Automated Entrance Authorization System

Final Year Project

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Automated Entrance Authorization System

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Abstract

In this report of the Automated Entrance Authorization System, all aspects of the mentioned system are discussed and explained. The necessity of this system raised due to Covid-19 pandemic. Due to the Covid pandemic people need to distance themselves from each other, but daily life cannot stop. Individual cannot lose our time and money. This system is also aiming to do this task; it can allow entrance to schools, colleges, universities and workplaces without touching anything for identification. Students, teachers and staff at institutions can walk in the campus freely with this hassle free, clean and secure system. They do not have to worry about touching any infected thing. The whole World is in a difficult situation due to Covid-19. Pakistan is going through tough times. New corona cases have reached 5,152 till today (19, April 2021). And Death toll is around 16,316 since March 2020 till today. Despite all the safety precautions the condition is worsening. This project is an effort to reduce physical interaction with any machine or person while entering your workplace and/or home etc. Airports, banks and events are using facial recognition for entrance. These systems are very successful and working in many developed countries. This is built on Python language using different algorithms. This system is to use Raspberry Pi which has a limited processing power and memory, so it needed an algorithm which is light weight as well as accurate. So, this program is using MobileNet Architecture which is a Convolutional Neural Network (CNN) for deep learning in facemask detection. And Viola-Jones Algorithm/Haar Cascade Classifiers is being used for facial recognition. The system will be considered complete when the accuracy of the system lies between 95-99% for facial recognition, 85-90% for mask detection and ±0.2°C for temperature measurement. The system will perform each task within a minimum amount of time possible and with maximum efficiency. To conclude, this system is an aid or facilitation in reducing workload, securing entrance authorization and ensuring health safety measures.

Acknowledgement

First and foremost, we thank Allah Almighty. Our instructors have been our strength throughout this project. We are very thankful to our parents and teachers for their support. We specially give our gratitude towards our primary advisor Sir Ali Faheem who has helped us throughout the way to accomplish the target by leading us from the problems and pros and cons of the system. This project is made possible because of our parents' prayers, our teachers' support and the department's tireless effort to provide the best facilities. And at last we want to thank ourselves for the support and cooperation we have received from each other.

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Revision History

Name	**Date**	**Reason For Changes**	**Version**
1st Draft	03-05-2021	Many issues like; formatting, references, abstract, introduction and some other sections.	1
Revision	26-05-2021	Citations and some changes in content of different sections	2
Revision	30-05-2021	Formatting and some new screenshots	3
Revision	05-07-2021	Changes in Literature Review, Non Functional Requirements and Architecture Evaluation	4

Chapter 1. Introduction

1.1 Introduction

The necessity of Automated Entrance Authorization system arised because of the Covid-19 pandemic. The Corona virus is attacking once more and again the whole World is suffering from it. People take safety precautions like distancing themselves from others, wearing face masks, using sanitizers and by following other SOPs given by the World Health Organization (WHO). In spite of our best efforts, the population is facing the third wave of this worldwide pandemic. Considering this, the mentioned project is another measure to keep us secure and safe at the same time by distancing. Making individuals free of barcode and thumb scanning so that physical contact can be to a minimum level. It will be an Automated Entrance System using face recognition. It will also measure body temperature and check whether the individual is wearing a facemask or not; allowing entrance only to authorized individuals with proper health safety measures. If in case a person fails to pass any of the tests, the system will not allow the entrance to him. It is a hardware embedded system working on Raspberry Pi using deep learning with Python. This system has a wide usability, it can be used at any place where people enter for work or to stay.

1.2 Objectives

The primary objective of this system is to offer a system that simplifies and automates the process of entrance without physical contact, through facial recognition, mask detection and body temperature measurement. In today's pandemic conditions, physical distance from each other is mandatory. Following the SOPs people have to avoid physical contact, wear facemasks and keep their distance. It is a biometric technology, aiming to recognize a person from a camera. Additionally, we seek to:

- Provide a valuable service to teachers, students and staff by granting entrance without any physical interaction.
- Bring down manual process errors by providing a reliable automated system.
- Increase security and privacy as no other unauthorized person can enter the premises.

1.3 Problem Statement

As of the current Coronavirus situation and in accordance with the SOPs provided by WHO (World Health Organization) people need to distance themselves from each other and wear facemasks while also avoiding any direct or indirect contact with things around them. This system is an idea to keep people in contact free while entering a place of work, especially in our educational institutions. It is a hardware embedded system working on Raspberry Pi using deep learning with Python.

1.4 Scope

The final product will enable the users to avoid physical interaction with the public devices and grant the access to the authorized users by facial recognition, mask detection and by measuring their body temperature. Through these measures, taken by this system human workload and physical interaction will be significantly reduced. This system can be used at entrances at schools, offices and events.

Automated Entrance Authorization System can be used at the entrance of places of work, airports, educational institutions, banks and events among many others. This system provides proper security by granting entrance to only authorized people, also checking if proper health safety measures are taken. Schools, colleges and universities can use this system at their entrances. They have to add students, teachers and staff in databases, after that the system checks whether the person in front of the camera is allowed to enter the premises or not, also whether the person is wearing a facemask or not and whether his/her body temperature is in the acceptable range or not. If all these conditions are met only then the system grants entrance to the person.

Chapter 2. Requirements Analysis

2.1 Literature Review

Face Recognition technology is being used widely now-a-days. Airports in developed countries are starting to use face recognition for boarding. They have passports which are compatible with facial recognition. This method replaces the conventional boarding method of screening your ticket and passport. So, they go through a hassle-free system without any effort.

National Australia Bank has joined forces with Microsoft for unlocking cash machines with face scan due to ATM crimes in those areas. It is a cloud-based system, designed with the use of Azure Cognitive Services, and it is developed to better the customer service by removing the demand for physical cards or devices to access cash from ATMs. Through this construct, a customer who joined the program is capable to withdraw cash from an ATM with the use of facial recognition technology and a PIN.

The San Francisco-based company developed the Mask detector in early times, when they heard about COVID-19 in 2020. The purpose was to comply with the public needs in order to calculate the face mask demand in surroundings and to check how many people are wearing the mask and try to take precautions for others as well as themselves.

Severe acute respiratory syndrome (SARS) spread in Asia in 2013. IRT was the method to measure body temperature. A surface emits thermal energy when the temperature is higher than the absolute temperature. The IR thermometer detects this released energy through the sensing element and converts it into an electrical signal. In 2014 five airports of USA used IRT to detect Ebola infection.

Brit Awards and National Television Awards at The O2, London used facial recognition for entrance by scanning their guests' faces via multiple booths at entrances.

2.2 User Classes and Characteristics

The system gives access only to the authorized users. In case of AEAS (Automated Entrance Authorization System), authorized users are students, faculty members and the staff.

Administrator: The administrator have the admin access to add, delete and modify end-user’s data stored in the database.

1) Administrator must be an employee of the organization.
2) He/She must have the knowledge of the software life cycle.
3) He/She must know how to operate an OS.

2.3 Design and Implementation Constraints

1. Memory: The device has a memory of 8 GB.
2. Secondary Memory: Raspberry Pi have a SD card slot and a program can read and write in that card. The program cannot exceed the amount of SD card's memory.
3. Language Requirements: Software uses Python 3 and its extended libraries.

