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Design and development of IOT based temperature and mask scan entry system

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Abstract
We propose a fully automated temperature scanner and face mask detection entry provider system. In this system we make use of a contactless temperature scanner and a mask monitor. a person won't be provided entry without temperature and mask scan. Only person having both conditions is allowed inside. The system uses temperature sensor and camera connected with a raspberry pi system that regulates the entire operation. If an individual is flagged by system for top temperature or no Mask the system gives buzzer alert and bars the person from entry and also, the face mask and temperature of person is sent out over IOT to server for the authorities.

Keywords: IoT (Internet of Things), temperature monitoring, mask detection, entry system, sensor integration, data collection, real-time monitoring, alert system, security, access control, thermal sensors, facial recognition, data analysis, user authentication, wireless communication, cloud computing, mobile application, web dashboard, privacy, compliance regulations, COVID-19, contactless entry, visitor management, health and safety, smart technology automation, machine learning, artificial intelligence, temperature thresholds, mask compliance, user database

1. Introduction

According to Merriam-Webster (2020), a pandemic is an outbreak of a disease that occurs over a wide geographic area and typically affects a significant proportion of the population. A global coordinated effort is needed to stop the further spread of the virus. According to the data obtained from World ohmmeters (2020), a website that reports daily status of the COVID-19 situation worldwide, the disease has infected nearly 23 million people and caused the death of nearly 790,000 people from December 2019 to August 2020. COVID-19 has also impacted the global economy and increased worldwide unemployment. So, to save lives and to prevent the global economy from getting worse, we need to prevent COVID-19 from spreading by taking precautionary measures. When those who are infected cough or sneeze, the droplets coming out from their cough or sneezing becomes the contagion of the disease and infects others who may inhale the droplets or touch surfaces that the droplets had settled on. People are being asked to practice social and physical distancing of keeping at least 1 meter away from each other and to avoid crowded places to avoid getting infected. To fight the rising number of cases in Malaysia, the government has mandated the wearing of face masks in all public places and taking temperature reading before entering any public area. Preventing people who have common symptoms of COVID-19 such as fever, cough, shortness of breath from entering public places could reduce the infection from spreading. According to study normal body temperature is between 36.5 ºC-37.5 ºC. Above this is fever. Indicating a viral or bacterial infection. In this situation the less physical contact with others, the better for our safety (Abdullah *et al*., 2017). Therefore, the researchers put forward the idea to build an innovative product that can measure body temperature by using a contactless detector integrated with a detector that can detect the wearing of a face mask (FMT detector). The main reason for choosing to develop this innovative product was to take simple steps in controlling the COVID-19 pandemic that could easily spread in public places. Through the use of innovative products can ensure that students and staff of PSP are generally in a safe state while on campus and in the library in particular where there will be a lot of interaction and congestion between students in confined spaces. If students do not wear face masks and experience symptoms of fever with abnormal body temperature, they can spread the disease easily to others. Therefore, with the availability of a detector, this device can be used to detect abnormal body temperature readings of 37.5 °C and above, A as well as detect whether a person is wearing a face mask or not before visitors enter the library.

This is a simple measure that can control the spread of COVID-19 among students, staff and polytechnic visitors who are experiencing symptoms. If a person forgets to wear a face mask, he can continue to wear it and if a person finds out that he has a fever through are adding from the detector, then he can continue to see a doctor for immediate treatment.

1.2 Objectives
The main objectives of the proposed project are

- To measure temperature of a human body.
- To detect facemask and allow to enter into any organization.

1.3 Justification of Study
The purpose of this project is to keep people safe, healthy and protecting human body from pandemic.

1.4 Scope of Study
Now that a lot of shops, offices and institutions are re-opening again after the Corona lockdown, many businesses are faced with the necessity to supply the most effective possible protection for his or her staff and customers. Face masks and temperature of the person checks play a crucial part within the protection effort. While this is often already done routinely used in a large scale at airports and railway stations, many businesses and institutions are struggling to fulfill the challenge. Mask monitoring often requires additional staff resources. At an equivalent time, temperature of the person checks by staff accompanies certain risks in terms of hygiene and data privacy. Common symptoms of covid-19 include fever, tiredness, sore throat, nasal congestion, loss of taste and smell. In most cases, it's transmitted directly (Person to person) through respiratory droplets, but also indirectly via surfaces. Therefore, the usage of face masks and sanitizers has shown positive results when it involves disease spread reduction. However, the crucial problem is that they are lack of approved vaccine and drugs to fight against corona virus.

2. Literature Review
2.1 Literature Review
Rehman *et al*. proposed a system that restricts the growth of COVID-19 by finding out people who are not wearing any facial mask in a smart city network where all the public places are monitored with Closed-Circuit Television (CCTV) cameras. While a person without a mask is detected, the corresponding authority is informed through the city network. A deep learning architecture is trained on a dataset that consists of images of people with and without masks collected from various sources. The trained architecture achieved 98.7% accuracy on distinguishing people with and without a facial mask for previously unseen test data. It is hoped that our study would be a useful tool to reduce the spread of this communicable disease for many countries in the world. Mohanlal Meenpal *et al*. designed in such a way that it uses a binary face classifier which can detect any face present in the frame irrespective of its alignment. We present a method to generate accurate face segmentation masks from any arbitrary size input image. Beginning from the RGB image of any size, the method uses Predefined Training Weights of VGG – 16 Architecture for feature extraction. Training is performed through Fully Convolution Networks to semantically segment out the faces present in that image. Gradient Descent is used for training while Binomial Cross Entropy is used as a loss function. Further the output image from the FCN is processed to remove the unwanted noise and avoid the false predictions if any and make bounding box around the faces. Furthermore, proposed model has also shown great results in recognizing no frontal faces. Along with this it is also able to detect multiple facial masks in a single frame. Experiments were performed on Multi Parsing Human Dataset obtaining mean pixel level accuracy of 93.884% for the segmented face masks.

