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Face Mask Wearing Detection for Entrance Authorization

Hidayah Samian[1], Munirah Ahmad Azraai[1] *, Mohd Ridhwan Abdul Rani[1], Azmanirah Ab Rahman[1]

[1]Faculty of Technical and Vocational Education,
Universiti Tun Hussein Onn Malaysia, Batu Pahat, 86400, MALAYSIA

*Corresponding Author Designation

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Abstract: Face Mask Wearing Detection Device for Entrance Authorization is to discipline each individual to wear a face mask. It is one of the easiest methods to lower the rate of corona virus infection and save lives. This novel Coronavirus (2021-nCoV) is very easy to affect every individual and it can also be fatal especially to individuals with chronic diseases such as asthma, high blood pressure, heart failure and many more. Therefore, this study aims to ensure that face mask wearing detection devices for entry into premises can help reduce the rate of Novel Coronavirus (2021-nCoV) infection in premises or public places by ensuring customers comply with Standard Operating Procedures (SOP) set by the Ministry of Health (MOH). For example, when a customer enters a premises, this device will detect the customer's face whether they are wearing a face mask or not. This device can also help to comply with the maximum limits of customers in the premises. This project aims to build a facial recognition device. The project uses technology designed as an individual aid and follows the SOP at this critical time. The project was developed using the Engineering Design Process development model which has four phases namely (1) identifying the problem, (2) making possible solutions, (3) prototype development and (4) testing and evaluating the product. The results show that the developed product can work well. In addition, three experts also agreed that this product can help discipline each individual to wear a face mask. However, in terms of design, this product still has room for improvement so that the quality of this product can be enhanced. In this writing, on the whole the developed product is able to function well and achieve the set objectives.

Keywords: Standard Operating Procedures, Ministry of Health, Liquid Crystal Display

1. Introduction

COVID-19 is the group of viruses that infect humans through inhalation and contact to the point of death is which is transmitted by the SARS-CoV-2 virus, which is a new type of virus from Novel Coronavirus (2021-nCoV). This can lead to lung injury (ALI) and respiratory distress syndrome

**Corresponding munirahaz@uthm.edu.my*

(ARDS) which results in lung failure and results in death (Shereen, Bashir, & Siddique, 2020).

The current COVID-19 pandemic caused by the novel SARS-CoV-2 Coronavirus (2021-nCoV), first detected in late 2019 in Wuhan province, China, has spread rapidly worldwide and has infected more than 10 million individuals in 29 Jun 2020 (Buck et al, 2021).

Standard Operating Procedures (SOP) is instructions and detailed guidelines for work that are documented in writing by the responsible party. SOPs detail the repetitive work processes that will be carried out or followed in the organization. They document the way activities are performed to facilitate consistent compliance with technical and quality device requirements and to support data quality (Garces Gómez, 2019). The development and application of SOPs is an essential part of a successful quality device because it provides information to individuals performing tasks correctly, and facilitates consistency in the quality and integrity of the product or end result.

Face masks are made of fabric that works to prevent germs from entering the human body through respiration. Face masks are respiratory protection used as a way to protect individuals from inhaling harmful substances or contaminants in the air. Respiratory protection or face masks are not intended to replace the preferred method of eliminating disease, but are used to adequately protect the users (Han & Goleman, 2019)

Hygiene is a widely accepted method of preventing the spread of disease infection. Washing hands with soap has been recommended as a primary and cost-effective preventative measure to prevent bacterial infections that cause influenza-related respiratory illnesses (Saunders-Hastings et al., 2017). In addition, face mask also considered as one method to prevent and spread disease.

1.1 Problem statement

The Standard Operating Procedures (SOP) issued by the National Health Council (NSC) to ensure the reduction of Novel Coronavirus (2021-nCoV) infections are still not fully complied with among Malaysians. In Malaysia, there are still a handful of people who take it easy and do not follow the SOPs set by the NSC. To address this problem, surveillance must be done at each entrance of the premises. However, this action will result in the involvement of a large workforce. The existing staff is not able to look after and monitor every area and space visited by the public. Hence, this project was developed to address the issue of people who often forget to wear a face mask when in public because it is still not familiar with the new norms.

