

Development of Automated Facemask and Body Temperature System

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Abstract: We are all aware that Covid-19 has had a significant impact around the world. As a precaution, many countries have been placed on lockdown. We should use masks and sanitize ourselves frequently as one of the key measures to protect ourselves and society from Coronavirus. Now, the government is stepping forward to ease the lockdown in order to maintain society's financial balance. They have insisted on wearing a face mask before leaving our home, and the manual way of wearing masks by people is a difficult issue to monitor. Therefore, this work proposes a Face Mask Detection system to determine whether a person is wearing a mask and an infrared sensor to detect the person's thermal temperature. An app linked to that system will send him a warning to protect the community from the coronavirus. If a person works for a company and has registered with the appropriate application, and he is not wearing a mask and has thermal heat in his body. As a company employee, he will receive an alert on his own. If a camera records an unidentified face (Visitor's face), an alert will be issued directly to the company's authorities. A corporation has a feature that allows employees to obtain data that indicates the number of alerts sent to them by the AI alert notice with the person's photo. It enables the firm to enforce the use of the mask and monitor the person's thermal heat in order to prevent the coronavirus from spreading across the workplace.

Keywords: Face Recognition, Face Detection, Face Mask, Coronavirus

1. Introduction

According to the World Health Organization (WHO), the COVID-19 pandemic has affected more than 114 countries since December 2019, and it has been labeled as a dangerous illness that has infected over 492 million people worldwide, resulting in more than 6.1 million deaths as of April 1, 2022. Since the outbreak of COVID-19 in Malaysia, a total of 4,256,469 cases have been reported, with more than 35,127 deaths [1]. This is due to a lack of social distancing to combat this lethal illness. Using a face mask during this epidemic is key in times when maintaining social distance is difficult. As a result, several face mask detection and monitoring systems have been created to provide effective supervision for hospitals, public transit, airports, retail establishments,

and sporting events.

Face detection has become the first step in a variety of applications that rely on facial analysis algorithms to identify, recognize, and capture facial motions in digital images, such as face recognition, face alignment, face verification, age recognition, face model, face authentication, access control, forensics, and human-computer interactions, over the years in the fields of image processing, computer vision, and pattern recognition. Face relighting, facial expression tracking, head posture tracking, facial expression identification, gender recognition, and other applications based on face detection [2].

2. Materials and Methods

2.1 Overview of the system

The steps of development of the automated facemask and body temperature detector are shown in Figure 1. First, without first heating and scanning the mask, no one will be permitted to enter. Only those who meet both requirements are allowed to enter right away. To regulate all processes, the system uses a temperature sensor and a webcam through a PC or laptop. The webcam is used to scan the mask, and the temperature sensor on the forehead is used to verify the body temperature. The ESP32 evaluates the LCD to display the body temperature. In this scenario, the relay module is used to lock or unlock the door that permits someone to access the building.

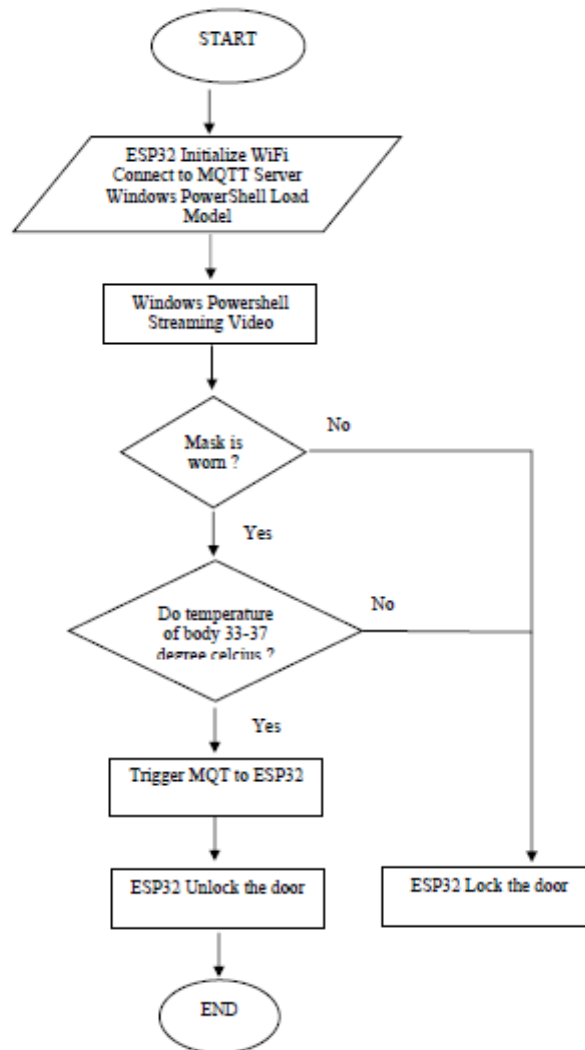


Figure 1: Steps of development of face mask and temperature detector with smart door

2.2 Hardware Implementation

The device's electronic components include an ESP32, a temperature sensor (MLX90614), an LCD Display, a relay module, and a solenoid lock. The microcontroller board used is the ESP32 which is a fantastic device that integrates a Wi-Fi-BT-BLE Micro Controller Unit module. It may be used for a variety of tasks, including speech encoding, music streaming, and MP3 decoding, as well as low-power detecting organization. There are two separately controllable CPU ports, and the clock rates range from 80 MHz to 240 MHz.

