Final Year Design Project

Final Report

[EEE 400C]

Project Title:

COVID-19 Automatic Indoor Safety Control Through Mask, Temperature and Distance Monitoring

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Chapter 1: Introduction [CO1, CO2, CO3, CO10]

1.1 Introduction

We all know that COVID-19 is not finished yet. Already a new variant has come up named Omicron. It can affect us anytime if we do not maintain safety rules. Our daily life got stuck because of this deadly virus. So, there is no alternative without maintaining safety. We have decided to build a system named "COVID-19 Automatic Indoor Safety Control through Mask, Temperature and Distance Monitoring" by remembering these things. In order to stay safe, this project can play a significant role by ensuring the safety of everyone in busy places.

1.1.1 Problem Statement

Presently Coronavirus is the most talkative subject of our everyday life. It is hampering our daily life. Our life has halted along these lines. We don't have some other alternative without keeping up with security and cleanliness. Yet, we cannot quit everything along these lines. We need to discover an answer to defeat this virus. Assuming we attempt to keep up with specific standards, we will want to protect ourselves from COVID-19. To fight against COVID-19, we have chosen to assemble an indoor safety monitoring and controlling system.

1.1.2 Background Study

Mask detection and social distance checking methods were implemented using OpenCV, a Python version of the open-source computer vision toolkit. Measuring temperature, detecting mask using Raspberry Pi, maintaining social distance between people are the three modules of the project [1]. An exhaustive investigation into the application of cutting-edge technology such as artificial intelligence (AI), the internet of things (IoT), robotics, and unmanned aerial vehicles (UAVs) to mitigate COVID-19's impact [2]. Robots can be used to improve indoor air quality and reduce COVID-19 exposure. The prime utilization of robots is to minimize person-to-person contact and to ensure the cleaning, sterilization, and support in indoor facilities. This will result in minimizing the life threat to personnel taking an active role in the management of the COVID-19 pandemic [3].

Using YOLOv3 can find persons' presence on a road or in a restricted location. Also using a monocular camera to construct a social distance warning system [4]. Faster R-CNN is used to detect a pedestrian in a static region and the YOLO is an algorithm that detects items and runs them in real-time using a convolutional neural network model [5]. TensorFlow, an interface for expressing machine learning algorithms, is utilized for implementing ML systems [6]. Grayscale is used for extracting descriptors instead of working on color photos in real-time since it rationalizes the technique and reduces computational requirements [7]. The drone can calculate the distance between two or more individuals is greater than 100 pixels, the drone will be classified as a crowd also MobileNetV2 is a powerful feature extractor for detecting and segmenting objects [8]. A wide-angle camera module can be used to detect any violation in minimum distance between the queued individuals. Individuals and managers must also be alerted if the minimum distance between people is violated in the queue. The system will alert if an individual stray into an impermissible area for more than 5 seconds [9].

Human physiological data from different sensors can be sent to the Raspberry Pi Web server, where they are displayed on a web page. The signals from sensors are sent to the Raspberry Pi via an amplifier circuit and a signal-conditioning unit (SCU). Because the signal levels are low (gain), an amplifier circuit is used to boost the signal and transfer it to the Raspberry Pi [10]. Using an MLX90614 temperature sensor, which may give quick and precise temperature readings without requiring physical touch. It also has a voice output function that can be used by people who have trouble seeing. The error caused by this system is 0.05, which indicates that it is accurate and acceptable [11].

Recently, numerous Face Detection algorithms have been specifically designed for face mask detection. A transfer learning model was designed with ResNet-50 for feature extraction and SVM for classification [12]. Although the method achieved high accuracy on multiple datasets, the datasets were not complex enough to generalize for all types of complicated real-world applications such as face detection on streets, public areas, etc. A Single-Shot Detector was proposed with MobileNetV2 for face mask detection achieving an accuracy of 92.64% on their self-prepared dataset that is a combination of multiple publicly available datasets [13]. A method was designed to detect medical masks in an operating room [14]. The combination of two detectors, one for faces and another for medical masks, enhances the models' performance, achieving 95% accuracy in detecting faces with surgical masks.

With recent worldwide events, a lot of studies related to the prevention of virus spreading prevention are being carried out. One of the most important topics in human body temperature monitoring. A very recent article entitled "Investigation of the Impact of Infrared Sensors on Core Body Temperature Monitoring by Comparing Measurement Sites" [15] does a very good evaluation of the performance of industrial thermometers when used on different target areas, like the tympanic or forehead. By comparing the relationship between facial skin temperature measured using an IRT and a direct thermometer, it was established that a safe threshold for fever would be 35.5 degree Celsius [15]. The tympanic definitely has a temperature that is very close to the core temperature of the human body [16, 17]. However, measuring tympanic temperature is not an easy process, as it requires the probe to be adjusted to the shape of the ear canal. More importantly, in the context of facing a global pandemic of a virus with an extremely high contagion rate, this accurate method is not a solution. At the moment, forehead temperature determination through IRTs is widely used across the globe as screening of potentially infected people, as it is convenient, non-invasive, and without risk of mutual infection. It has proven its effectiveness during the SARS era [18]. However, IRT devices don't exactly have proven reliability [19]. When using a non-contact IRT it came to the conclusion that a higher temperature than 35.6 degree Celsius could be considered as fever [20].