2.4 Assumptions and Dependencies

It is acknowledged that the hardware design works correctly with the third-party operating system (Raspberry Pi OS, Raspbian) and the developed computer software. Because system acquires new updates, the user must have access to make changes. Updates should be done from time to time to minimize the inconvenience in the system.

2.5 System Features / Functional Requirements

Since Automated Entrance Authorization System consists of three major parts named Facial Recogniser, Mask Detector and Temperature Measurer, so functional requirements are examined in three parts:

- Functional Requirements of Facial Recogniser
- Functional Requirements of Mask Detector
- Functional Requirements of Temperature Measurer

Functional Requirements of Facial Recogniser
There are three features of this which are described below:
Pattern: This feature provides the ability to draw a pattern on the face for detection.
Description and Priority: If the user brings his/her face in front of the camera, the pattern of his facial features are matched with the pattern of facial features in the database. Detection of the face pattern is done by Facial Recogniser, so this function is between the user and the FR.
Stimulus and Priority:
Basic Data Flow:

1. First of all, the user brings his/her face in front of the camera

2. The state/movement of the face is detected by the camera.
3. The face is recognised by the camera.
4. The result of the real-time scenario is displayed on the screen.

Functional Requirements of Mask Detector

There are three features of this which are described below:

Pattern: This feature provides the ability to draw a pattern on the face which is having a mask for detection.

Description and Priority: After face recognition is done, the user's mask is to be detected next. Detection of the mask is done by the Mask Detector, so this function is between the user and the MD.

Stimulus and Priority:

Basic Data Flow:

1. First of all, the user brings his/her face in front of the camera.
2. The state/movement of the face’s mask is detected by the camera.
3. The mask is recognised by the camera.
4. The result of the real-time scenario is displayed on the screen.

2.5.1 PIR (Motion Sensor)

Identifier	PIR (Motion Sensor)	
Purpose	To detect any person in front of camera for entrance	
Priority	Medium	
Pre-conditions	System powered on (Red light)	
Post-conditions	Camera module starts working	
Typical Course of Action		
S#	**Actor Action**	**System Response**
1	A user comes in front of the system	PIR detects motion and sends signal to camera module
Alternate Course of Action		
S#	**Actor Action**	**System Response**
1	No one is in front of system	Only PIR is working other features on standby

Table 1: UC-1

2.5.2 Face Recognition

Identifier	Face Recognition		
Purpose	To recognise any person's face in front of camera		
Priority	High		
Pre-conditions	A person in proximity (1st Orange light)		
Post-conditions	Facemask detection starts working		
Typical Course of Action			
S#	**Actor Action**		**System Response**
1	A user comes in front of the system		PIR detects motion and sends signal to camera module
2			Camera module looks up the person's face in database
Alternate Course of Action			
S#	**Actor Action**		**System Response**
1	No one is in front of system		Only PIR is working other features on stand by

Table 2: UC-2

2.5.3 Facemask Detection

Identifier	Facemask Detection	
Purpose	To detect if the person is wearing facemask	
Priority	High	
Pre-conditions	User is authorized to enter (2nd Orange light)	
Post-conditions	Temperature module starts measuring temperature	
Typical Course of Action		
S#	**Actor Action**	**System Response**
1	A user comes in front of the system	PIR detects motion and sends signal to camera module
2		Camera module looks up the person's face in database
3		Facemask detected
Alternate Course of Action		
S#	**Actor Action**	**System Response**
1	No one is in front of system	Only PIR is working other features on stand by

Table 3: UC-3

2.5.4 Temperature Measurement

Identifier	Temperature Measurement		
Purpose	To measure temperature of person entering		
Priority	Medium		
Pre-conditions	Facemask should be detected (3rd Orange light)		
Post-conditions	Grant entrance by moving the bar		
Typical Course of Action			
S#	**Actor Action**	**System Response**	
1	A user comes in front of the system	PIR detects motion and sends signal to camera module	
2		Camera module looks up the person's face in database	
3		Facemask detected	
4		Measures temperature	
Alternate Course of Action			
S#	**Actor Action**	**System Response**	
1	No one is in front of system	Only PIR is working other features on stand by	

Table 4: UC-4

2.5.5 Grant Entrance

Identifier	Grant Entrance
Purpose	To grant entrance by moving the bar up
Priority	Medium
Pre-conditions	All the 3 conditions are met/All 3 orange lights and then green light.
Post-conditions	Bar is down and the system is reset for new a user

Typical Course of Action		
S#	**Actor Action**	**System Response**
1	A user comes in front of the system	PIR detects motion and sends signal to camera module
2		Camera module looks up the person's face in database
3		Facemask detected
4		Measures temperature
5		Allows person to pass
Alternate Course of Action		
S#	**Actor Action**	**System Response**
1	A user comes in front of the system	PIR detects motion and sends signal to camera module

Table 5: UC-5

2.6 Use Case Diagram

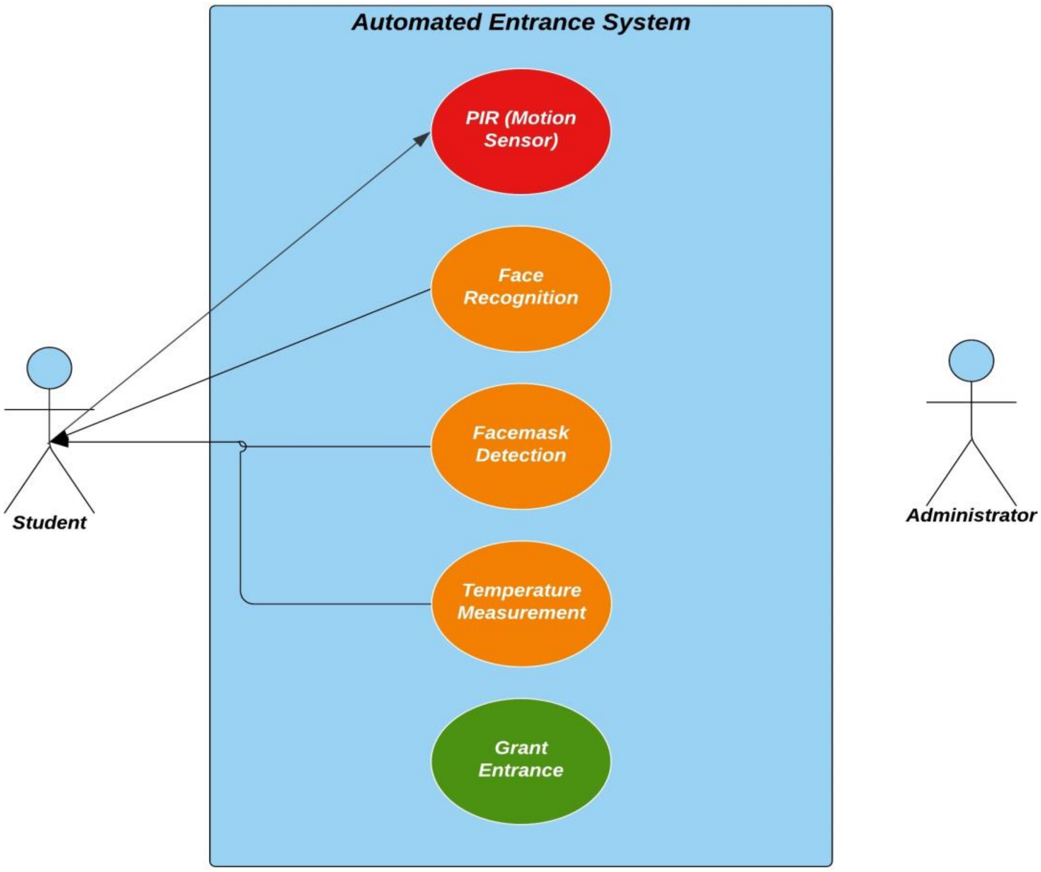

Figure 1: Use Case Diagram

In Figure 1, use case diagram of the system is shown which tells the relationship between user, the system and the administration.