2.2 Proposed System
Here we are proposing a completely automated temperature scanner and entry provider system it is a multipurpose system that features a large selection of applications. In this system we make use of a contactless temperature scanner and a face mask monitor the scanner is connected directly with an individual's barrier to bar entry if heat or no mask is detected. An individual will not be provided entry without temperature and mask scan. Only person having both conditions are allowed inside. The system uses temperature sensor and camera connected to a raspberry pi system that regulates the whole operation. The camera is employed to scan for detecting face mask and temperature sensor for detecting person's temperature. The raspberry processes the sensor inputs and decides whether the person is to be allowed. Whenever the person has normal temperature and wearing face mask then the system operates a motor to open the barrier allowing the person to enter the premises. If a personal is flagged by system for top temperature or no Mask the system glows the red light and bars the person from entry. Also, the face and temperature of person is sending out over IOT to server for authorities to wish action. To solve this problem, we here propose a fully automated temperature scanner and entry provider system. It is a multipurpose system that has a wide range of applications. The system makes use of a contactless temperature scanner and a mask monitor. The scanner is connected directly with a human barrier to bar entry if high temperature or no mask is detected.

Any person will not be provided entry without temperature and mask scan. Only person having both conditions is instantly allowed inside. The system uses temperature sensor and camera connected with a raspberry pi system to control the entire operation.

The camera is used to scan for mask and temperature sensor for forehead temperature. The raspberry processes the sensor inputs and decides whether the person is to be allowed. In this case the system operates a motor to open the barrier allowing the person to enter the premises. If a person is flagged by system for high temperature or no Mask the system glows the red light and bars the person from entry. Also, the face and temperature of person is transmitted over IOT to server for authorities to take action and test the person for COVID. Thus, the system provides a 100% automated system to prevent the spread of COVID.

2.3 Advantages of Proposed system
- Fully automatic detection of Face Mask.
- Fully automatic detection of Body Temperature
- Fully automatic operation without human use.
- Real time detection of Body Temperature.
- Real time detection of Face Mask.

- No Human errors.
- Results approach is effective.
- Effectively monitoring of personnel.
- Effectively recognize face masks.
- Alerts with Mail Alerts with Buzzer
- Sound Bars the person from entry if a person is flagged by system for high temperature or no Mask.

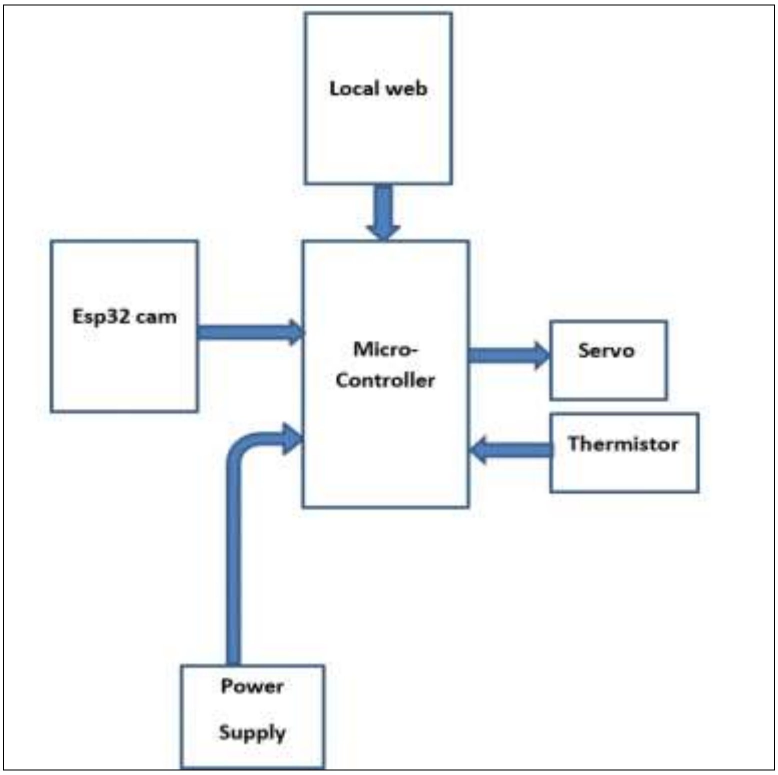

Fig 1: Block diagram of mask and temperature detection.

2.4 Block Diagram

The block diagram contains Raspberry pi 3B+, Camera, Servo Motor, wireless temperature sensor, Buzzer. RPI camera module is connected to the CSI port on the Raspberry pi. We have connected the pins of Non-Contactless Temperature sensor to Raspberry Pi 3 B+ as SDA pin of sensor to SDA pin 3 (GPIO 2) of pi and SCL pin of sensor to SCL pin 5 (GPIO 3) of pi. VIN to 5v pin 2 and GND to GDN of pi. We have connected the pins of Buzzer to Raspberry Pi 3 B+ as +ve pin of buzzer to pin 16 (GPIO23) of pi and -ve pin of buzzer to GDN of pi. We have connected the pins of Servo motor to Raspberry Pi 3 B+ as BROWN wire of servomotor to GND of pi, RED wire of servomotor to 5v pin 4 and ORANGE wire of servomotor to pin 11 (GPIO 17) of pi.

2.5 Identification and Classification for the Types of Face Masks

As we mentioned before, in our proposed face mask detection and classification module, the second module is to detect and classify the types of face masks, either it is an N-95 mask or a surgical mask. For this module, we combined the dataset that is described in the Section 3.3.1 by excluding face without mask images. The new combined dataset consists of 28,717 images in total. We used two pre-trained models (VGG-16 and MobileNetV2), which achieved the highest accuracy in the face mask detection and classification module, as described before. For this module, we split our dataset 22,973 images for training and 5743 images for testing and feed to the two fine-tuned models, which are VGG-16 and MobileNetV2. The process of fine-tuning both models for transfer learning is the same as described before.

We computed and reported the accuracy and kappa values of both models for the types of face masks identification and classification. Table 9 reported the comparative accuracy and kappa values of both of the models, and we conclude that the VGG-16 achieved higher accuracy than MobileNetV2. We also reported the confusion matrix of both models. Figure (a) shows the confusion matrix of VGG-16 on test data, and a similarly on (b) shows the confusion matrix of MobileNetV2 on test data for the identification and classification of types of face masks, as shown in Figure 19. We computed and compared the results regarding the class-wise accuracy, precision, and other parameters for the evaluation of our models individually. We reported the class-wise accuracy, precision, recall, and f1-score for the evaluation of our VGG-16 and MobileNetV2 models, respectively, for the face mask type identification and classification, as shown in Tables 10 and 11.

Table 9. Comparative results of the models for types of face masks detection and classification.