In recent years, object detection techniques using deep models are potentially more capable than shallow models in handling complex tasks and they have achieved spectacular progress in computer vision [21]. Deep learning object detection models [22] can now mainly be divided into two families: (i) two-stage detectors such as R-CNN [23], Fast R-CNN [24], and Faster R-CNN [25] and their variants and (ii) one-stage detectors such as YOLO [26] and SSD. In two-stage detectors, detection is performed in stages, in the first stage, computed proposals and classified in the second stage into object categories. However, some methods, such as YOLO, SSD MultiBox, consider detection as a regression issue and look at the image once for detection.

1.1.3 Literature Gap

Using MLX90614 could be more efficient for this project. MLX940 is a temperature sensor that needs human contact. But in this pandemic, people should avoid human contact as much as possible [1]. Improving air quality won't be enough for reducing Covid-19 exposure [3]. Using YOLO V4 or Faster R-CNN could make the object detection system faster [4]. YOLO imposes strong spatial constraints on bounding box predictions since each grid cell only predicts two boxes and can only have one class [5]. They have trained their model by using only 2 types of masks. They should have used more types of masks [6]. For all datasets, there was a significant gap between the top-performing and worst-performing methods [7]. Implementing a temperature detection system could have made this project complete [8]. They could have extended the detection for the complete floor area, contact tracing, and support for additional queues. The system could be extended easily with minimal time and is quickly adaptable to different situations [9]. They are using a temperature sensor that needs human contact [10]. The proposed system also counts the number of people entering the premises. So that they can set a number limit for reducing the physical contact between people. But for a bank or university, it would be very tough to set a number limit [11]. This device will not be helpful for those people who do not have hands [12]. This design contains 117,264 training images and 5000 testing images with 80 classes. Moreover, this system is very complex [13, 14]. ESP8266 and Arduino Uno are the same with the programming perspective but ESP8266 doesn’t have much computational power in comparison to Arduino Uno [15]. Detecting objects on different scales is challenging in particular for small objects [21]. The algorithm requires many passes through a single image to extract all the objects [24]. YOLO performs poorly on small objects [26].

1.1.4 Relevance to current and future Industry

Recently Jamuna Future Park authority has launched a safety monitoring system, which will check an individual's face mask and measure body temperature. Since this is a test subject, there might be some unknown consequences. The future industry is still uncertain as this was launched recently. So, after some test cases and public feedback, the system can be improved or developed according to customer satisfaction. In order to stay safe, this project can play a vital role by ensuring the safety of everyone in busy places.

1.2 Objectives, Requirements, Specification and constraints

1.2.1. Objectives

- Ensuring health safety in indoor facilities.
- Contributing to our society in order to tackle this deadly virus.
- Assisting Bangladesh in regaining its prior economic status.
- Working as a barrier to minimize the spread of COVID-19.

1.2.2 Functional and Non-functional Requirements

Functional Requirements

- Implementing an organized and friendly verification system.
- Continuous electric supply & internet connectivity.
- Making a fully automated system.

Non-Functional Requirements

- To implement the entire system using common PVC/Plywood to establish the main structure.
- To establish the system in such a way that is more effective in ensuring social distance by adding an alarm and visual feed.

1.2.2 Specifications

<u>1st Approach</u>

Sub-System	Requirements	Components	Specifications	Comment
Mask Detection System	Central Processing Unit	Arduino Uno	• Operating Voltage: 5V • Input Voltage:7-12V • Output Voltage: 6-20V • Digital I/O Pins: 14 pins	Used to detect if an individual is wearing a mask and to operate the temperature-sensing unit.

	Facial Recognition	ESP32-CAM WI-FI + Bluetooth Camera Module	• Wi-Fi BT/BLE SoC module. • Low-power dual-core 32-bit CPU processor. • Support OV2640 and OV7670 cameras with built-in flash.	It will scan the face and detect the mask.
		HC-SR04 sensor	• Operating voltage: +5V • Theoretical Distance Measuring: 2cm to 450cm • Practical Measuring Distance: 2cm to 80cm • Accuracy: 3mm • Measuring angle covered: <15°	ESP32-CAM need a certain distance to scan face and that is why we are using this ULTRASONIC SENSOR to let them know the required distance.
Temperature Sensing System	Temperature sensing	MLX90614 temperature sensor	• Small size, low cost. • Factory calibrated in a wide temperature range: -40 to 125 °C for sensor temperature and -70 to 380 °C for object temperature. • High accuracy of 0.5°Cover wide temperature range. • Measurement resolution of 0.01°C. • Power saving mode.	Used as a temperature sensor to differentiate between normal and high temperature.
Distance monitoring	Central unit	ESP8266 module	• Wi-Fi enabled • Arduino like hardware IO • Advanced API for hardware IO • Code like Arduino • 10 GPIO • PCB antenna	Used to work as a transmitter and as a receiver at the same time to measure the distance between 2 devices.