2.7 Nonfunctional Requirements

2.7.1 Performance Requirements

The system must be interactive, and the delays involved must be less. So, in every action-response of the system, there are no immediate delays. In the case of popping error messages, evaluations, there are no delays less than a couple of seconds. This is also applicable on the computation for greater than 95% of the Information stored regarding the registered users.

2.7.2 Safety Requirements

There are less risks involved in the system as the developers try their best to develop something which is not crashing as the functionalities are fulfilling their tasks as per their assignment in a defined pattern.

2.7.3 Security Requirements

The security requirements of the system are the primary one. The product is be handled only by the administrator and the authorized users. Only the administrator has the rights to assign permissions like creating new accounts and handling them. Only the authorized users, who are created by the administrator, get the access for entrance.

2.7.4 Additional Software Quality Attributes

Reliability:

The reliability of our system is stated in terms of measurements. Measurements are taken during testing when we are collecting and analyzing data about the performance of the software. In other words, is tracking the occurrence of failures during testing.

Usability:

In general, the system is easier to use in order to obtain the desired goal. Since it is a real-time surveillance, therefore users find it quite easy to use.

Portability:

The system is Hardware Oriented composed of both hardware and software components. It is built in Python modules and the Hardware is Raspbian having an OS. So, it is a system dependent on the hardware and the operating system.

Correctness:

Correctness includes the output of the system. Our system is giving an accuracy in a bracket of 95%. It follows IEEE standards of documentation.

Efficiency:

The Raspberry Pi has a processor of 2.4GHz and a RAM of 8GB. So, there is quite a chance that the system gets slow. Moreover, AEAS does not eat up the whole of the memory of our Raspberry as we are placing a feature of motion detection. This allows the system to wake only when a person is being sensed otherwise it is on sleeping mode. So, in this way the system is quite efficient.

Integrity or Security:

In every existing system, integrity comes with the help of security. In the case of AEAS, prevention of unauthorized access to system functions, preventing information loss, ensuring that the software is protected from virus infection, and protecting the privacy of data entered the system. It is so because only the admin has the right to make changes, no external device can be connected to the system and lastly no internet connection is given so there are no chances of viruses in the system.

Availability:

In general, the system is available for fulfilling the assigned tasks. Since the team is ensuring a top-notch availability, therefore the repairing of operating faults is done in a minimum amount of time so that service does not outrage for long.

Robustness:

The only condition that is affecting the working of the system is external. This includes the weather conditions. The system should not be placed in damp, moist or extremely hot conditions. This can result in system failure and ultimately the product dies.

2.8 Other Requirements

For information regarding nonfunctional requirements, refer to section 2.5: “System Features”. Each feature has its requirements listed alongside the feature information. There are no additional functional requirements.

Chapter 3. System Design

3.1 Application and Data Architecture

This system is hardware embedded which runs on Raspberry Pi. It has camera and temperature modules embedded on it. The face recognition function requires a dataset of faces of authorized people. The facial recognition part retrieves features of faces in a real time process. The facemask function does not require a dataset in real time as it is pre-trained model, checking the facemask of the person in front of the camera. The temperature function measures temperature using the IR temperature module.

Programming Language	Python (3.8)
System	Custom Built
Hardware Platform	Raspberry Pi 4 (8GB)
Architecture	Client side
Database	No Database
System host	Local Host on any machine
Processing	Analytical Report
Network architecture	WLAN and Local host
Built Functions	Image recognition
Ingrained system	CPU
Data Training	GPU for fast training and better accuracy
Frame work	Tensorflow, OpenCV, Numpy. Scipy, Keras

Table 6: System Information

3.2 Component Interactions and Collaborations

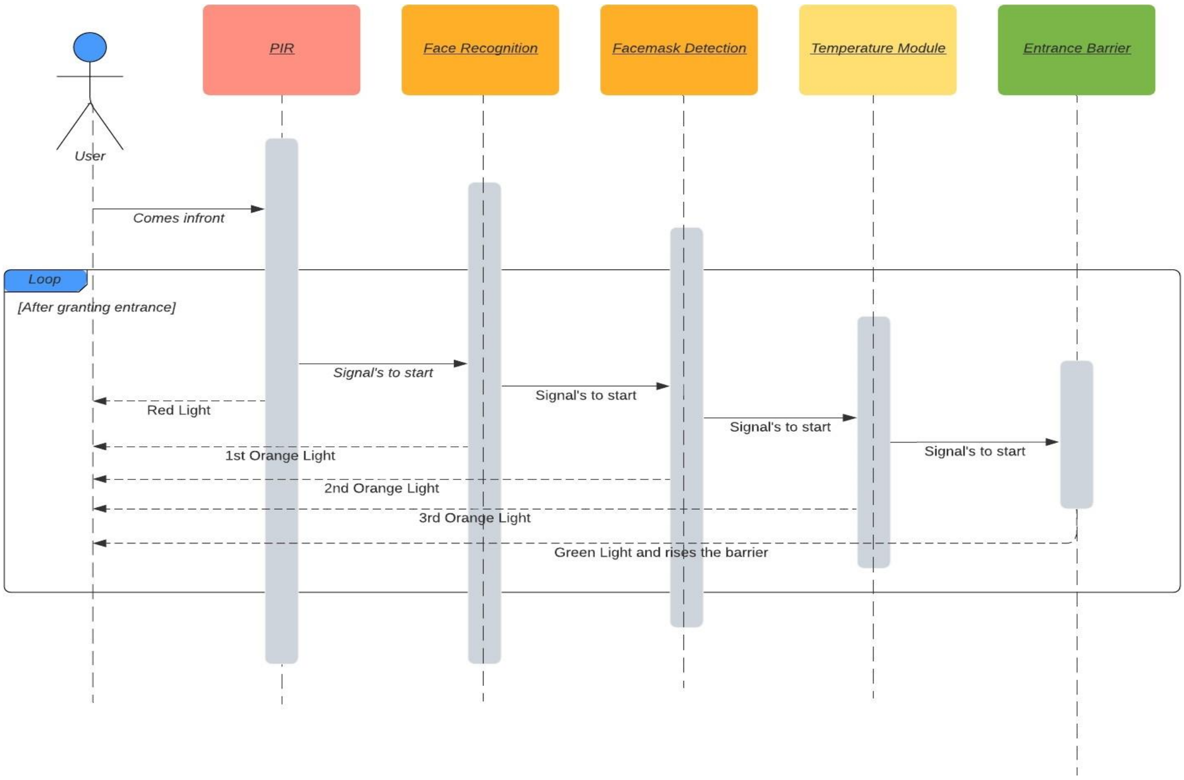

Figure 2: Sequence Diagram

In Figure 2 the sequence diagram of the system is shown which represents the sequence of actions inside and outside the system.