1.2 Objective

Each study has its own objectives that are set to be achieved once the study is produced. The following are the objectives of the study that have been set for this study:

i) Design a face mask wearing detection device.

ii) Develop a face mask wearing detection device.

iii) Testing the functionality of this device

2. Methodology

The methodology section describes all the necessary information that is required to obtain the results of the study. There are six work steps that need to be done by the researcher to develop a Face Mask Wearing Detection Device for Entrance Authorization. There are four phases to develop a face mask wearing detection device for entry into the premises. Phase 1: Determining the Problem and Background of the Project, Phase 2: Identify Possible Solutions, Phase 3: Prototype Development and Phase 4: Test and evaluate the product.

2.1 Research Design

Problem analysis is the initial phase of the study conducted to identify problems that arise and set the direction of product development as well as identify the function of the product to be developed. At this stage, the objectives and goals of the study are determined based on the problem factors that exist. This determination is made to ensure that the development process is carried out in accordance with the objectives and purposes of the study and is used as a guide throughout the development phase.

Problem solving in the study conducted is a step taken to propose appropriate solutions and methods to be applied throughout the project development process or proposing some solutions that are able to overcome the problems encountered.

Data collection has been done for customers that follows SOPs when entering premises. Based on the data, most of the customers failed to wear mask properly when entering a premise also affected the customers in a premise. Thus, customer failed to comply SOPs during pandemic are the problem statement for this project.

The selection of this problem-solving method consists of several factors that influence the development process of Face Mask Wearing Detection Device for Entrance Authorization which consists of design method, material to be used, required functionality and complexity of project development method. Lastly, created a form of control model capable of solving the problems encountered by developing a prototype.

2.2 Development Procedure

Engineering Design Process (EDP) is a process to solving problem that occurred and can be used in almost any situation. The use of this model helps to study and understand the problem and its possible solutions at each step or phase of the research process.

EDP is a process that includes steps that can be repeated, although not always in the same sequence but still guided by the objectives of the study. Furthermore, there are a number of steps that cover several aspects such as planning, designing, testing, and refining the design. This process is often initiated based on clear research objectives and goals and is a journey process aimed at solving problems (National Academy of Engineering, 2020).

Based on Figure 1, there are six procedures that need to be done by the researchers to develop a Face Mask Wearing Detection Device for Premises Entry Permission. There are four phases carried out to develop Face Mask Wearing Detection for Entrance Authorization