Models	Accuracy	Kapa Value
VGG-16	98.17%	0.963
MobileNetV2	97.37%	0.94

3. Methodology

3.1 Description of Methodology

According to Saco lick (2020) SDLC or the Software Development Life Cycle is a process that produces software with the highest quality and lowest cost in the shortest time possible. It provides a well-structured flow of phases that helps organizations to quickly produce high-quality software which is well tested and ready for use. Agile model was chosen to implement in SDLC process which anticipates change and allows for much more flexibility than traditional methods. Clients can make small objective changes without huge amendments to the budget or schedule. This method saves the client money and time because the client tests and approves the product at each step of development. If there are any problems faced, then changes can be made during production cycles to fix the issue. There are several phases in the agile model which we will be using which are planning, analysis, design, implementation, testing, and maintenance. In this section,

3.7 Body Temperature Detection

Our proposed IoT-based SSDWG has multiple features, and it is divided into two modules. The most prominent part of SSDWG measures the temperature of the human body in real-time in a contact-free manner, and it stores the person's body temperature, along with a picture of a suspected person in our system, as shown in Figure 7, and we can track the most vulnerable persons through recorded temperature data because [6] some of the most common symptoms of COVID-19 are temperature or fever.

Temperature measuring sensor MLX90614 is used in our proposed SSDWG. It is a non-contact wireless infrared thermometer that is used for human body temperature measurement, and its micro-controller is capable of wireless communications. We proposed contact-free temperature checking mechanisms because it is not violating the social distance SOP's. An image processing module is used to capture a suspected photo whose body temperature is not average. In our proposed model, we placed our temperature measure sensor and image capturing module on the front side of SSDWG. Whenever any person

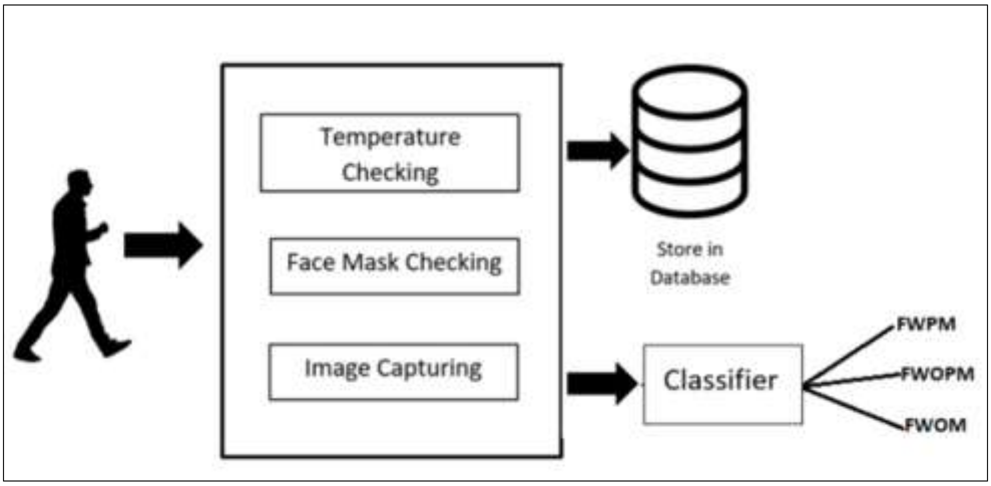

Fig 2: Temperature measuring and mask detection module.

wants to pass from SSDWG, he/she must stand in front of the temperature sensor for 3 s; the temperature sensor detects the human body temperature and contact-free sensor shown in Figure 8. If the human body temperature is detected are 100.4 Fahrenheit or 38.0 Celsius, or more than this, the temperature sensor passes the indication to the alarm, and the body temperature and photo captured from CCTV are stored in the database; the authors proposed a complete system to auto-detect routine examinations on a teleophthalmology network. They used pathological pattern mining with lesion detection methods to obtain the information from the image.

3.8 IoT Based Smart Screening and Disinfection Walkthrough Gate (SSDWG)

Our proposed system is IoT-based Smart Screening and Disinfection Walkthrough Gate (SSDWG), which consists of different modules. SSDWG is a multi-sensor and multipurpose smart device that is designed to reduce the chances of the spread of COVID-19 carriers. In-countries, like Pakistan and other developing countries, where governments did not apply lockdown and economic activities are entirely not stopped, people are allowed to go to the market, and they can travel according to some standard operating procedures (SOP's). In this scenario, the virus may carry on their clothes, shoes, hands, or other surfaces. Moreover, people are not bothering to follow the given SOPs of government, and they are not taking care of social distancing. The framework of our proposed SSDWG is explained in a detailed way in Figure 6. When any person walks through from SSDWG, then, in the first step, the temperature checking module checks the temperature using a contact-free manner. If the temperature is 99 Fahrenheit or more than this, then a picture of that particular person is captured and it stores it in a database with his temperature and his health status, as suspected. Simultaneously, our mask detection module can detect the person wearing a mask or not. Meanwhile, the person who is controlling the entrance can divert that suspected person for proper COVID-19 testing. Our proposed IoT Based Smart Screening and Disinfection Walkthrough Gate (SSDWG) can be placed at the entrance of all kinds of public places, hospitals, or any crowded area that may be suspected of COVID-19.

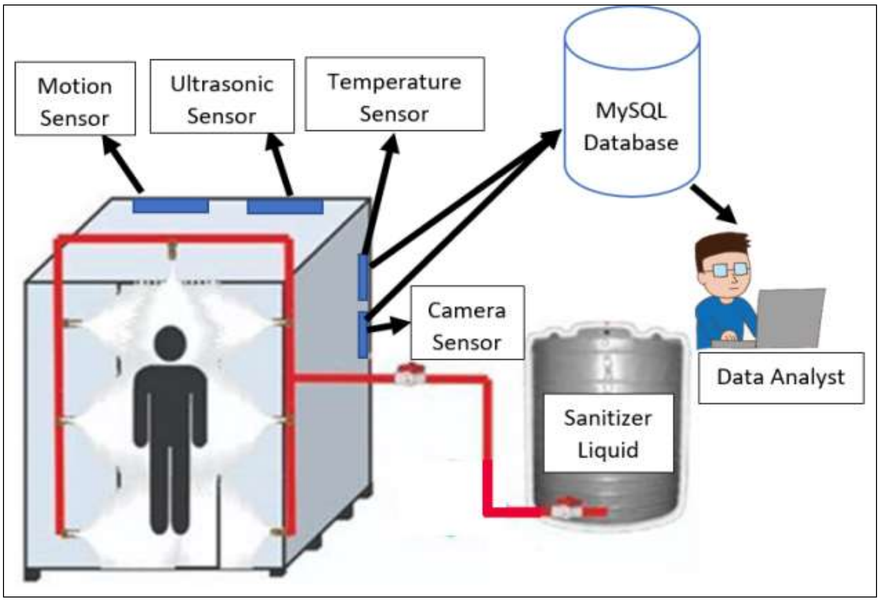

Fig 3: Smart Screening and Disinfection Walkthrough Gate (SSDWG).