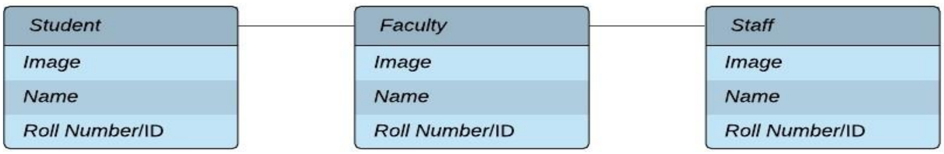

Figure 3: ER Diagram

In Figure 3 the Entity Relationship diagram of the system is shown which represents the relationship and links between different entities of the Automated Entrance Authorization System.

3.3 System Architecture

Technical Architecture:

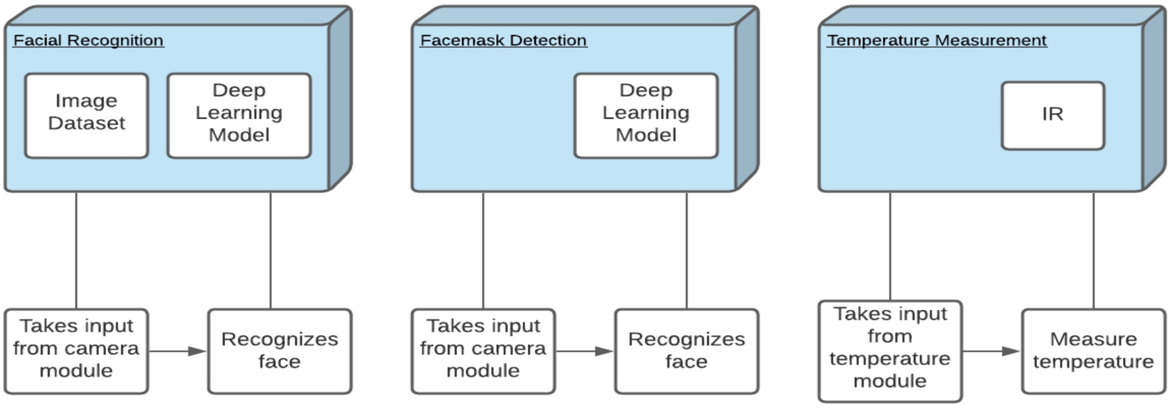

Figure 4: Technical Architecture

In Figure 4 the Technical Architecture of the system is shown which tells system architecture used for different features and the whole system combined.

3.4 Architecture Evaluation

For object detection, the similarities and differences between CNN and Haar Cascade Classifiers were studied. We used the following characteristics to assess and estimate the quality and the performance of various methodologies for real-time object detection and detecting objects from images, see Figure 5.

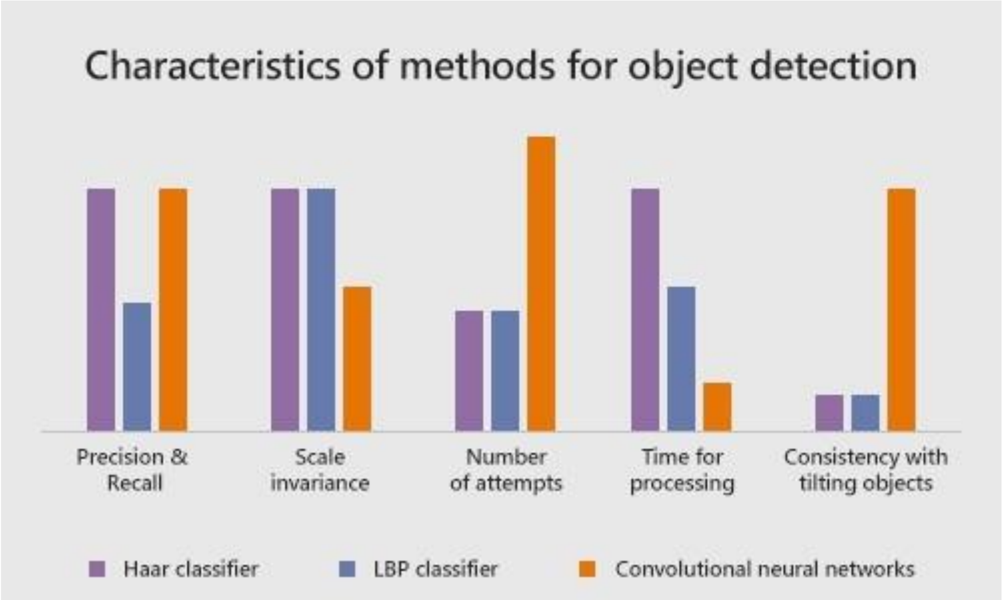

Figure 5: Characteristics of methods of object detection

Accuracy (Precision)

CNN and Haar Cascade Classifiers, both have comparatively a high level of accuracy when they are detecting objects in the images. Simultaneously, the LBP classifier has a high percentile value of false positives and a low accuracy.

Scale Consistency (Invariance)

Due a very strong invariance i.e., remaining constant, objects can be handled and managed quite easily by Haar Cascade and LPB Classifiers. Whereas, due to very low scale invariance, the CNN cannot handle and manage the scaling objects.

Number of Experiments (For Working Model)

For object detection, a very few experiments are by the Cascade Classifiers to get a working model whereas on the other hand dozens of attempts are required by the CNN and it is not so fast.

Processing Overhead (Time)

For processing, a CNN does not require much time. On the other hand, the LBP Classifier also does not require much time too. On contrary, Haar Cascades take a much longer time to carry their processes.

Consistency with Tilting Objects

With tilting objects, another extraordinary advantage of the CNN is that it remains consistent. Whereas on the other side, in this case, the Cascades are not consistent.

In several scenarios and cases, the CNN beats the Cascade Classifiers. If the objects do not scale much and you have sufficient time to train the model, it is an intelligent approach to use Convolutional Neural Network.