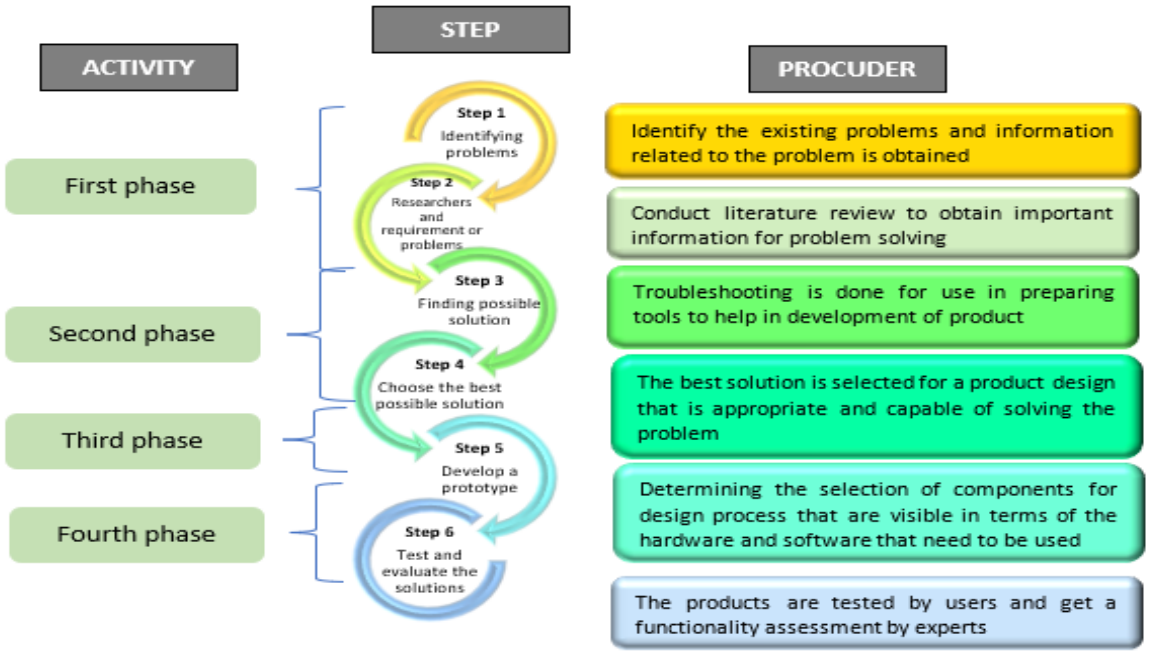
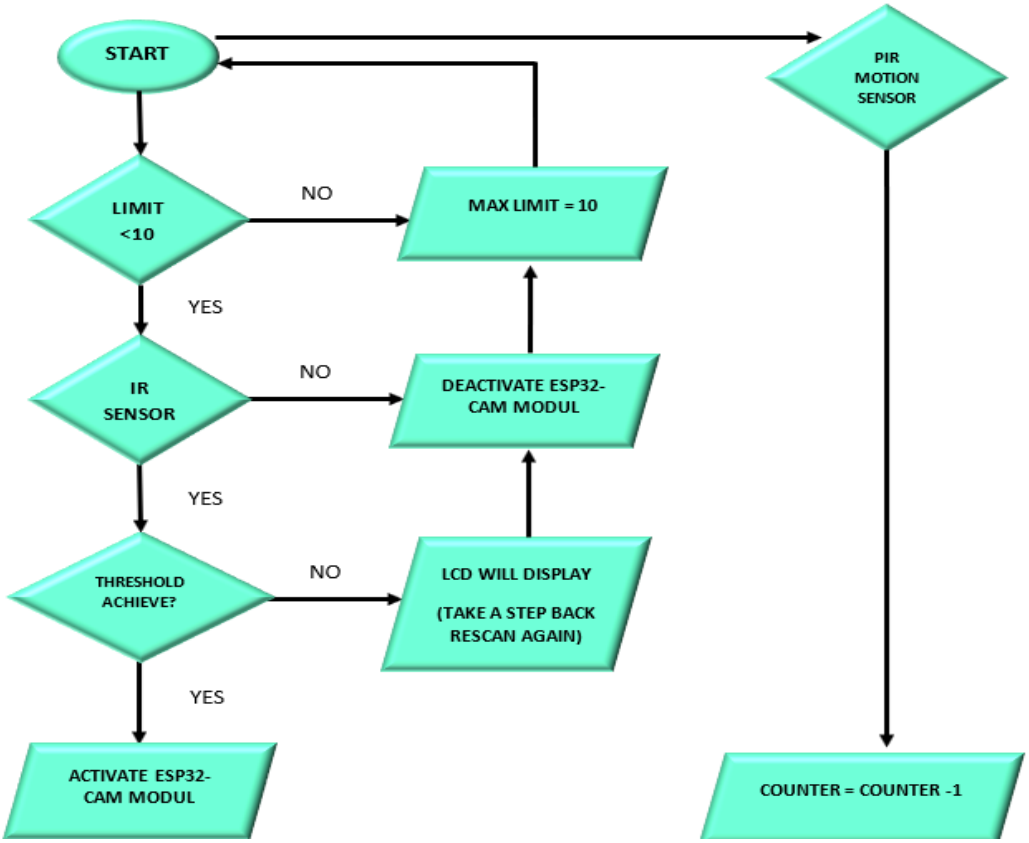


Figure 1: Phases in Product Development

When designing the system for the prototype, flowchart is needed. This is to ensure the working principle of the prototype and to arrange the programming in a systematically. The main component is decided based on the flowchart as in the figure 2.