3.9 Mask Detection Module

The second module of SSDWG is to detect the mask-wearing by people who are passing through it. We used five pre-trained deep learning models, which are VGG-16, Mobile Net V2, Inception V3, ResNet-50, and Convolutional Neural Network (CNN), to detect a face mask wear in three classes: face with proper mask (FWPM), face with improper mask (FWIPM), and face without a mask (FWOM). Further, our proposed model identifies and classifies the types of face masks in two classes, which are N-95 and a surgical mask. We fine-tuned these five pre-trained models with transfer learning for training, which is much faster and easier than training a model from scratch with randomly initialized weights. In a similar way, the authors used a deep neural network to analyze vibration signals that are caused by walking persons on the floor to detect the person localization in large buildings. We set the output layer of these models as non-trainable by freezing the weights and other trainable parameters in each layer to not be trained or updated when we feed our dataset. Further, we added an output layer to train on our dataset. This output layer would be the only trainable layer in our new model. We used the Adam optimizer with a learning rate of 0.0001, cross-entropy for our loss, and accuracy for our matrix. Figure 9 shows the architecture of the CNN model. The architecture of CNN consists of an input layer, an output layer, and multiple hidden layers. The hidden layers typically consist of convolutional layers, pooling layers, fully connected layers, and normalization layers (ReLU). This network's input is the images with face mask (proper and improper) and without a face mask input size of 224 by 224 and three RGB channels. The first layer is a convolutional layer with the Relu function, as shown in Equation (1), with a kernel size of 224 by 224 and 64 output channels.

$$Relu\ (x) = max\ (0, x)$$

Relu function returns 0 if it receives any negative input, but it returns that value for any positive value of *x*. The next layer of the architecture is max pooling, which involves shrinking the image stack. To pool an image, the window size is defined as (112 × 112, 64 output channels). The window is then filtered across the strides' appearance, with the max value being recorded for each window. With the max-pooling layer, we have a normalization layer that is known as the Rectified Linear Unit (Relu) process, which is shown in Equation (1), which changes all of the negative values within the filtered image to 0. This step is then repeated on all of the filtered images, and the Relu layer increases the non-linear properties of the model. On the third layer, the same as the first layer, we had a convolutional layer that process images with a kernel size of (56 × 56) and process RGB to 256 output channels. There is also a pooling layer before the fully connected layer with the kernel size of 7 × 7.

3.10 Results and Discussion

The result of the development this innovation project involving the detection of face masks and body temperature is to achieve the overall objectives that have been set. The first objective to detect and display the temperature readings of those entering the library is achieved where the LCD display will show the body temperature readings on the screen obtained from the face scanner for visitor information. Then, the second objective of tracking and reminding students, staff and visitors entering the library area to wear face masks by displaying indicator signs on the screen was also achieved. The 'facemask = /' sign will be displayed when the wearing of a perfect face mask is detected. If there are those who do not wear a face mask or wear a face mask incorrectly, the LCD display will show a sign 'facemask = X' as a reminder so that those who forgot can wear a face mask or can wear it properly before entering the library. Furthermore, temperature readings can also be accessed via a connection to a PC monitor or laptop with an HDMI cable with remote access using a VNC viewer. In this way, the project owner, the PSP's library, can see the output on their PC, laptop or mobile phone through a webcam and sensor for temperature readings and the wearing of face masks. Next, the third objective to warn students, staff and visitors whose temperature is 37.5°C and above or not wearing a face mask by displaying an indicator sign on the screen along with a buzzer sound as a reminder was also achieved. Warnings are given with an 'X' sign display meaning do not allow entry with the sound of the buzzer installed. The following tables show the results of each test that has been performed including unit testing (Table 2), integration testing (Table 3) between the installed components and finally user acceptance testing (Table 4). All these tests are implemented to ensure that each component functions as specified and in achieving the objectives that have been set.

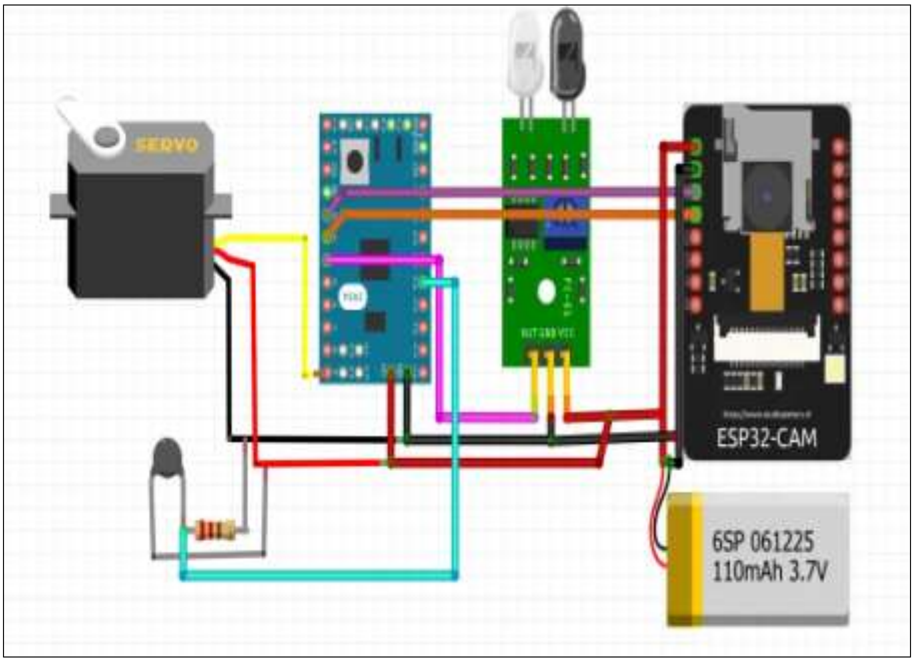

Fig 4: Circuit diagram of mask and temperature detection.