3.5 Component-External Entities Interface

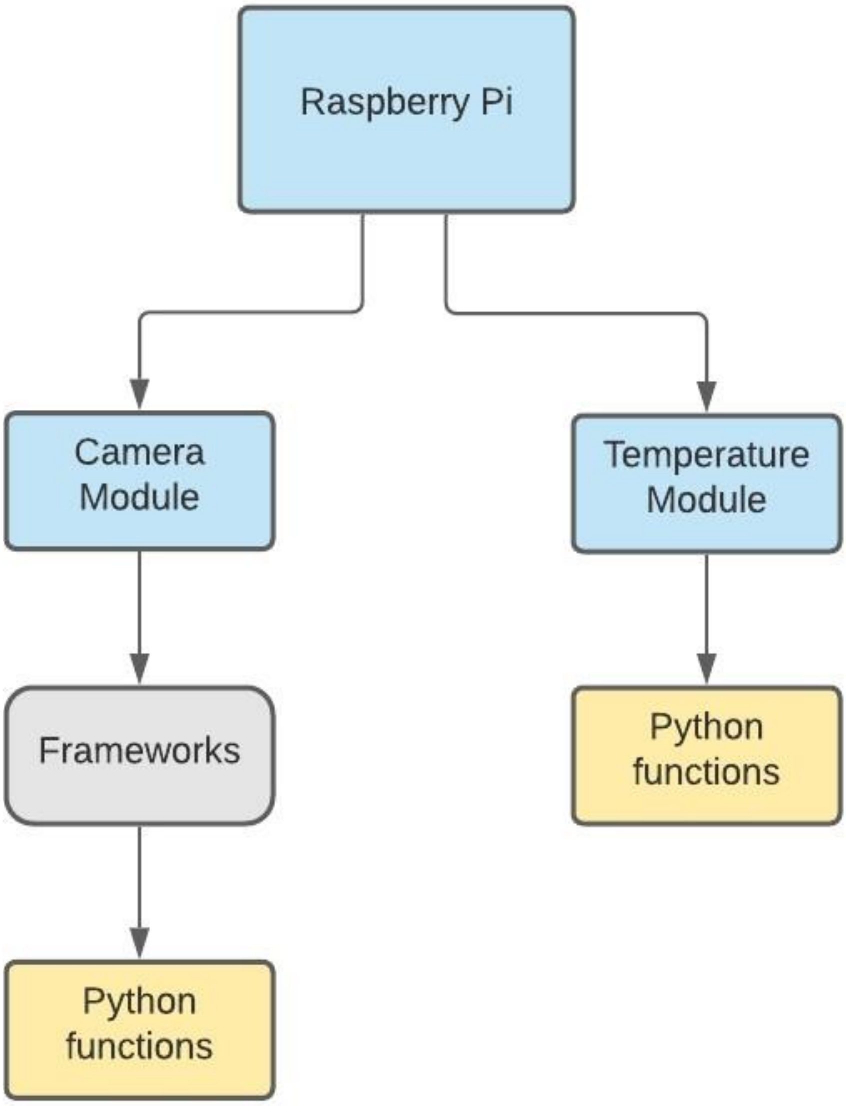

Figure 6: Component-Component Interaction

In Figure 6 component to component interaction of the Automated Entrance Authorization System is shown which shows how different components of the system interacts with each other.

3.6 Screenshots/Prototype

3.6.1 Workflow

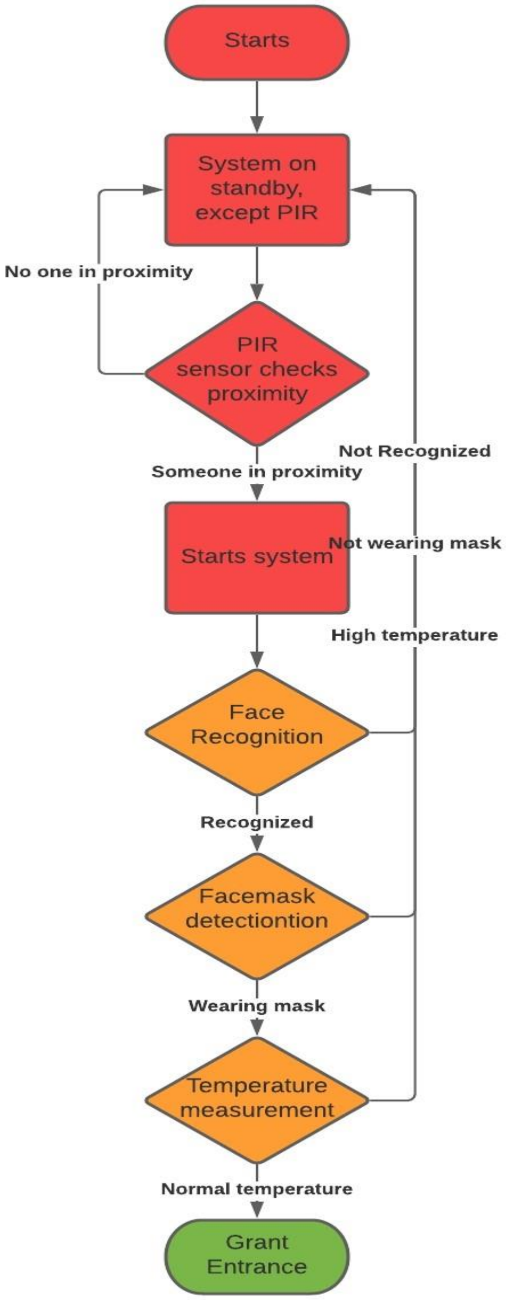

Figure 7: Workflow Flowchart

In Figure 7 workflow of the Automated Entrance Authorization System is shown which shows how the system works from start to end.

3.6.2 Screens

Screenshots of working face recognition and facemask detection functions.

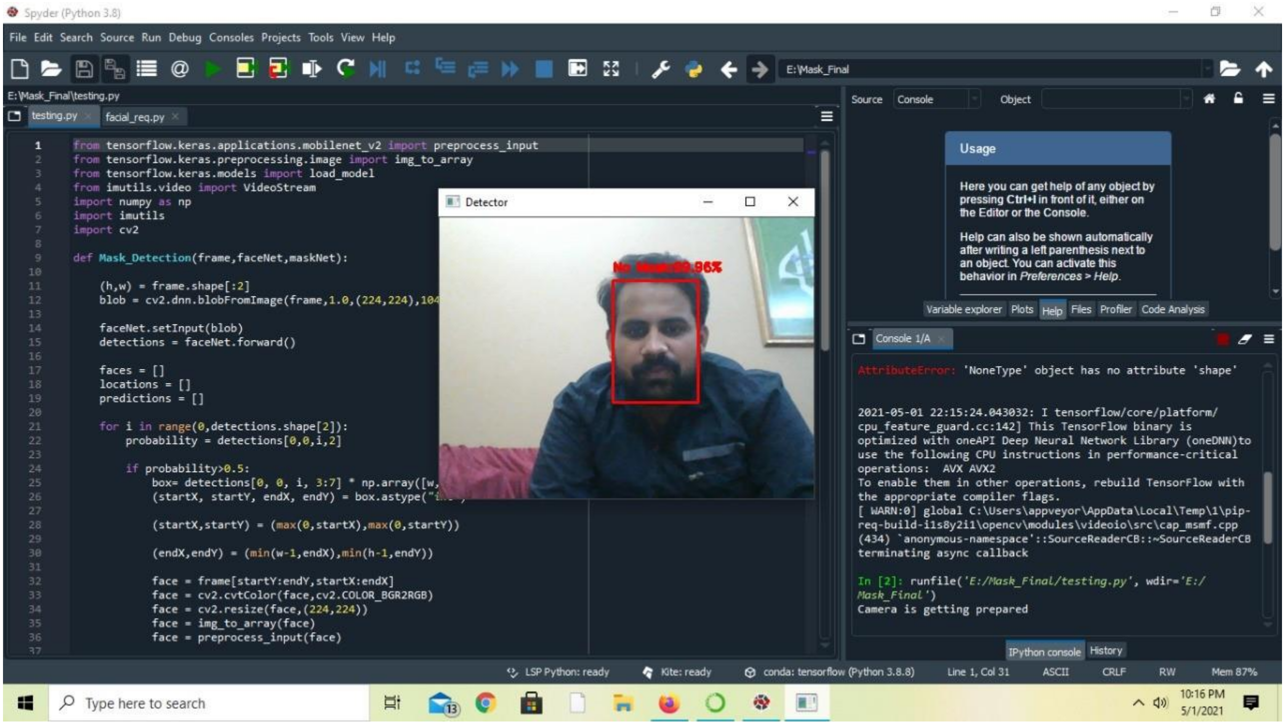

Figure 8: Screenshot 1

In Figure 8, working of system is shown when there is no mask on the face of a person.