2nd Approach

Sub-System	Requirements	Components	Specifications	Comment
Mask Detection System	Central Processing Unit	Raspberry Pi 4	• CPU: Quad Core Cortex-A72 ARM (v8) 64-bit SoC. • Speed: 1.5GHz. • Ram: LPDDR4-3200 8GB. • Networking- 1 IEEE 802.11ac Wireless Connection at 2.4 GHz and 5.0 GHz • 1 Bluetooth 5.0 and BLE Wireless Connection.	Used to detect if an individual is wearing a mask and to operate the temperature-sensing unit.
	Facial Recognition	Pi camera	• The sensor has a native resolution of 5 megapixel. • In terms of images and video, the camera is capable of 2592x1944 pixel static images, and supports 1080p30, 720p60 video.	Used to scan an individual's face and detect a mask.
Temperature Sensing System	Temperature sensing	MLX90614 temperature sensor	• Small size, low cost. • Factory calibrated in a wide temperature range: -40 to 125°C for sensor temperature and – 70 to 380°C for object temperature. • High accuracy of 0.5°Cover wide temperature range. • Measurement resolution of 0.01°C. • Power saving mode.	Used as a temperature sensor to differentiate between normal and high temperature.
Social Distance Maintain System	Distance Measurement	Wi-Fi 360 Degree CC Camera	•CCTV Type - 360 Degree. •Sensor - 1/2.7" CMOS 2MP WDR Sensor. •White Balance - Auto / Manual. •Lens - 1.56mm lens. •Video Resolution - 1080p Full HD.	Will be set on the wall to give live video feed for distance measurement.
Door System	Security Door	SG90 9G Micro Servo Motor	• Operating Speed: 0.12sec/60 degree (4.8V) ~0.1sec • Torque: 1.6kg/cm (4.8V) • Servo Type: Analog Servo.	Used to rotate the gate lever.

Constraints

- Limited space restriction on public or narrow places.
- For best outcomes, some of the components are not budget friendly.
- Proper lighting system.
- Continuous electric supply & internet connectivity.

1.2.3 Technical and Non-technical consideration and constraint in design process

Technical Considerations

- Availability of components.
- Easy components interfacing.
- Cost effective.
- Easy maintenance.

Non-technical Considerations

- Advertising.

1.2.4 Applicable compliance, standards, and codes

Name	Standard Number	Definition	How it affects the solution
Automatic System Management	IEEE 828	Software configuration management is the task of tracking and controlling changes in the software also revision control.	This system focuses on controlling each sub-system through few software and providing results automatically.
System Architecture	IEEE 1471	A system architecture can consist of system components and the sub-systems developed, that will work together to implement the overall system.	This solution has a flowchart (conceptual diagram) that represents the whole architecture of this system.
Wireless Fidelity (Wi-Fi)	IEEE 802.11	Wireless Fidelity is a standard developed by IEEE 802.11, which tells the accuracy of the given signal in terms of range and quantity of data.	This technology is used in the distance monitoring subsystem where we fetch the data from the camera and run YOLOv3 for distance measurement.

International Electrical Code	NFPA 70	NEC is the benchmark for safe electrical design, installation, and inspection to protect people and property from electrical hazards.	Our project follows all the proper guidelines given by NFPA.
Quality Management System	ISO 9001:2015	Quality management is the act of managing all activities and functions needed to maintain a consistent level of excellence in an organization, product or service.	Our project has the ability to manage all activities and functions to achieve our goal properly.
Medical Surgical Mask	YY0469:2011	The standard specifies the technical requirements, test methods, marking and instructions for use and packaging, transport, and storage.	We are providing these medical surgical masks in our vending machines.

1.3 Systematic Overview/summary of the proposed project

This system will ensure full safety before entering into a bank, office, university etc. This system contains three sub-system and those are, mask detection, contactless temperature and social distance measurement system.

1. Mask Detection System

In this subsystem, the primary purpose is to detect whether people are wearing masks or not. If someone is not wearing a mask, this system will detect the problem and show on the LCD “No Mask, No Entry.” If someone fulfills the criteria of this system by wearing a mask, the system will automatically move to the next subsystem by giving a green signal.

2. Measuring Body Temperature

This is the next stage of this system. Here it will measure the temperature of each individual, whether their temperature is within average human temperature or not. If the temperature exceeds the normal range of temperature, the system will detect it, and on the LCD, it will show "TEMPERATURE IS HIGH." And if someone's temperature is below the threshold temperature, the system will send a signal to the servo motor, and the door will open.

3. Social Distancing System

After entering the office, visitors will collect a wearable device. They have to wear it as a wristwatch. An ESP8266 Wi-Fi module, led, buzzer, and the battery will be used to build this system. It will ensure a safe distance. If the distance between two people is less than 3.3 feet, it will alert them by turning on the buzzer and led. If they maintain a safe distance, it will remain as it is. That's how this system will work.

1.4 Conclusion

After implementing the above system, it can automatically solve three problems (ensuring wearing masks, maintaining social distance, and measuring temperature) that people face in this pandemic situation with a very low budget and without any human intervention.

Chapter 2: Project Design Approach [CO5, CO6]

2.1 Introduction

To get the desired outcome, we have identified two design approaches. One of our designs is decentralized and the other one is centralized. The working procedure of these two designs are different, but give the specific desired output.

2.2 Identify multiple design approach

There are three sub-system in the project which are Face mask detection, measuring human body temperature and Maintaining social distances. The first design approach is decentralized.