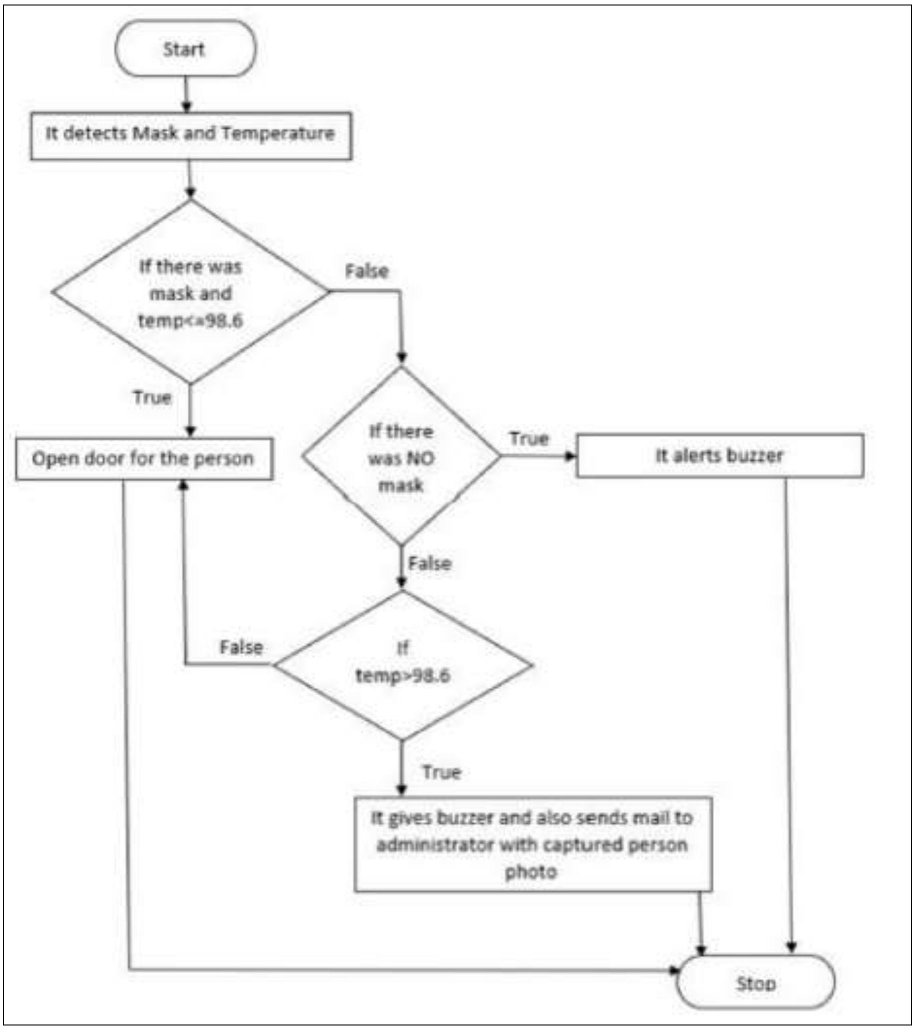

Fig 4: Flow diagram of mask and temperature detection.

When the system starts it detects mask and temperature of a person. If there is a mask and temperature is less than or equal to 98.6°F then opens door for the person. If there is no mask for the person then the system alerts with buzzer sound and person will be bars away from entry. If the person is having temperature above 98.6°F then system. Alerts with buzzer sound, send alert mail to admin and person will bars away from the entry. If there is no mask and temperature above 98.6°F then system alerts with buzzer sound, sends alert mail to admin and bars away person from entry.

Steps

- Whenever the person enters the door, the system will detect the temperature by using temperature sensor and check mask by using camera.
- If the person temperature is less than or equal to 98.6 and if he or she wear the mask then the doors will be open and person will be allowed inside.
- If the temperature is normal but he doesn't wear the mask then it shows a red light, doors will not be open and the person will not be allowed inside.
- If the person temperature is high than the normal temperature and person were mask then the image of then the image of that person is sent to the administrator by e-mail.
- Face mask recognition with 90+% accuracy in 50ms speed.
- Body temperature test with measurement range from 35°C ~ 42°C (95°F ~ 107.6°F), precision of ±0.3°C
- Real-time detection for multiple people
- Built-in Intel OpenVINO-based iVINO AI recognition software
- High-precision thermal camera
- IP65 front-panel waterproof protection
- Supports sound/light alarm and access gate control

Table 1: List of the Components

IoT Device

- Microcontroller (e.g., Arduino, Raspberry Pi, ESP8266, ESP32)
- Wi-Fi or Ethernet module for connectivity.

Sensors

- Infrared Temperature Sensor (e.g., MLX90614)
- Image sensor or camera for mask detection and facial recognition
- Passive Infrared (PIR) sensor for motion detection
- Ultrasonic sensor for distance measurement (optional)

Mask Detection Module

- Machine learning model for mask detection
- Training dataset for the mask detection model

Facial Recognition Module

- Facial recognition software or library (e.g., OpenCV, Dlib)
- Database for storing facial features (if needed)

User Interface

- LCD display or LED matrix for displaying information
- Buzzer or speaker for audio alerts
- Touchscreen (optional)

Connectivity

- Wi-Fi or Ethernet module for internet connectivity
- Bluetooth (optional)

Power Supply

- Power adapter or battery power source
- Voltage regulator (if needed)

Enclosure

- Housing or casing to protect the components from environmental factors

Data Storage

Micro SD card (For local storage)

Cloud storage (e.g., AWS, Azure, and Google Cloud) for remote data storage

Communication Protocols

- MQTT, HTTP, or other protocols for sending data to the cloud or remote servers

Cloud Services

- Cloud-based server for data processing and storage
- IoT platform for device management and monitoring

Mobile Application

- Android/iOS app for remote monitoring and control

Web Dashboard

- Web application for real-time data visualization and management

Security Features

- Encryption for data transmission
- User authentication and access control
- Secure boot process for the device

Power Management

- Low-power modes and sleep modes for energy efficiency

Cables and Connectors

- Wiring and connectors for connecting components

Mounting Hardware

- Brackets, screws, and other hardware for installation

Documentation and Manuals

- User manuals and technical documentation for setup and maintenance

Compliance and Safety Features

- Compliance with relevant regulations (e.g., GDPR for data privacy)
- Safety features (e.g., over-temperature protection)

Testing and Calibration Tools

- Tools for testing and calibrating temperature and mask detection accuracy

Maintenance and Support

- Plans for system maintenance and customer support

3.11 Required Components

- Raspberry Pi
- DC Motor
- Flap
- Gearing Arrangement
- Temperature Sensor
- Camera
- Barrier Outer Frame
- ESP8266 Wifi Module
- Wires and Connectors
- Resistors
- Capacitors
- Transistors
- Red & Green Indicators
- Buzzer Siren
- Nuts and bolts
- Sensor Mounting Shaft & Panel
- Supporting Frame
- Mounts and Joints