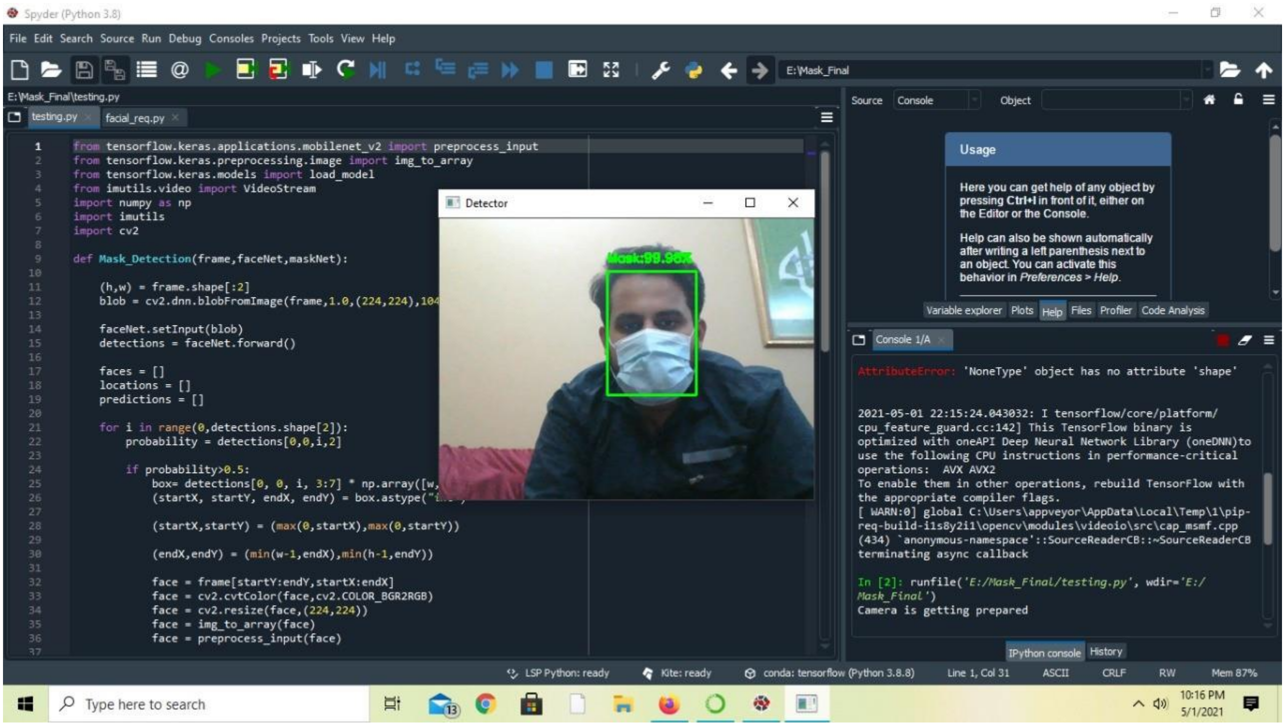

Figure 9: Screenshot 2

In Figure 9, working of system is shown when there is a mask on the face of a person.

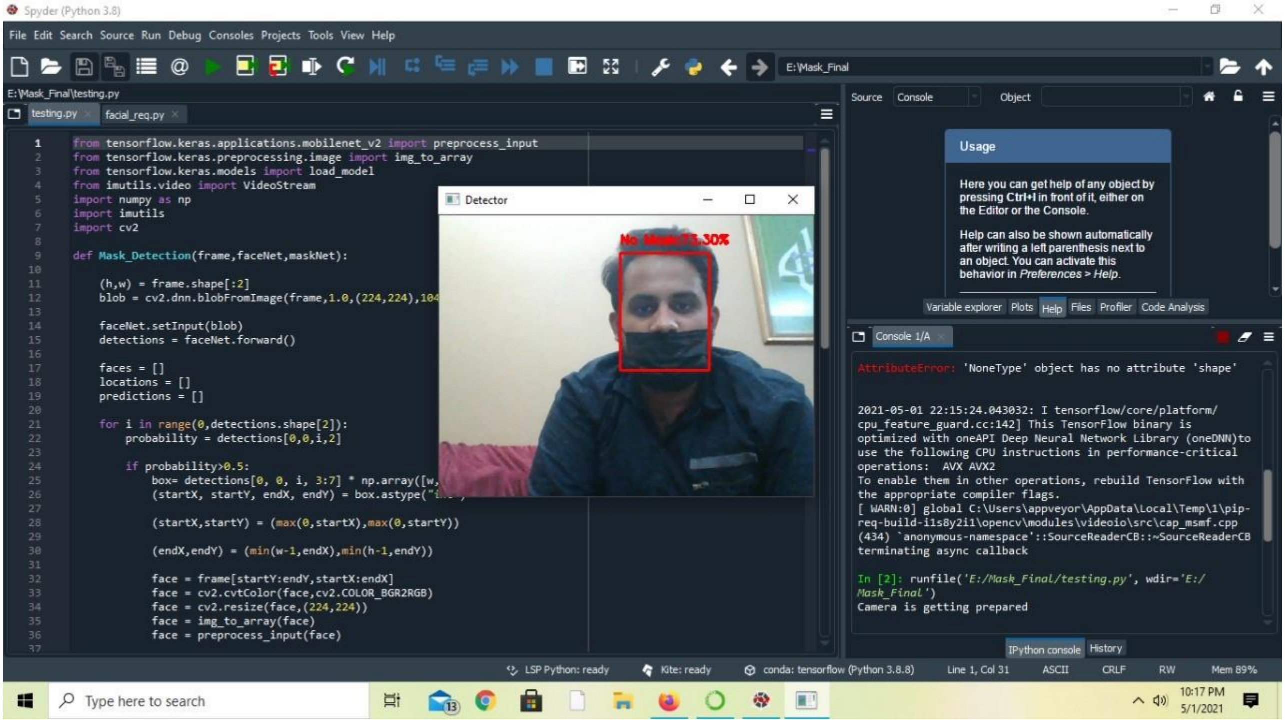

Figure 10: Screenshot 3

In Figure 10, working of the system is shown when the mask is below the nose.