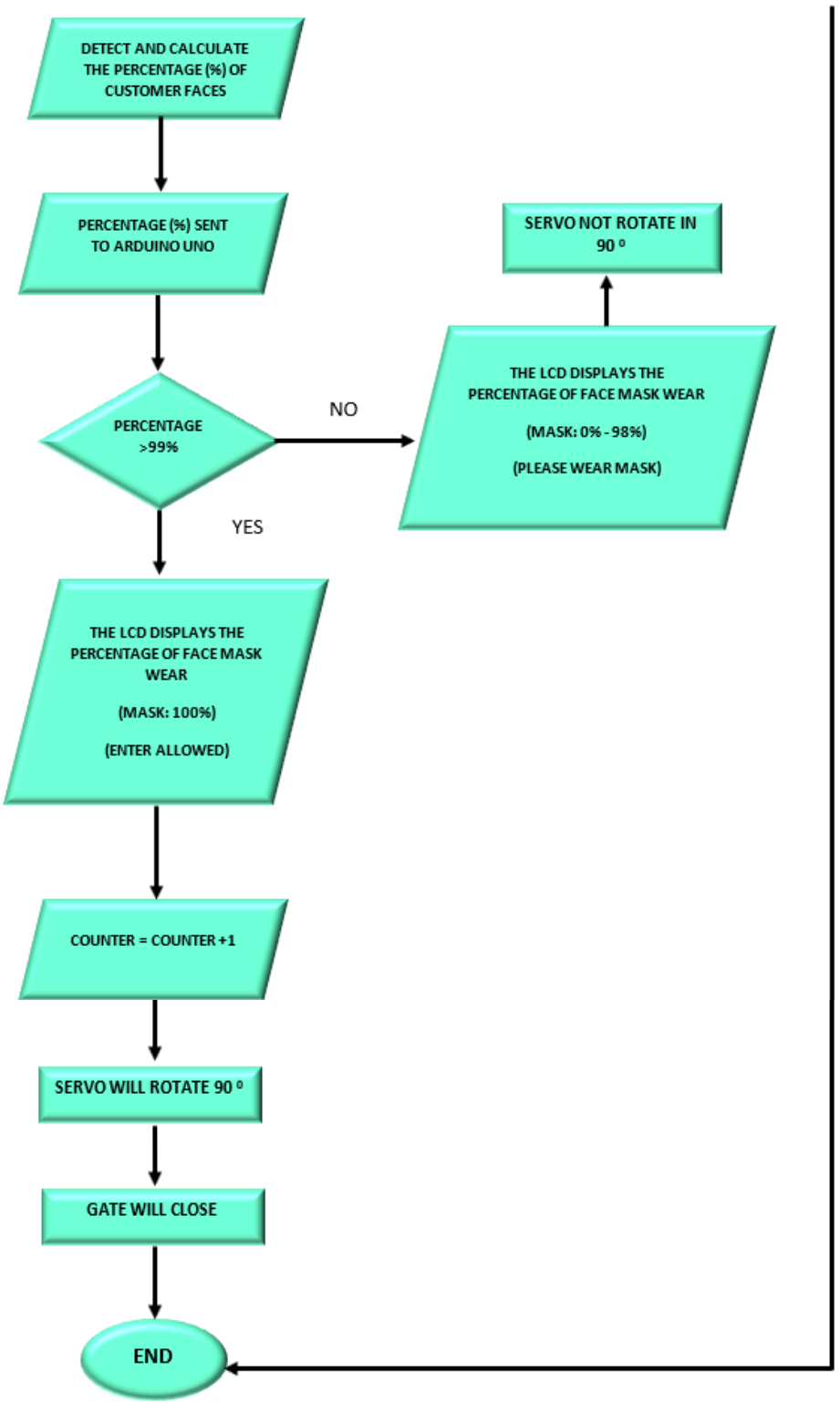


Figure 2: Flowchart of the prototype

2.3 Schematic diagram

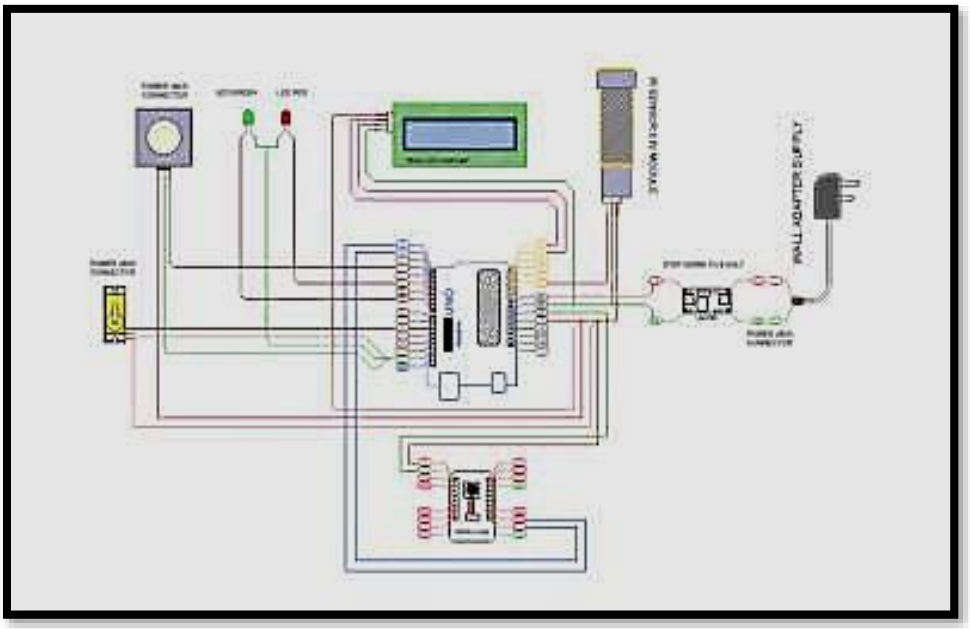


Figure 3: Schematic diagram for the connection between components of prototype

Schematic diagram was developed as in Figure 3. This schematic diagram is drawn using the AutoCAD software for better understanding the connection between components such as *ESP32- CAM*, *Arduino Uno*, *IR sensor*, *MG995 Servo Motor*, LCD, LED green, LED red, PIR motion sensor, Adapter 9V and LM 2596.