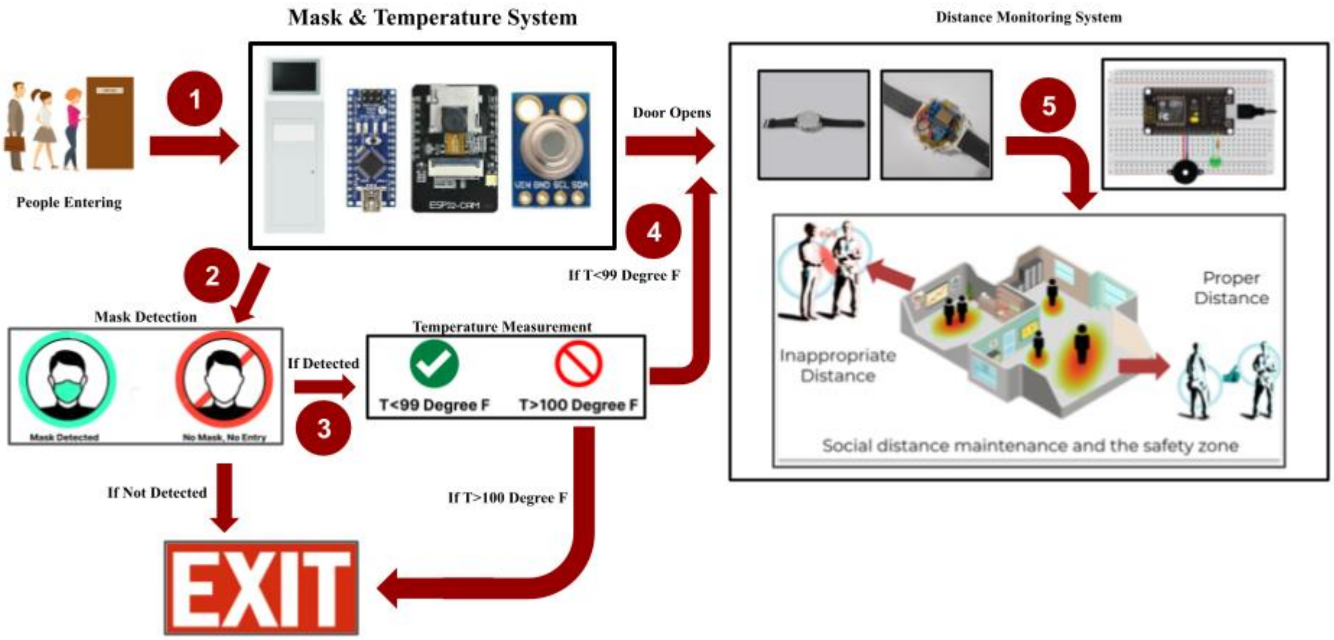


Figure [1]: Graphical diagram of the proposed system.

The second approach is centralized and it also makes sure of the three safety precautions.

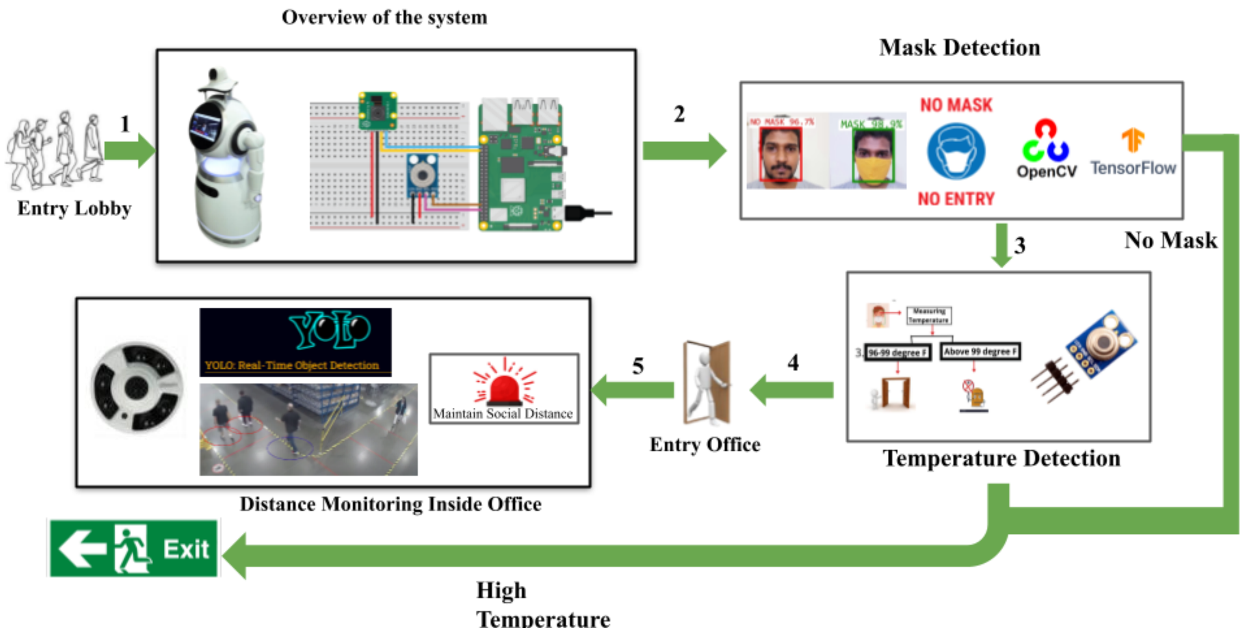


Figure [2]: Graphical diagram of the alternate system.