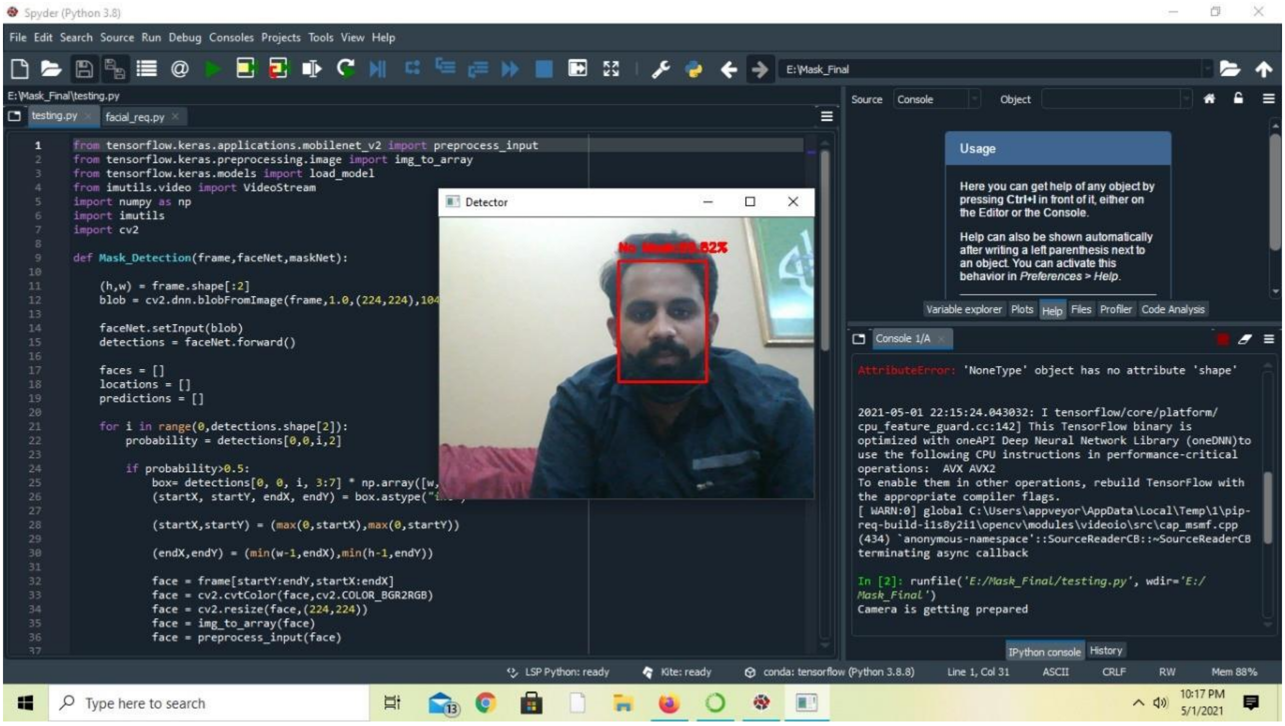

Figure 11: Screenshot 4

In Figure 11, working of the system is shown when the mask is on chin.

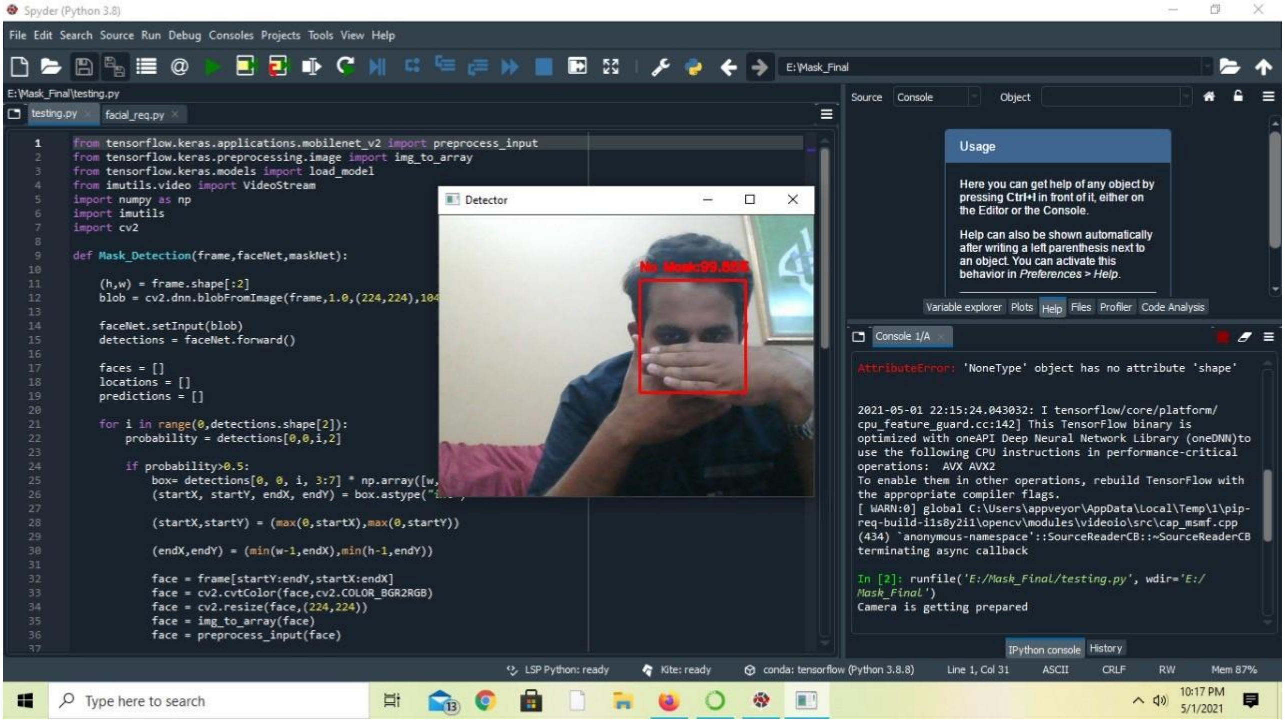

Figure 12: Screenshot 5

In Figure 12, working of the system is shown when the person is trying to cheat with the system by put hands on the face instead of mask.

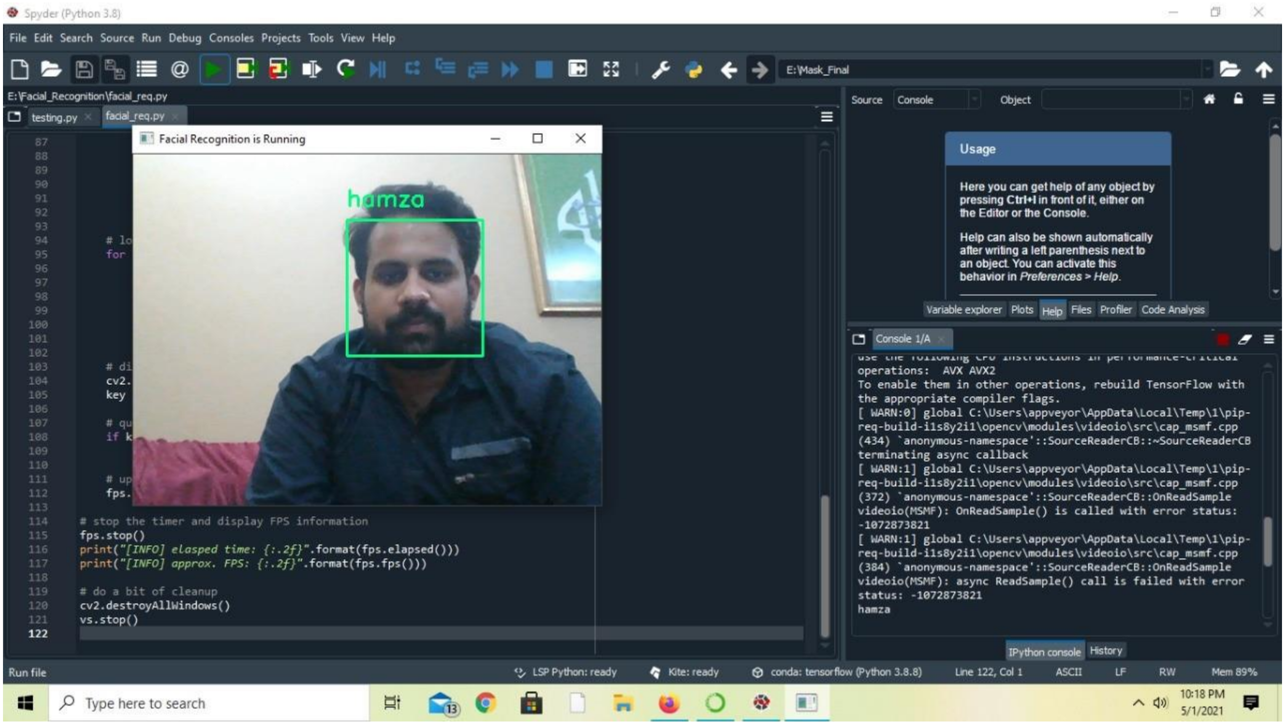

Figure 13: Screenshot 6

In Figure 13, working of face-detector is shown

3.7 Other Design Details

The project can be run on any python interpreter. You can use Jupyter notebook, PyCharm Professional, Anaconda etc. This design details includes the dependencies of the packages installed able to run the project. NumPy, SciPy, OpenCV, TensorFlow, Keras among other libraries and frameworks were used.