2.4 Prototype design

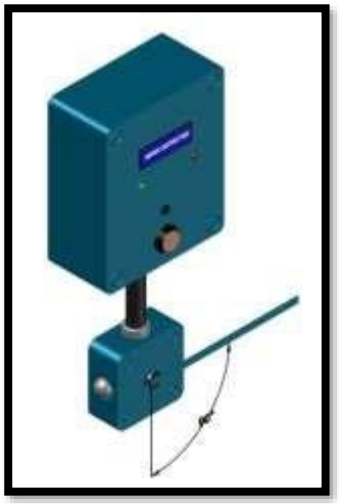


Figure 4: 3D model the prototype design

The 3D model has been made by using SolidWork to visualize the actual prototype and listing the hardware part of the prototype. Based on figure 4, the dimension could be determined for actual usage.

3. Results and Discussion

The following sub section explain in detail all the data gathered from the project

3.1 IR sensor effectiveness

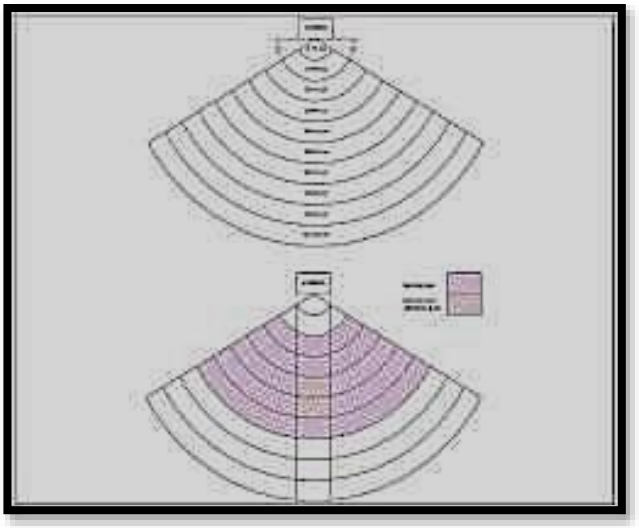
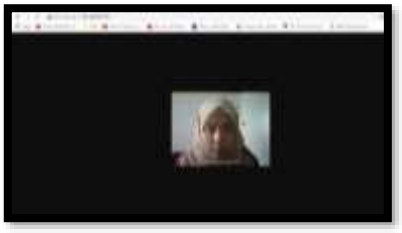