- Base Frame

3.12 Applications
- Railways Entry
- Airport Entry
- Offices Entry
- Museums and Amusement Parks
- Other Public Places

3.13 Software Requirement:
1. Xampp for local server environment
2. IDE (phpstorm/visual Code/sublime text)

3.14 Experimental Results
This study deals with controlling the spread of COVID-19 according to the WHO's given instructions for public safety and awareness. As we discussed in the methodology section, our proposed model consists of two modules. The first module deals with contact free temperature detection and abnormal temperature individuals' record-keeping system to disinfects using sanitizing liquid. In the second module of our proposed system, we implemented a mask detection and classification system in which our system is trained to detect and classify the individuals' face mask in three classes, which are face with proper mask (FWPM), face with improper mask (FWIPM), and face without mask (FWOM) while they are passing from SSDWG. The system is trained using different machine learning models, and we achieved good accuracy on the test data in experiments.

Our proposed SSDWG is designed for all kinds of public places, we want to ensure that individuals have to pass from SSDWG. The attached sensors to this gate are activated;
a contact-free temperature measuring sensor detects the person's temperature. The CCTV module captures the image from a surveillance video of the person whose temperature 100F or more than 100F, and the system will store the data in the database with the status of suspected. As mentioned before, the face mask detection module detects and classifies individuals' face mask in three classes: FWPM, FWIPM, and FWOM. The disinfection module showers sanitizing liquid on the person for 10 s while passing from SSDWG.

The person controlling the entrance can divert suspicious persons for COVID-19 testing. For the experiments, we used three datasets, as we mentioned above in dataset Section. In our proposed model, we achieved a high accuracy on the Github (Masked Face-Net). We fine-tuned five pre-trained models and re-trained these models to perform testing using
test dataset. Our proposed model achieved a high accuracy on the combined dataset using the VGG-16. Figure 13 shows the comparative accuracy of VGG-16 on all datasets (MAFA and Masked Face-Net are available on Github, and third dataset from Bing).

4. Design and Development
4.1 Data Flow Diagram
This Diagram is a traditional visual representation of the information flows within a system. It can be manual, automated, or combination of both.

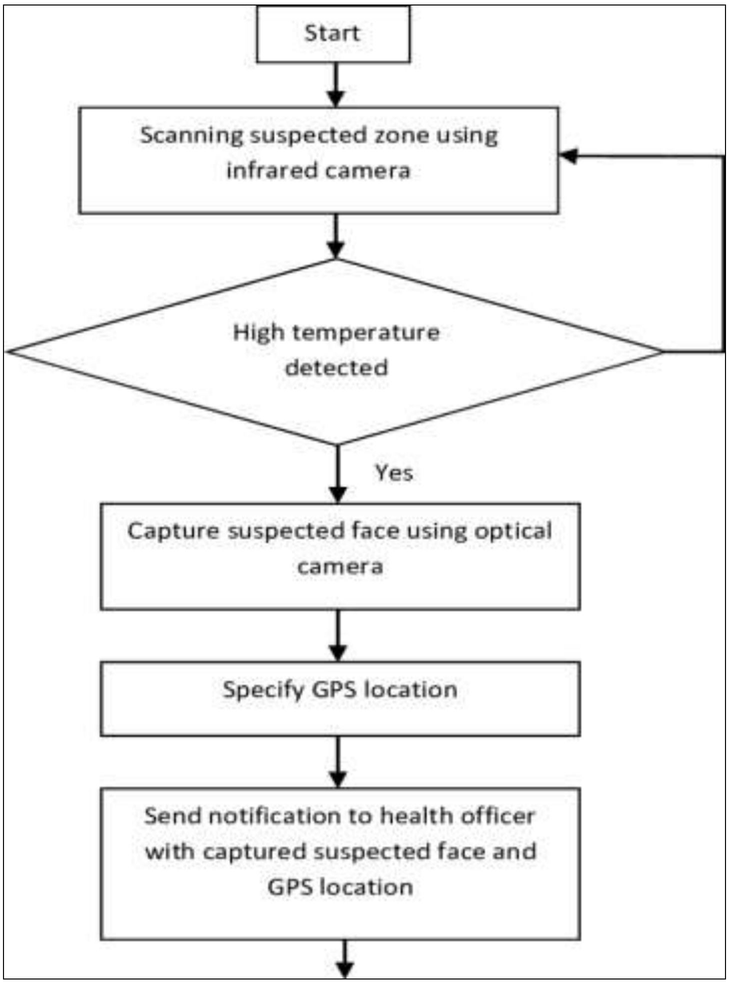

Fig 5: Entity Relationship Diagram

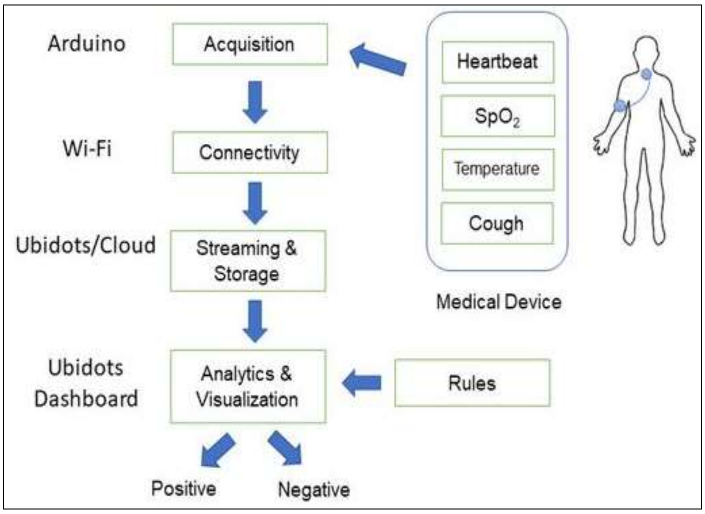

Fig 6: Flow diagram of mask and temperature detection.

4.3 Sequence Diagram

We are trying to describe our software activity by using this sequence diagram.

