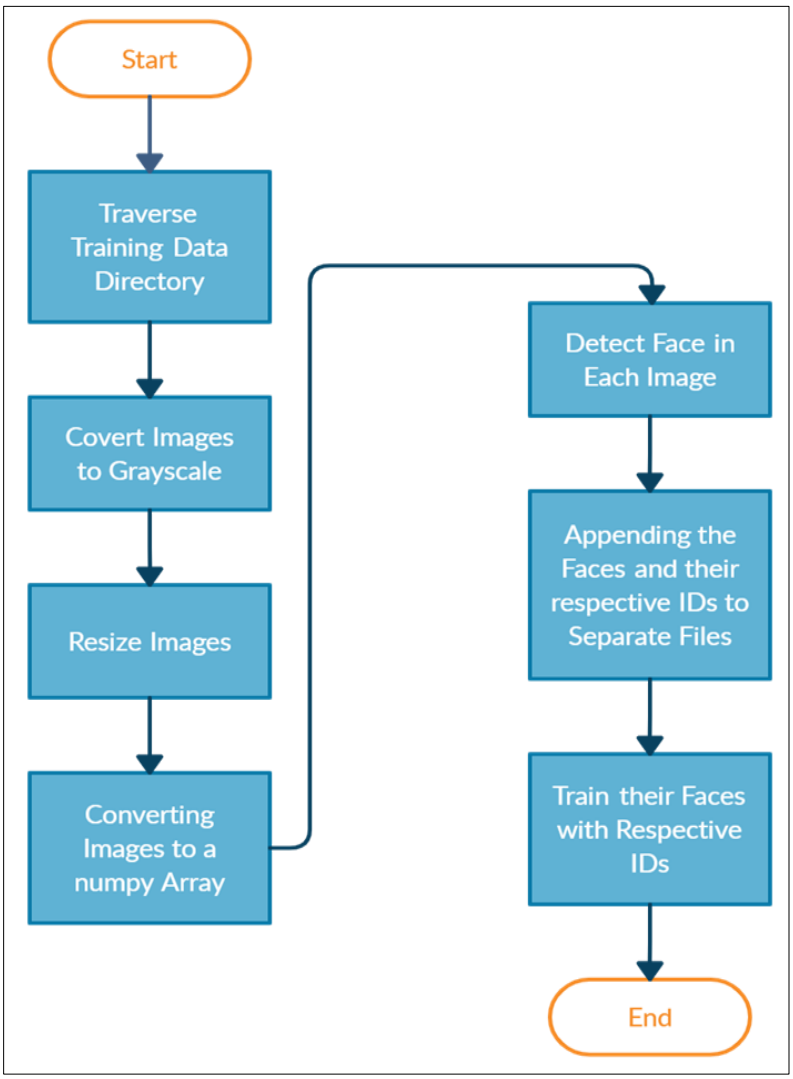

Figure 2 Flow-Chart Training Process

3.3. System Architecture

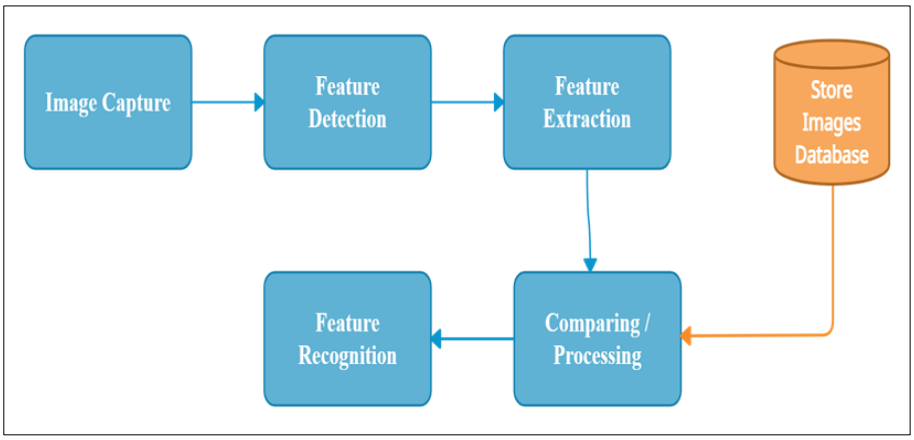

Figure 3 Test Scenario

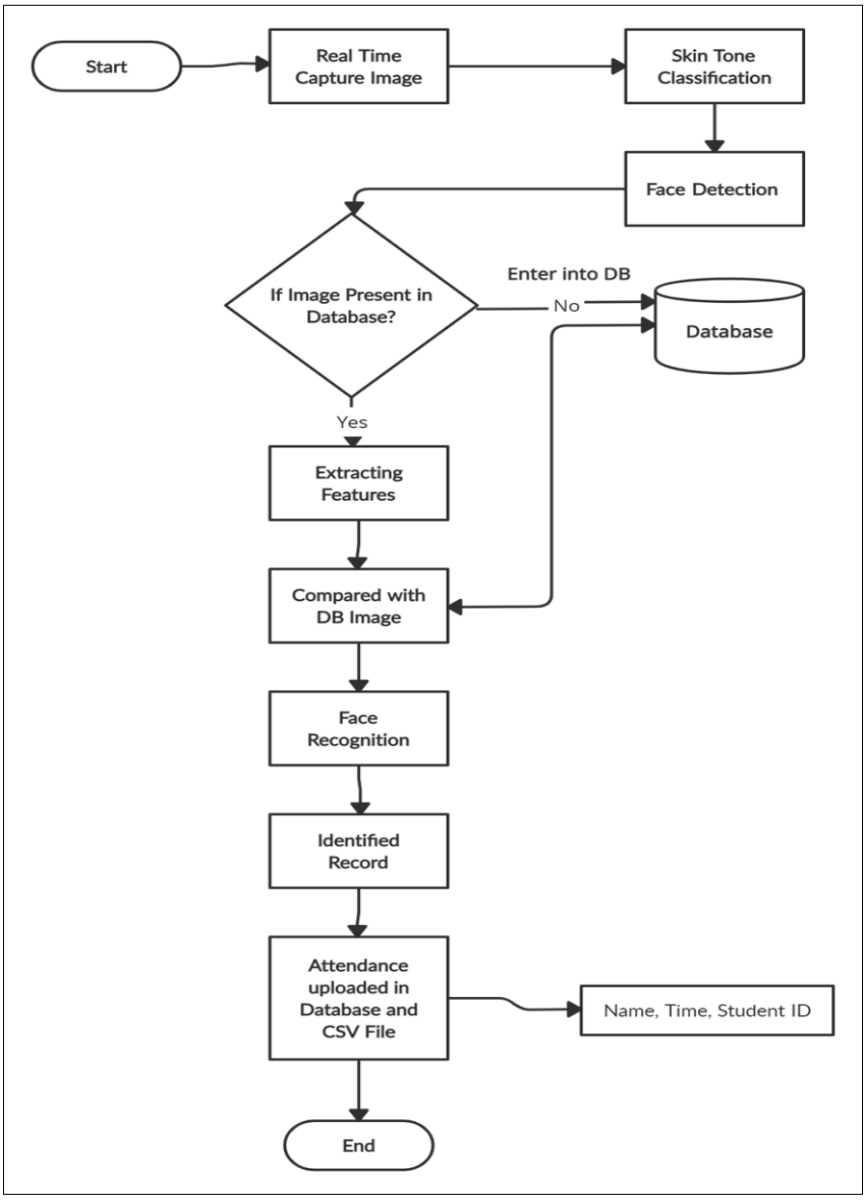

Figure 4 Research Flow-Chart of the Proposed System

3.4. Implementation and Deployment

3.4.1. Installing Python

The first step is to install Python on the computer. Installation using the python.exe file according to the instructions on the screen as shown in Figure 5 below