The Melexis Integrated Microelectronics Systems MLX90614 sensor measures temperature using an infrared thermopile sensor. Two units are incorporated within the MLX90614 sensor to supply output heat. This sensor utilizes Stefan- law, and Boltzmann's which explains the force a black person's body exerts through heat. In simple terms, anything that emits IR energy will have a direct relationship between the intensity of that emission and the object's temperature. I2C communication is used by MLX90614 sensors to convert files to value ratings, which was a 17-bit ADC. The LCD is an electronic device made of liquid crystals that display pictures and messages for the user. Generally, the 16×2 LCD Display is a module used in circuits and is suitable for public viewing. The 16×2 display has two rows that will display 16 characters per line and will produce 32 characters on the LCD.

For switching remote devices, a relay module is a distinct piece of hardware. It enables remote device control across a network or the Internet. With commands from ClockWatch Enterprise sent over a local or wide area network, devices can be remotely turned on or off. Computers, peripherals, and other powered devices can be managed remotely from anywhere in the office or the world. The Relay module can be used to sense the On/Off status of various external devices and to control them. The serial port is used to connect to the PC interface. Two SPDT relays and one optically isolated input with a wide voltage range are housed in the relay module

A latch for electrical locking and unlocking is referred to as a solenoid lock. Only when the solenoid is turned on is unlocking possible with the power-on kind. When a power outage or wire cut occurs, a door of this sort is secured and not opened, providing good safety. This kind is typically employed in locations where crime prevention is necessary. Figure 2 shows the block diagram of this project.

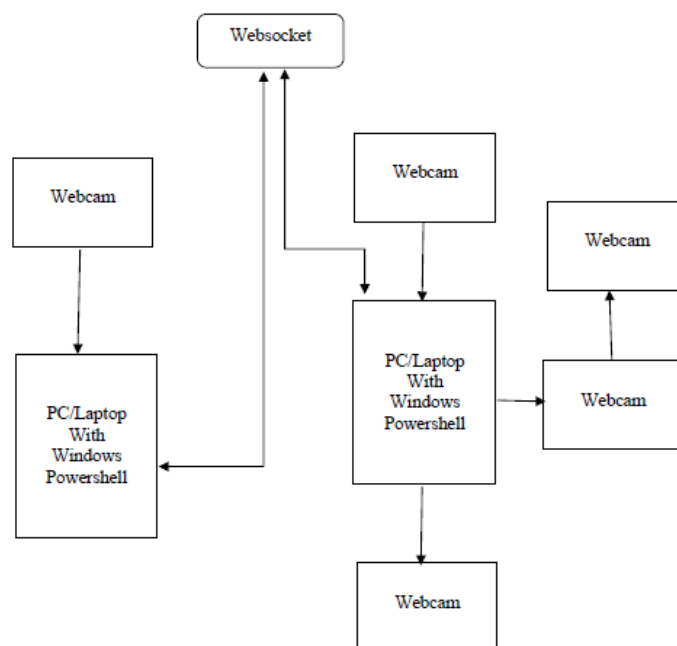


Figure 2: Block Diagram for proposed work

3. Results and Discussion

3.1 Prototype Design

Figure 3 shows the final design of the project prototype. This device includes an IR sensor used to detect the hand and forehead, a temperature sensor to detect the temperature, a webcam to capture a person's face with a mask and a magnetic lock to access the entry system. Furthermore, these devices can be used for any premises in front of the door.



Figure 3: Prototype design for facemask and temperature detector

3.2 Facial Recognition Test

The computer's command prompt was opened, and the precise location of the detect mask video file was entered to check the outcome. By entering "python detect mask.py" and pressing the enter key, the program was launched. The computer then executed a facial detection algorithm. Detection of a face in a window called a frame. The detector's accuracy score indicated that the face mask was detected when it classified the face as a mask or no mask. Face photos of the author and his family members were used to do face mask detection in real time. In order to map face features from the video, the MobileNet algorithm was used. The result obtained in Figure 4 shows that the temperature sensor can detect the temperature and the mask detector scans the persons will appear on the LCD screen in written form. The status will appear as "Mask: Passed Temp: Passed". Figure 5 illustrates when a mask is worn or at normal temperature and if a mask is not worn it will appear as "Mask: Failed Temp: Passed".