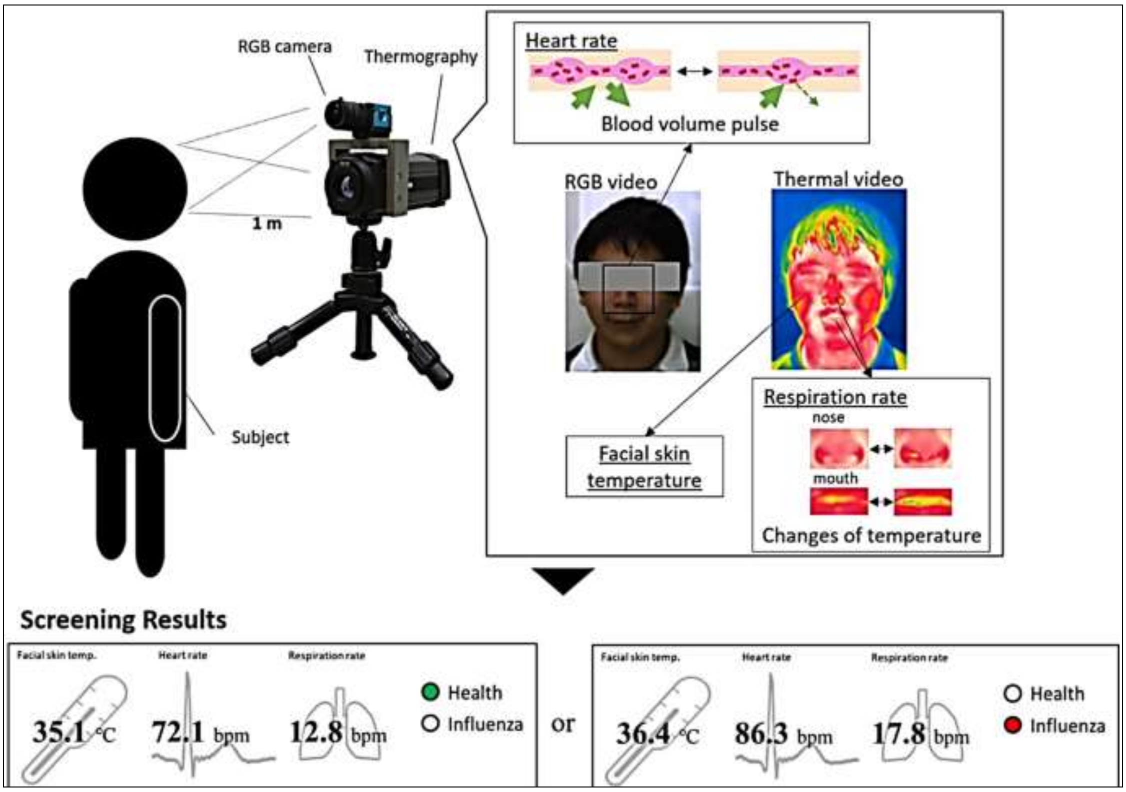

Fig 2: Experimental diagram of mask and temperature detection.

4.4 Working Procedure

The block diagram contains Raspberry pi 3B+, Camera, Servo Motor, wireless temperature sensor, Buzzer. RPI camera module is connected to the CSI port on the Raspberry pi. We have connected the pins of Non-Contactless Temperature sensor to Raspberry Pi 3 B+ as SDA pin of sensor to SDA pin 3 (GPIO 2) of pi and SCL pin of sensor to SCL pin 5 (GPIO 3) of pi. VIN to 5v pin 2 and GND to GDN of pi. We have connected the pins of Buzzer to Raspberry Pi 3 B+ as +ve pin of buzzer to pin 16 (GPIO23) of pi and -ve pin of buzzer to GDN of pi. We have connected the pins of Servo motor to Raspberry Pi 3 B+ as BROWN wire of servomotor to GND of pi, RED wire of servomotor to 5v pin 4 and ORANGE wire of servomotor to pin 11 (GPIO 17) of pi.

5. Implementation and Testing

5.1 Implementation of the Project

When the system starts it detects mask and temperature of a person. If there is a mask and temperature is less than or equal to 98.6°F then opens door for the person. If there is no mask for the person then the system alerts with buzzer sound and person will be bars away from entry. If the person is having temperature above 98.6°F then system. Alerts with buzzer sound, send alert mail to admin and person will bars away from the entry. If there is no mask and temperature above 98.6°F then system alerts with buzzer sound, sends alert mail to admin and bars away person from entry.

- Whenever the person enters the door, the system will detect the temperature by using temperature sensor and check mask by using camera.
- If the person temperature is less than or equal to 98.6 and if he or she wear the mask then the doors will be open and person will be allowed inside.
- If the temperature is normal but he doesn't wear the mask then it shows a red light, doors will not be open and the person will not be allowed inside
- If the person temperature is high than the normal temperature and person were mask then the image of then the image of that person is sent to the administrator by e-mail

5.2 Test Results and Reports

We test our project more than 100 Times and got some issues. Then we have fixed it and now our system is working perfectly. We try to integrate scanner system in our system as a check. In this project we have successfully implemented a working prototype for Face Mask and Body Temperature detection system. This project can be used in places where large gatherings of people occur such as schools, colleges, offices, shopping malls etc. The system first detects whether the person is wearing a facemask and sends the data to the microcontroller. The non-contact temperature sensor reads the person's body temperature and upon checking it opens the barrier arm and allows the person inside. The accuracy of facemask detection can be achieved by training the module with a larger image dataset. Raspberry Pi 3B+ has almost the necessary computational power for detecting facemask from image/video stream. In conclusion, Face Mask and body temperature detection can help us in the large gathering of people in one place without masks and also by this we can reduce the risk of getting infected.

6. Discussion and Conclusion

6.1 Discussion

Body temperature measuring is adequate for preventing an outbreak of COVID-19. Fever, dry cough, sore throat, headache, muscle or body aches, congestion or runny nose, nausea or vomiting, and diarrhea are the most significant common symptoms of COVID-19.

To measure individuals' temperature manually consumes a considerable number of human resources, time, and administrative resources ref. introduced a prototype system that consists of a contact-free temperature sensor. Their proposed system has the features of contact-free temperature measurement and attendance, which are taken at the entrances of school campuses in Hong Kong. Their experiments showed that the system could measure body temperature with adequate accuracy for screening purposes.