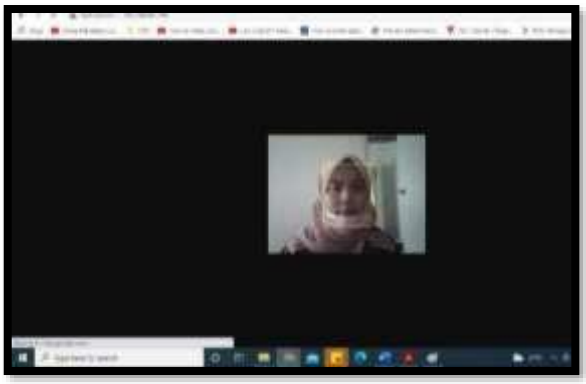
Figure 5: Operational Face Recognition Area

Analytical data that has been taken; distances are identified that need to be determined for the system to initiate facial recognition. This to ensure face recognition is done only one person at a time at a distance of the customer in front of the device. Data taken by setting the test distance scale from 0 cm to 100 cm along with the recognition time required to detect the face. To keep the customer at the distance setting, the device has used the IR sensor to help the system set the customer's facial recognition distance. Figure 5 shows the detail of area for face recognition.

3.2 Customer Face Recognition Functionality Analysis

Table 1: Customer Face Recognition Test

No	Picture	Percentage
1.	 	 The percentage of displays on the LCD is 0% because the customer is not wearing a face mask

2.	 	  The percentage of displays on the LCD is 10% because the customer is not wearing a face mask.
3.	 	 The percentage of displays on the LCD is 100% because the customer is not wearing a face mask

Data analysis on Table 1 is to determine the percentage value of wear mask for the proper way of wearing mask. The images recorded by ESP32-CAM were compared to face shapes in the database and made face detection results. The percentage value of wear mask for the prototype to allow customer to enter the premises is above 98%. The gate was control by servo motor which the rotation is 90^0.

3.3 PIR motion sensor

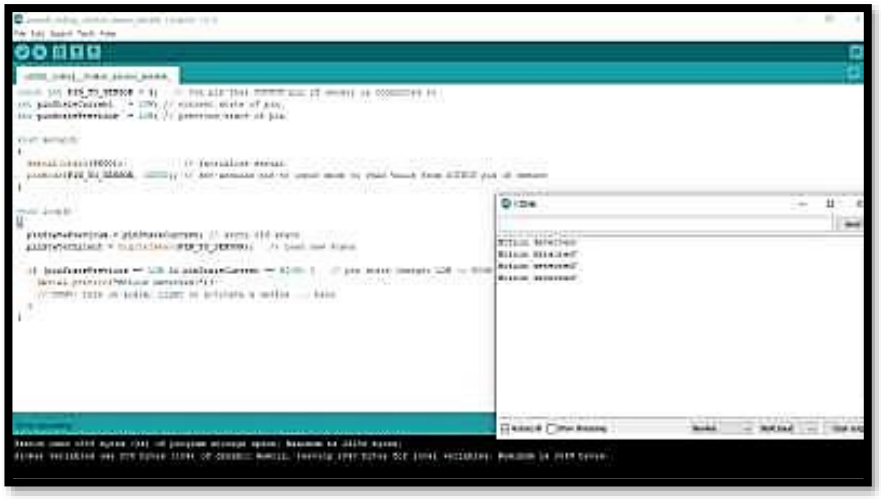


Figure 6: PIR Motion Sensor Test Result

The analysis was performed by using a sample encoding PIR motion sensor. The detection, will give a reading to the Arduino IDE monitor serial. Therefore, researchers have made several tests to determine the parameters used for PIR motion sensor detector on this product namely distance, delay and efficiency on PIR Motion Sensor. PIR motion sensor was used for detecting the customers movement leaving the premises which used as counter to limit the number of customers in the premises. The reading as in the Figure 6.