Figure 5 Open Python Extension

3.4.2. Installing Pycharm

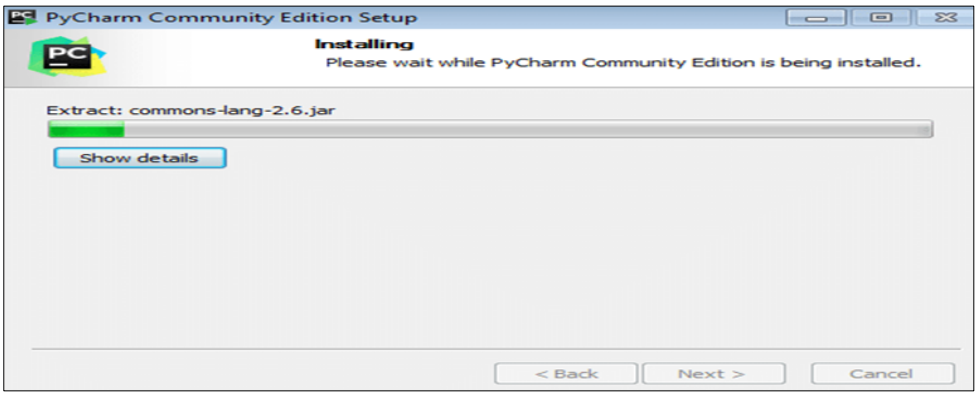

Figure 6 Setup Environment

3.4.3. Codes Implementation

- Basic Codes

```
import cv2
import face_recognition

imgAshik = face_recognition.load_image_file('ImagesBasic/Ashik.jpg')
imgAshik = cv2.cvtColor(imgElon,cv2.COLOR_BGR2RGB)
imgTest = face_recognition.load_image_file('ImagesBasic/Himel.jpg')
imgTest = cv2.cvtColor(imgTest,cv2.COLOR_BGR2RGB)

faceLoc = face_recognition.face_locations(imgAshik)[0].
encodeAshik = face_recognition.face_encodings(imgAshik)[0].
cv2.rectangle(imgElon,(faceLoc[3].,faceLoc[0].),(faceLoc[1].,faceLoc[2].),(255,0,255),2)

faceLocTest = face_recognition.face_locations(imgTest)[0].
```

```
encodeTest = face_recognition.face_encodings(imgTest)[0].
cv2.rectangle(imgTest,(faceLocTest[3].,faceLocTest[0].),(faceLocTest[1].,faceLocTest[2].),(255,0,255),2)

results = face_recognition.compare_faces([encodeAshik].,encodeTest)
faceDis = face_recognition.face_distance([encodeAshik].,encodeTest)
print(results,faceDis)
cv2.putText(imgTest,f'{results} {round(faceDis[0].,2)}',(50,50),cv2.FONT_HERSHEY_COMPLEX,1,(0,0,255),2)

cv2.imshow('Ashik',imgAshik)
cv2.imshow('Ashik Test',imgTest)
cv2.waitKey(0)
```

- Main Codes

```
import numpy as np
import cmake as cm
import pandas as pd
import open-cv
import face_recognition

import os
from datetime import datetime
# from PIL import ImageGrab

path = 'ImagesAttendance'
images = [].
classNames = [].
myList = os.listdir(path)
print(myList)
for cl in myList:
curImg = cv2.imread(f'{path}/{cl}')
images.append(curImg)
classNames.append(os.path.splitext(cl)[0].)
print(classNames)

def findEncodings(images):
encodeList = [].
for img in images:
img = cv2.cvtColor(img, cv2.COLOR_BGR2RGB)
encode = face_recognition.face_encodings(img)[0].
encodeList.append(encode)
```

```
return encodeList

def markAttendance(name):
with open('Attendance.csv','r+') as f:
myDataList = f.readlines()
nameList = [].
for line in myDataList:
entry = line.split(',')
nameList.append(entry[0].)
if name not in nameList:
now = datetime.now()
dtString = now.strftime('%H:%M:%S')
f.writelines(f'n{name},{dtString}')

#### FOR CAPTURING SCREEN RATHER THAN WEBCAM
# def captureScreen(bbox=(300,300,690+300,530+300)):
# capScr = np.array(ImageGrab.grab(bbox))
# capScr = cv2.cvtColor(capScr, cv2.COLOR_RGB2BGR)
# return capScr

encodeListKnown = findEncodings(images)
print('Encoding Complete')

cap = cv2.VideoCapture(0)

while True:
success, img = cap.read()
#img = captureScreen()
imgS = cv2.resize(img,(0,0),None,0.25,0.25)
imgS = cv2.cvtColor(imgS, cv2.COLOR_BGR2RGB)

facesCurFrame = face_recognition.face_locations(imgS)
encodesCurFrame = face_recognition.face_encodings(imgS,facesCurFrame)

for encodeFace,faceLoc in zip(encodesCurFrame,facesCurFrame):
matches = face_recognition.compare_faces(encodeListKnown,encodeFace)
faceDis = face_recognition.face_distance(encodeListKnown,encodeFace)
#print(faceDis)
matchIndex = np.argmin(faceDis)

if matches[matchIndex].:
name = classNames[matchIndex].upper()
```

```
#print(name)
y1,x2,y2,x1 = faceLoc
y1, x2, y2, x1 = y1*4,x2*4,y2*4,x1*4
cv2.rectangle(img,(x1,y1),(x2,y2),(0,255,0),2)
cv2.rectangle(img,(x1,y2-35),(x2,y2),(0,255,0),cv2.FILLED)
cv2.putText(img,name,(x1+6,y2-6),cv2.FONT_HERSHEY_COMPLEX,1,(255,255,255),2)
markAttendance(name)

cv2.imshow('Webcam',img)
cv2.waitKey(1)
```