2.3 Describe multiple design approach

First Approach:

For our first approach, we decided to go with a decentralized system. In this approach, the first step is measuring human body temperature, and if the condition is fulfilled, the system will go for the next step, detecting face masks. Arduino Nano will command these two subsystems. After passing these two steps, the door will be automatically opened. Then every individual will take a portable device to make sure people are maintaining proper distance in the office or not. In addition, the distance monitoring subsystem works independently without any connection with the Arduino NANO we used previously. In this project, we are using Arduino NANO, 16x2 LCD, MLX90614, Ultrasonic Sensor-Sr04, Servo Motor, LED Green and Yellow, Potentiometer, Button, ESP8266, Buzzer, Vibrator Motor, 150mah Battery, TP4056 Charging Module, 5V Power Supply, ESP32 Cam, Connecting wires, Resistor- 10k, 220ohm.

In measuring body temperature, the MLX90614 temperature sensor uses its code. When people enter, data will be sensed by the MLX90614 sensor, and then it will give a signal to the Arduino. Then the Arduino will show its result on the LCD. For example, suppose someone's body temperature is below 100-degree Fahrenheit. In that case, the LCD will display "Temperature is normal," but If the temperature is 100 or above 100 degrees Fahrenheit, it will show "Temperature is High, please exit." Then it will go to the next step, which is detecting face masks. We take thousands of pictures with masks and without a mask for face mask detection, which we have collected from the internet. Then we submitted all the samples to the "Teachable Machine" website, and then it automatically developed and trained it properly. After that, we upload the code into ESP-32Cam, which will stream video and detect the face masks of every individual. ESP32-CAM needs a certain distance to scan faces, and that is why we are using this ULTRASONIC

SENSOR to let them know the desired distance. People will maintain a 35 to 60cm distance from the camera to scan their faces. If not, the camera will not scan their face and ask them to come closer or take a step back. To pass the scan, they need to pass the threshold value, which is 80% of their face covered. After scanning the face, the output will be shown on the LCD. If someone does not wear a mask, the LCD will show “No mask is detected, please exit,” and if someone wears a mask, it will show the “Accuracy level” and then “Thank you for wearing the mask.” Arduino NANO will command this whole process.

Then if our system detects all actions are okay, it will open a drawer in which distance-monitoring devices will be kept. After collecting the device, our system will automatically open the door to enter. For distance measurement, our first target was to monitor the distance indoors. We made devices for each person to carry to fulfill that requirement. We can implement the device in three different designs depending on the preference of our stakeholders. After our temperature system measures a person's temperature to be normal, a drawer will open, and the people will take one device from it. Next, they will press the button to power up the device, and our system will activate. Each of our devices consists of an ESP8266 module, a buzzer, a led and a battery. We chose the ESP8266 because it does not require any microprocessor and we can easily upload any code directly using the built-in Wi-Fi. Our device will constantly check for another device in its range, and at the same time, it will send a signal. It determines the distance value by calculating the RSSI (Received Signal Strength Indicator) value. So, whenever two devices' signal strength becomes powerful, our buzzer and led will turn on. Thus, the person will know they are breaking the safe distance protocol and the buzzer and led will not turn off until they maintain a distance of more than 3.3 feet.

Second Approach:

For our second approach, we decided to go with a centralized system. The mask detection, temperature measurement, and distance monitoring subsystems work from a single Raspberry Pi 4B board for all three of our subsystems. To fight against COVID-19, everyone should wear a facemask, and to ensure this safety precaution, we have designed our project accordingly. We are using some hardware components such as Raspberry Pi 4B, PI CAMERA, LCD, 360 Degree Wi-Fi Camera, and building the code by using Machine learning. Our system will automatically detect each individual's facemask through a Pi camera. The Pi camera will be connected with the Raspberry pi to make this system. We use a pi camera in this subsystem because it has a 5MP OmniVision OV5647 sensor in a fixed-focus module with a replaceable Lens. It also provides a High-Definition video camera for Raspberry Pi 1080p Max video resolution and 30fps max frame rate.

At first, we will train our model, people with and without facemasks and train this model. We have collected pictures of with and without masks with different face shapes and face angles. After that, we will build the code using Machine learning. This code will send necessary data to the Raspberry pi, and the pi camera will scan the face to detect the facemask. Then it will show that "Mask is detected" or "Mask is not detected" on the LCD. If someone is not wearing a mask, our system will not allow them to take the next step and it will command them to exit.