Chapter 4. Test Specification and Results

4.1 Test Case Specification

Identifier	TC-1
Related requirements(s)	Face recognition
Short description	This function recognises a face from camera using given dataset
Pre-condition(s)	Person’s face should be in the dataset
Input data	Face image
Detailed steps	Deep learning model recognizes the face
Expected result(s)	Accurate face recognition
Post-condition(s)	Move towards next function (facemask detection)
Actual result(s)	Accurate face recognition
Test Case Result	Accurate face recognition

Table 7.1: TC-1

Identifier	TC-2
Related requirements(s)	Facemask detection
Short description	This function detects a facemask from camera
Pre-condition(s)	Person should be authorized
Input data	Face image
Detailed steps	Deep learning model detects the facemask
Expected result(s)	Accurate facemask detection
Post-condition(s)	Move towards next function (temperature measurement)
Actual result(s)	Accurate facemask detection
Test Case Result	Accurate facemask detection

Table 7.2: TC-2

Identifier	TC-3
Related requirements(s)	Temperature Measurement
Short description	This function measure temperature
Pre-condition(s)	Person should be authorized to enter
Input data	IR
Detailed steps	IR sensor measures temperature
Expected result(s)	Measure temperature
Post-condition(s)	Move towards next function
Actual result(s)	Measuring accurate temperature
Test Case Result	Turns off automatically

Table 7.3: TC-3

Identifier	TC-4
Related requirements(s)	Temperature Measurement
Short description	This function measure temperature
Pre-condition(s)	Person should be authorized to enter
Input data	IR
Detailed steps	IR sensor measures temperature
Expected result(s)	Measure temperature
Post-condition(s)	Move towards next function
Actual result(s)	Measuring accurate temperature
Test Case Result	Measuring accurate temperature

Table 7.4: TC-4

4.2 Summary of Test Results

Module Name	Test cases run	Number of defects found	Number of defects corrected so far	Number of defects still need to be corrected
Face recognition	TC1	0	0	0
Facemask Detection	TC 2	0	0	0
Temperature measurement	TC 3	1	1	0
Temperature measurement	TC 4	0	0	0
Complete System	4	1	1	0

Table 7.5: Summary of All Test Results

Chapter 5. Conclusion and Future Work

5.1 Project summary

This project has provided a safe and secure solution for entrance by allowing a contactless entry, checking facemask and temperature alongside face recognition. It becomes a need in keeping with the current pandemic situation, where everyone is worried about their health and taking precautionary measures. This system provides an entrance system with facial recognition, mask detection and temperature measurement. Making it very useful and productive in most environments.

5.2 Problems faced and lessons learned

Many problems were faced during the completion of this project. First, it is a huge project. It was a difficult task to learn and implement. We had no prior knowledge of computer vision and different modules.

No Physical meetings were held which was a huge difficulty. Help of the Instructors was very limited as we were working remotely for the entire year. It was difficult for us to manage time and our team.

We had many technical problems like working on code and hardware. The temperature sensor was making the Raspberry Pi trip, after trying many different solutions we found out that the problem was with the soldering of wires.

We learned a lot of different things like all the modules, libraries and frameworks. We learned a great lesson that by mutual understanding, communication and support we can achieve great things.

5.3 Future work

In future versions of this system an LCD can be embedded with it, showing user activity and interacting with the user so that the system can be more user friendly.

A database of authorized people can be included so that it can be used for a large number of people.

The system can be linked to the cloud, so that the administrator can see any activity related to the system.

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Appendix A Glossary

AEAS - Automated Entrance Authorization System

OS - Operating System. An operating system (OS) is system software that manages computer hardware, software resources, and provides common services for computer programs.

FR - Facial Recognition. Facial recognition is a way of identifying or confirming an individual's identity using their face.

HDMI - High Definition Multimedia Interface. The most frequently used HD signal for transferring both high definition audio and video over a single cable.

MD - Mask Detector. It identifies whether a person is wearing a mask or not.

TM - Temperature Measurer. It measures the temperature.

Appendix B Deployment/Installation Guide

(Connect the System with Power Supply)

- Attach DC power with system.

(Connect the System with Internet)

- Take any PC or Laptop (installed environment)
- Connect the AEAS with the same Internet connection on which Laptop or PC is connected

(Create Data Set)

- Create data set according to the requirements.

(Execution)

- The system is ready to perform its task according to the given data set.

Appendix C User Manual

This document introduces the interaction with the system.

- Hardware needs a consistent DC power supply.

Mask Detection:

- In order to get your mask checked, bring face in front of the camera with mask. To pass this check, mask should properly worn. If mask is placed under the nose the condition will not be fulfilled and it will not move to the next step. If the face is not recognized in 10 seconds the system will restart and it starts again. After restarting it checks for a motion to be detected.

Facial Recognition:

- In order to get your face recognized, bring your face in front of the camera. If the face is not recognized in 10 seconds the system will restart and it starts again from the step of mask detection.

Temperature Measurement:

- In order to get your body temperature measured, bring your hand close to the sensor. System will measure your body temperature and compare it with optimum temperature. If and only if the temperature is less than or equal to the optimum temperature, the system will allow the access to the person.

Grant Entrance:

- After passing these three tests, the motor opens the barrier for the person for 5 seconds to let him pass through it. After the barrier comes back to its mean position, the system again looks for a motion to detect and perform all the three above mentioned functionalities.

Appendix D Student Information Sheet

Roll No	Name	Email Address (FC College)	Frequently Checked Email Address	Personal Cell Phone Number
20-10609	Rai Shahnawaz Khan	20-10609@formanite.fccollege.edu.pk	Daily	03040480845
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21-10563	Hamza Zahid	21-10563@formanite.fccollege.edu.pk	Daily	03224144766

Appendix E Plagiarism Free Certificate

This is to certify that, I am **Hamza Zahid** S/o **Zahid Taj Din**, group leader of FYP under registration no **3** at Computer Science Department, Forman Christian College (A Chartered University), Lahore. I declare that my final year project report is checked by my supervisor and the similarity index is **17**% that is less than 20%, an acceptable limit by HEC. Report is attached herewith as Appendix F. To the best of my knowledge and belief, the report contains no material previously published or written by another person except where due reference is made in the report itself.

Date:______________ Name of Group Leader:__________________________ Signature: ______________

Name of Supervisor: **Ali Faheem**	Co-Supervisor: **Maria Tamoor**
Designation: **Lecturer**	Designation: **Assistant Professor**
Signature:________________________	Signature: ______________________

Senior Project Management Committee Representative: ______________________

Signature: ______________________

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