3.4 As Built Prototype

Figure 7: Full view angle of Prototype Face Mask Wearing Detection Device for Entrance Authorization

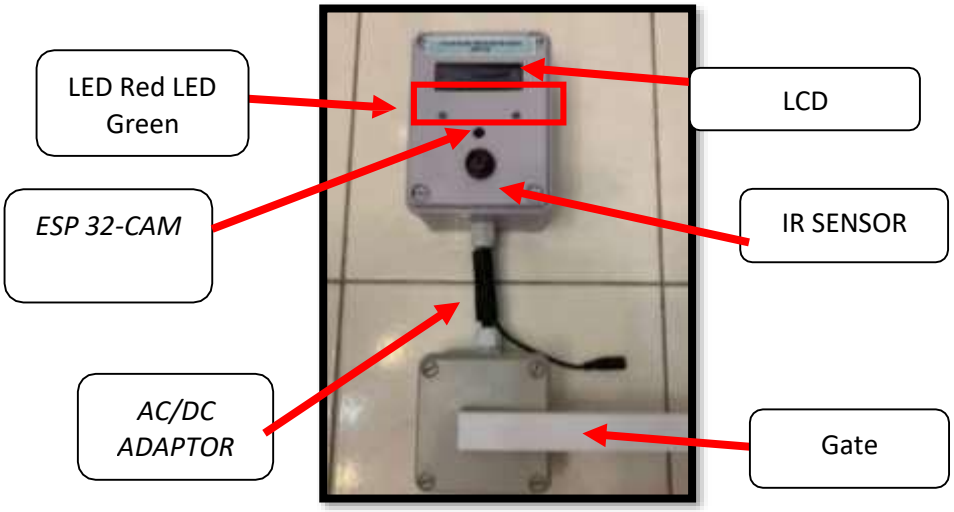


Figure 8: Detail component for Prototype Face Mask Wearing Detection Device for Entrance Authorization

The prototypes produced are characterized by lightweight, quality, durable and high-mobility materials. The price for producing this prototype is cheap due to use of economic, component and materials.

The system was built using Arduino IDE to programmed Arduino Uno and ESP32-CAM with friendly-user interface. The output of camera ESP32-CAM can be monitor the customers face using the other device which connected with the same Wi-Fi. The prototype operates when the customer approaches the IR sensor and the customer's face will be detected by the ESP32-CAM and matched to the image in the user database but if the distance setting is not reached by the IR sensor, the ESP32-CAM Module is inactive and the LCD will display "Take a step back re scan again ".

Activation of ESP32 - CAM, it will detect the customer's face whether the customer is wearing a face mask or not. The calculation of the percentage of customer face recognition implemented by the ESP32-CAM will be sent to the Arduino Uno for further decision.

If the percentage calculation is equal to or greater than 99%, the LCD will display "Mask: (percentage)" and "ENTER ALLOWED" and the Servo will rotate 90 degrees clockwise and it will rotate 90 degrees counterclockwise after a few seconds delay. While the percentage calculation is less than 99%, the LCD will display "Mask: (percentage)" and "PLEASE WEAR MASK" and the Servo will not rotate.

4. Conclusion

The analysis performed is based on the views and comments from experts in the relevant field in the expert confirmation form on the functionality and also the prototype design developed. With this analysis, experts have provided their views and comments that can help researchers for Face Mask Wearing Detection Device for Entrance Authorization more quality, more its functions to produce more efficient products.

Expert supervision on this prototype has commented that it has worked well and met the objectives of the study.

In addition, the supervision of experts has given recommendations for this prototype that is, make the addition of a temperature measuring system, clean the size of the LCD so that the output is clearer. Analysis should also be included for the production of more efficient prototypes by taking the average error rate of distance face detection. However, overall, this prototype can help the public to be more disciplined in following the SOPs set during this pandemic.

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