- Labeling Unknown faces

```
if faceDis[matchIndex].< 0.50:
name = classNames[matchIndex].upper()
markAttendance(name)
else: name = 'Unknown'
#print(name)
y1,x2,y2,x1 = faceLoc
y1, x2, y2, x1 = y1*4,x2*4,y2*4,x1*4
cv2.rectangle(img,(x1,y1),(x2,y2),(0,255,0),2)
cv2.rectangle(img,(x1,y2-35),(x2,y2),(0,255,0),cv2.FILLED)
cv2.putText(img,name,(x1+6,y2-6),cv2.FONT_HERSHEY_COMPLEX,1,(255,255,255),2)
```

4. Result and Discussion

In every period, respective lecturer will enter their course details. After submitting details, camera will start automatically to make attendance.

In the Figure 7 shows the face recognition-processing window where one-registered students are recognized by system and if they were not registered, it will show 'unknown', then attendance will be updated in the CSV excel sheet and names of absentees will be stored in the systems to the respective faculty.

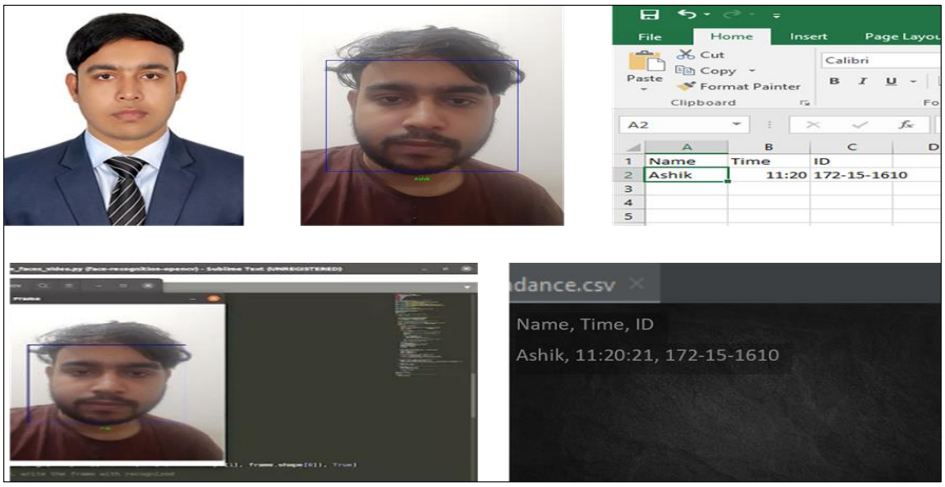

Figure 7 Sample Final Research

5. Conclusion

Before creating this project. The old method to taking attendance created many problems for almost all organizations. There were many loopholes in the process, time consuming and less productive that caused many difficulties.

In this paper, we have proposed a real time attendance system based on face recognition, which provide timesaving, high security, automated easy time tracking, no proxy attendance, easy to manage, smart integration and more accurate services. The proposed system will be able to mark the attendance via facial recognition. It will detect faces via face camera and then recognize them. After recognition, it will mark the attendance of recognized users and update the attendance record.

In the future, is to improve recognition rate, more security, reliable, user friendly and covert this into high integrated system and using available advance tools, the current project can be modified by infrared camera interfacing, it can be used in smart surveillance monitoring security system.

Compliance with ethical standards

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Disclosure of conflict of interest

There are no conflict of interest at this manuscript.

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