A pandemic-like flu requires rapid temperature measuring. ref. authors designed a low-cost, scalable device used for measuring temperature to control the spread of the flu pandemic. Their proposed temperature measuring module is developed by a medical grade version of the Melexis MLX90614 series of smart infrared temperature sensors. When the temperature is high, an alarm will alert the authorized person at the entrance to find the suspected student. We also used the Melexis MLX90614 contact-free temperature measure sensor in our proposed model. We also compared the comparative features of our FMT detector developed for this project uses a low-cost equipment equipped with a webcam, thermal sensor and Raspberry Pi 3B which is expected to be easily used in helping to deal with the current COVID-19 situation especially in monitoring body temperature and the use of face masks. This detector was developed as one of the initiatives taken to assist PSP management in general and librarians in particular in providing a detector that can control the spread of the virus among students and staff. At an increasing rate of infection in an extraordinary number where it can cause, then it is very important that everyone follows the rules of mandatory mask wearing in all public places, especially in enclosed areas such as libraries. Students, staff and visitors who come in contact with outsiders can infect themselves and spread the virus to their friends and colleagues at the polytechnic. This small step can curb the spread of the virus where the use of which is installed at the entrance can ensure that everyone is wearing a face mask and they know their current body temperature. At the same time, this is also an opportunity for the developer to further increase of knowledge in using the available hardware and software to develop and program IoT (Internet of Things) equipment from scratch, and it provides a very lucrative opportunity for future preparation. Proposed future improvements for project quality improvement are where the use of more powerful devices such as high-spec laptops or PC and Raspberry Pi 4 to reduce coding time. Also, it is recommended to use the camera interface that is the Camera Serial Interface (CSI) for less latency to get camera input. Besides that improving one's knowledge of the GUI interface will also be very helpful in this project. Finally, use an Ethernet jack for stable LAN remote access into the project. For future projects, the FMT detector can be applied together with an app for use in public vehicles or can also be in houses and cars so that everyone can be reminded to wear a face mask and alert with their body temperature before going out in public. We have also compared our results of the mask detection and classification module with previous work that was done by different researchers. The authors used ResNet-50 for feature extraction from images and YOLO v3 for face mask detection and classification.

Two datasets were used; one is the Medical Masks Dataset (MMD), published by Mikolaj Witkowski, which consists of 682 images. The second public masked face dataset is a Face Mask Dataset (FMD), which consists of 853 images. The authors combined these two datasets, and the merged dataset contains 1415 images by removing bad quality images and redundancy, and they achieved 81% accuracy for mask detection. We also used a pre-trained ResNet-50 model for face masked detection, and we achieved 99.2% accuracy.

We also used the Inception V3 model and achieved 99.46% accuracy. Similarly, the authors of used fine-tuning for transfer learning the Inception v3 model to classify the images into a mask or no mask and achieved 99.2% accuracy. The authors used the Simulated Masked Face dataset, which consists of 1570 images, in which 785 images are masked facial images and 785 unmasked facial images. Simulated face masks are the images of individuals on which face masks are added on individual's faces by photo editing techniques. Further, we used the fine-tuned VGG-16 model in which we achieved 99.81% accuracy. A similar model was used by the authors of for face mask detection and classification. Their dataset contains 25,000 images and 224 × 224 pixel resolution. 80% of the data is used for training and 20% for the testing, and they achieved an accuracy rate of 96%.

6.2 Conclusion
In this project we have successfully implemented a working prototype for Face Mask and Body Temperature detection system. This project can be used in places where large gatherings of people occurs such as schools, colleges, offices, shopping malls etc. The system first detects whether the person is wearing a facemask and sends the data to the microcontroller. The non-contact temperature sensor reads the person's body temperature and upon checking it opens the barrier arm and allows the person inside. The accuracy of facemask detection can be achieved by training the module with a larger image dataset. Raspberry Pi 3B+ has almost the necessary computational power for detecting facemask from image/video stream. In conclusion, Face Mask and body temperature detection can help us in the large gathering of people in one place without masks and also by this we can reduce the risk of getting infected. COVID-19 has become a pandemic and it is now spreading rapidly through direct and indirect contacts among individuals. Manual systems of measuring temperature and disinfecting are being used in homes and public places for disinfection, but these systems may become a source of the spread of infection of COVID-19. Now, this virus will stay in our lives, and we have to live with it, but we need to adopt precautions strictly to break the chain of this virus. This research aims to control the spread of COVID-19 by preventing and minimizing local transmission carriers. Our proposed model is a practical approach for rapid screening and disinfecting numerous people with an automated. The modules of our proposed SSDWG are measuring temperature in a contact-free manner and detecting the person wearing a face mask or not in three classes, which are face with proper mask (FWPM), a face without a proper mask (FWOPM), and face without a mask (FWOM), which can play a pivotal role in controlling and tracing the person who may suspect of COVID-19.

Both of the modules of our proposed SSDWG gave us very impressive results and showed that Smart Screening and Disinfection Walkthrough Gate (SSDWG) can help to control the local transmission and defeat this novel COVID-19 pandemic. Our mask detection and classification module gave us accuracies of 99.81%, 99.6%, 99.46%, 99.22%, and 99.07% by using the VGG-16, MobileNetV2, Inception V3, ResNet-50, and CNN, respectively, for face mask detection and classification in three classes, which are (FWPM, FWIPM, and FWOM).

6.3 Future Scope
According to the achieved results, the proposed solution is usable for that reason it was proposed and under certain performance limitations (such as number of processed frames or measurements per second). Moreover, it depends on both open hardware and free software, being definite and desirable advantage for such systems. In future, it is planned to experiment with various deep learning and computer vision frameworks for object detection on Raspberry Pi in order to achieve higher frame rate. Moreover, we would like to extend this solution with environment sensing mechanisms for suitable building air conditioning and ventilation airborne protection in order to reduce the spread of coronavirus indoors, especially during summer. Finally, the ultimate goal is to integrate the system presented in this paper with our framework for efficient resource planning during pandemic crisis in order to enable efficient security personnel scheduling and mask allotment, together with risk assessment based on statistics about respecting the safety guidelines and air quality. In future work, we will propose a deep learning framework by using pre-trained deep learning models to monitor the physical interaction (social distancing) between individuals in a real-time environment as a precautionary step against the spread of the COVID-19. The CDC (Centers for Disease Control and Prevention) also states that anyone with a hearing impairment should consider a clear transparent face mask. Therefore, we will also focus on the detection and classification of transparent face mask type. According to the WHO guidelines, the sneezing and coughing are the major symptoms of COVID-19, in the future, we will work on analyzing the individuals who are coughing and sneezing by using the deep learning models, which will be helpful in controlling the spread of COVID-19.

7. References

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