Figure 4: Result when wearing a mask

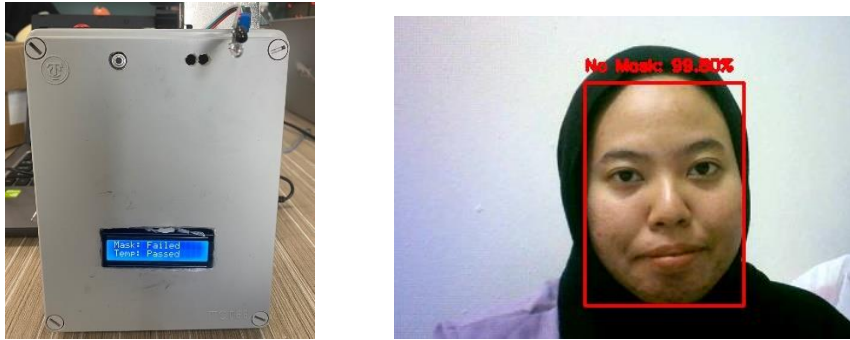


Figure 5: Result without mask

Data from three distinct angle views left, front, and right were obtained by adjusting the test distance scale from 20 cm to 100 cm and measuring the recognition time necessary to detect the face. In Table 1, Table 2, Table 3, Table 4, and Table 5 respectively, the data gathered for the front-angle view, left-angle view, and right-angle view of the facial recognition effectiveness test was reported.

Table 1: Full Mask Angle View of Facial Recognition Effectiveness Test


Condition	Full Mask Angle View			
	Distance camera (cm)	Mask	Accuracy	Colour
	20	Failed	77%	Green
	40	Passed	99.71%	Green
	60	Passed	99.96%	Green
	80	Passed	99.81%	Green
	100	Passed	99.41%	Green

Table 2: Half Mask Angle View Facial Recognition Effectiveness Test


Condition	Half Mask Angle View			
	Distance camera (cm)	Mask	Accuracy	Colour
	20	Passed	58%	Green
	40	Failed	71%	Red
	60	Passed	76%	Green
	80	Passed	76%	Green
	100	Failed	83%	Red

Table 3: Forehead Mask Angle View Facial Recognition Effectiveness Test


Condition	Forehead Mask Angle View			
	Distance camera (cm)	Mask	Accuracy	Colour
	20	Failed	97%	Red
	40	Failed	52%	Red
	60	Failed	77	Red
	80	Failed	95	Red
	100	Failed	99.9%	Red

Table 4: Right Angle Full Mask View Facial Recognition Effectiveness Test


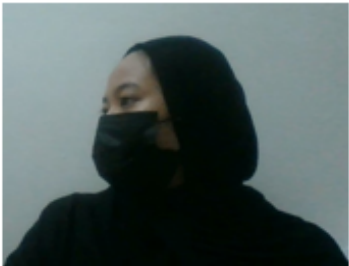
Condition	Right Angle Full Mask View			
	Distance camera (cm)	Mask	Accuracy	Colour
	20	Failed	97.09%	Red
	40	Passed	97.65%	Green
	60	Passed	99.76%	Green
	80	Passed	93.01%	Green
	100	Passed	89%	Green

Table 5: Left Angle Full Mask View Facial Recognition Effectiveness Test

Condition	Left Angle Full Mask View			
	Distance camera (cm)	Mask	Accuracy	Colour
	20	Failed	86%	Red
	40	Passed	99.97%	Green
	60	Passed	93.41%	Green
	80	Passed	94%	Green
	100	Passed	91%	Green

3.3 Discussion

Based on the collected data, the researcher can identify the distance that must be determined for the system to initiate facial recognition and the accuracy of every angle when using a facemask. This is to ensure that face recognition is performed by a single person at a distance from the customer in front of the device. Another aspect of facial recognition that requires investigation is the rate of recognition. This is important since clients wear face masks in a variety of ways. As a result, face mask-worn variations are tested to reduce the system error rate in determining face mask detection.

The distance that must be established for the system to begin facial recognition is based on the analytical data that has been gathered. This is to ensure that only the customer in front of the camera is performing facial recognition. The distance between the customer's face recognition and the distance chosen by the customer was set by the researcher using an IR sensor to support the system.

4. Conclusion

In conclusion, this project managed to develop a detection system of temperature and face masks for visitors to a premise. The system will determine whether the visitors are wearing a face mask by using a facial recognition system and temperature detection using IR energy before access permission is granted. This system also acts as a safety feature to deter people with fever symptoms from entering a certain premise. This system also demonstrates the automated system of temperature and mask-wearing detection that is more efficient than the manual inspection.

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