On the contrary, if the mask is detected, our system will continue its process automatically by going to the next step, measuring the human body's Temperature. For our other approach, we will use the same temperature sensor. Still, the microcontroller will be Raspberry pi, and we will code in Raspberry pi software for temperature detection. Still, there will be no portable device to carry in this process so that the gate will automatically open for the next step. However, the result will also be given in the LCD monitor based on the correct which if the Temperature is more than 100 degrees Fahrenheit, it will show that the Temperature is High, and If one's Temperature is below 100, it will show the Temperature is average please enter. Our distance monitoring subsystem works alongside the other two subsystems on this system. To maintain a safe distance indoors, we use several cameras to cover the whole premises. We will use the 360 Degree Wi-Fi camera because it has a built-in Wi-Fi module that will help us acquire that data directly in our Raspberry Pi. Raspberry Pi 4B also has a built-in Wi-Fi system to receive the video feed and run the designated code. For this system, we are using a YOLOV4 darknet-based real-time machine learning system to determine the distance between the people. If anyone breaks the safe distance threshold, our system will alert them by turning the buzzer and led. The alarm will only stop after no one on the particular premises breaks the safe distance of 3.3 feet. So, we will run the YOLOV4 on the received webcam feed from the cameras and turn the alarm whenever someone violates the safe distance protocol.

2.4 Analysis of multiple design approach

After going through many reference papers and with proper simulation, the most optimal design is the decentralized one. The overview of both the design and their result based on different aspects is as follows:

- **Cost:** The total cost of the first approach is around 8,184 BDT. On the other hand, the total cost of the second approach is about 35,000 BDT. Therefore, we can notice that the first approach is more cost-effective than the second one.

- **Criticality:** We are using Arduino IDE code for the first approach, and for the second approach, we are using machine-learning code. Machine learning is very complicated. Therefore, we can declare that the first approach will be the best option for these criteria.

- **Success rate:** The success rate for the first design approach is higher in terms of mask, temperature and distance monitoring. In the second design approach, the success rate may vary depending on many factors.

- **Task dependencies:** The first approach is decentralized, independent and sequential. However, the second approach is centralized and interrelated and integrated. The first approach will be the best option for this project in this criterion.

● **Environment sustainability:** The equipment we are using does not require any fossil fuel or high-power consumption, or gas leakage that will significantly affect our environment. Both approaches are environment-friendly.

● **Maintainability:** Our first system will be connected in front of a door. Therefore, there is not any risk of being stolen. However, the robot used for the second approach is wireless. Thus, anytime it might be stolen. In this criterion, the first approach will be suitable.

After considering all the criteria and simulation results, we have decided to choose the first approach as our optimal solution.

2.5 Conclusion

After considering all the criteria, the most suitable approach is the decentralized system based on many criteria, which are cost, efficiency, usability, manufacturability, impact etc. So, based on this factor, implementing this project's hardware will be much more user-friendly to all and reliable in tackling this Covid-19 spread.

Chapter 3: Use of Modern Engineering and IT Tool [CO9]

3.1 Introduction

To design, develop and validate the solution for the prototype of this project, we have used some modern engineering and IT tools. We have selected these tools as per our prototype requirements.

3.2 Select appropriate engineering and IT tools

Hardware parts	Software parts
Arduino Nano	Arduino IDE
ESP32-Cam	Proteus Design Suite 8.11
Ultrasonic Sensor	Eagle
LM2596 Module	
LCD	
MLX90614 Sensor	
Servo Motor	
NodeMCU ESP8266	
A buzzer and led	
Battery	
PCB	

3.3 Use of modern engineering and IT tools

For the Mask detection process

Arduino Nano: We are using Arduino Nano for the prototype design. We are using this microcontroller to monitor the people wearing masks or not and the temperature of the human body. It will also be used to open the gate after having accurate mask and temperature results.

ESP32-Cam: We are using this ESP32-Cam module to scan faces because it's inexpensive and easy to use and is perfect for IoT devices requiring a camera with advanced functions like image tracking and recognition. This module will scan the face.

Ultrasonic sensor: We are using that Ultrasonic Sensor because ESP32-Cam needs a certain distance to scan the face. An ultrasonic sensor will alert whether people need to come closer or take a step back.

LM2596 Module: LM2596 module is a buck converter; step-down voltage regulator. After giving a 9V supply to the LM2596 module, it will convert 9V to 5V and supply that 5V to ESP32-CAM.

LCD: We are using LCD to show the output of mask detection and measurement of temperature.

For Temperature Measurement

MLX90614 Sensor: This is the non-contact temperature measurement device for this project. Many Features and benefits are as follows: small in size, low cost, Easy to integrate, Factory calibrated in the wide temperature range. - Invisible to the human eye, all objects emit infrared light, and the concentration varies with temperature. The sensor moves toward what we want to measure, and it will detect the temperature by absorbing IR waves emitted.

For Distance Monitoring

Node MCU ESP8266: We are using this module because it has built-in Wi-Fi and Bluetooth, which will help us send and receive the RSSI value from another module.

A buzzer and led: We are using the buzzer and led to alert the person that they are breaking the safe distance protocol and need to move to a safe distance of more than 3.3 feet.

Battery: We are using a 5V battery to power up each device.

PCB: We will use a PCB to make a compact design, which will hold all the other parts, and this will help us with wiring issues.

Arduino IDE: We are using Arduino IDE software to upload the code of controlling the system intro Arduino Nano, detecting mask into ESP32-Cam, measuring body temperature into MLX90614 sensor and distance monitoring into our ESP8266 module.

Proteus Design Suite 8.11: We use Proteus software to make our PCB layout.

3.4 Conclusion

In this chapter, we have discussed the modern engineering and IT tools we are using for the prototype of this project. And all the tools we have selected for the prototype are IEEE recommended, and these tools are appropriate for implementing the prototype to get the desired outcome.

Chapter 4: Optimization of Multiple Design and Finding the Optimal Solution [CO7]

4.1 Introduction

Two design techniques have been discovered to achieve the desired result. One of our concepts is decentralized, while the other is centralized. These two designs have different functioning procedures, yet they produce the same result. After many test results, simulations, and field test cases, we came across our desired optimal design approach with proper explanation and data table.

4.2 Optimization of multiple design approach

1st approach:

Mask Detection: In the first approach, we are using Arduino NANO, ESP32-CAM, Ultrasonic sensor, LM2596 and LCD, and we are using Arduino Code to run the system using Arduino IDE Software.

Arduino NANO: Here, Arduino is the main microcontroller which will do the mask detection and temperature measurement process. It is inexpensive, and it is much more user-friendly to use. Arduino simplifies a large amount of work that needs to be done to get a running system.

ESP32-CAM: The ESP32-CAM is a full-featured microcontroller with an integrated video camera and micro-SD card socket. It is inexpensive and easy to use and is perfect for IoT devices requiring a camera with advanced functions like image tracking and recognition.

Ultrasonic Sensor: The ultrasonic sensor has high frequency, high sensitivity and high penetrating power; therefore, it can easily detect external or deep objects.

LM2596 Module: This module can provide all the active functions for a step-down (buck) switching regulator, capable of driving a 3-A load with excellent line and load regulation.

LCD: We are using LCD to show the output.

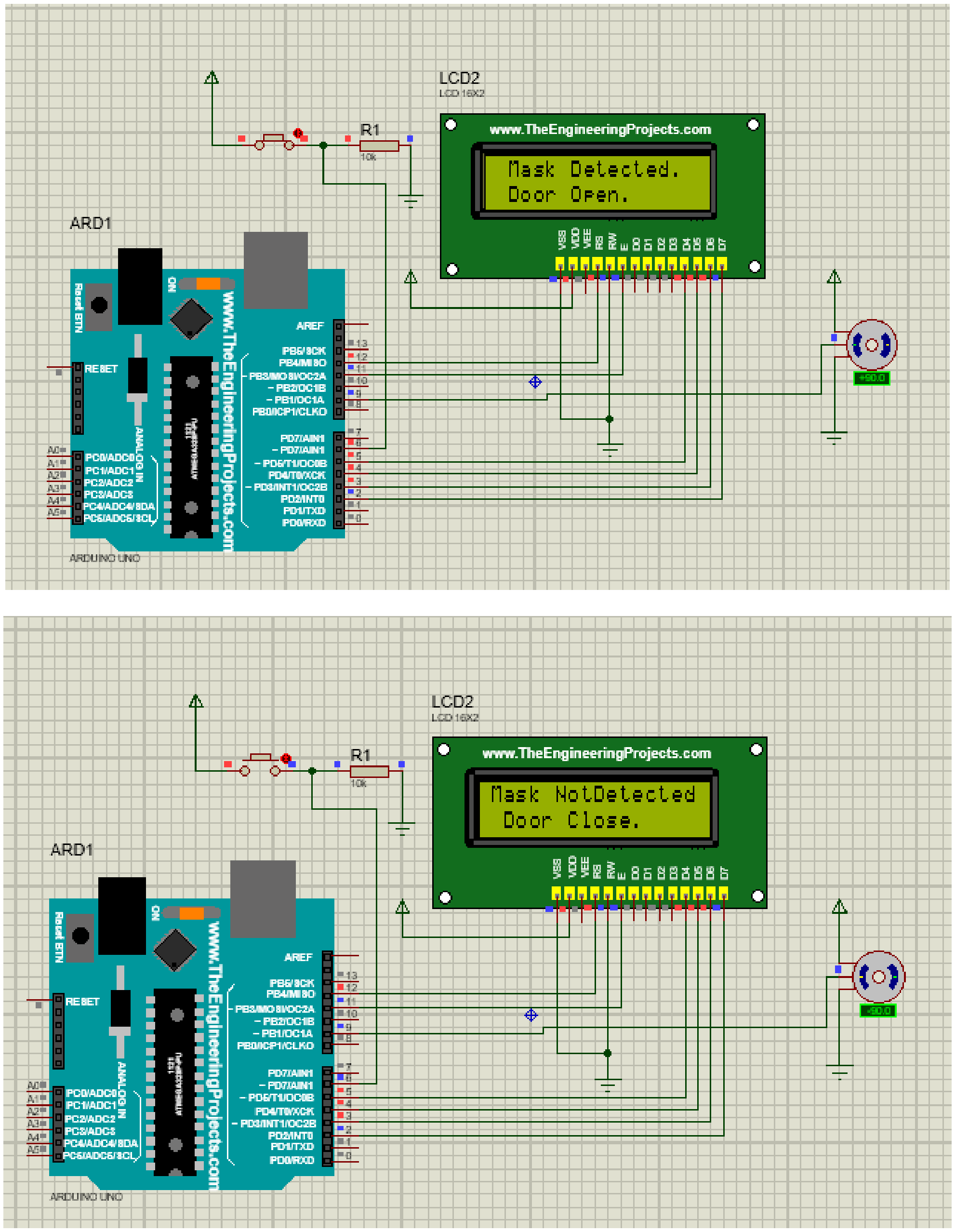


Figure [3]: Proteus implementation of the mask detection sub-system for 1st approach.

For our Software simulation process, we are using Arduino UNO, LCD, and Servo motor. We will use ESP32-CAM for our hardware implementation, but that device is not available on Proteus. To make you understand, we are using the built-in camera of a laptop. After connecting all the equipment and implementing the code in Arduino IDE software, we can observe the simulation result as per our objective. After capturing the image of an individual, it will compare the picture with our trained model. Then if the person is wearing a mask, the "Thank you for wearing a mask" text will appear on the LCD, or if the person is not wearing a mask on their face, the "Please, wear a mask" text will appear.

Temperature Measurement

To functionally verify and check the temperature of each individual, we have used an Arduino and LM35 sensor for measuring the temperature. For our hardware implementation, we will use MLX90614, but for our Proteus design and MLX90614 not being available in Proteus software, we simply used LM35 to check our verification. Therefore, after connecting all the equipment and implementing the code in Arduino IDE software, we can observe the necessary test result as per our objective. When the temperature exceeds 38 degrees Celsius, it will be measured as a high temperature. As a result, people will not be able to enter.

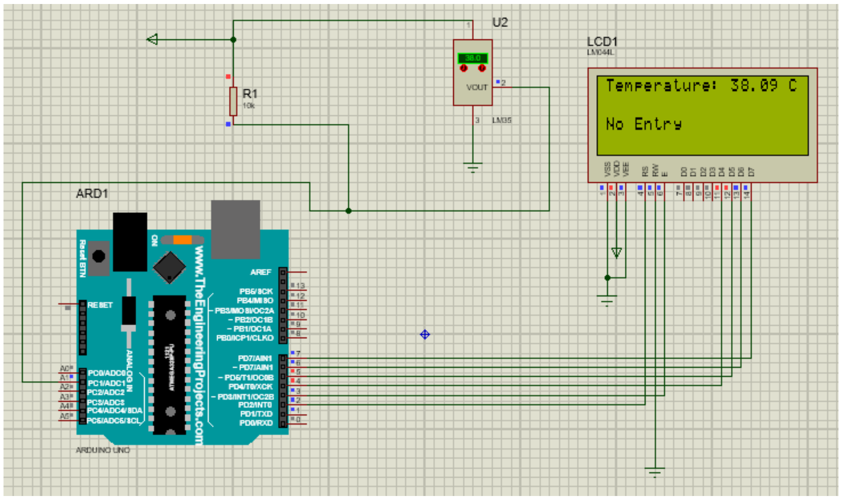


Figure [4]: Proteus implementation of the temperature sub-system for 1st approach.

When temperature is beyond 38 degree Celsius, it will be measured as high temperature. As a result, people will not be able to enter. Moreover, if the temperature is less than 37 degree Celsius it will be measured as normal temperature so people will be able to enter.

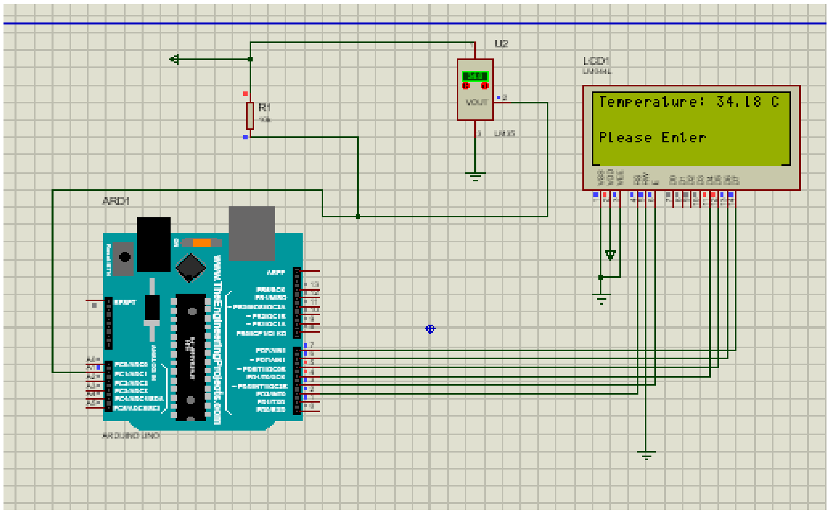


Figure [5]: Proteus implementation of the temperature sub-system for 1st approach.

Distance Measurement

In the devices we made for the distance monitoring system, we considered different sensors like:

LM393: The distance this sensor gives depends on the amount of light in a room, and it can cover a tiny area.

HC-SR04: This ultrasonic sensor is quite assertive in detecting objects more than 1.5m away. But, we cannot tell a person apart from any object.

RFID: To use RFID, we need to use a passive RFID sensor, which has an increased range compared to active RFID. However, the cost would increase, which is not feasible.

ESP8266: We decided to use this sensor because it is a compact microcontroller with a Wi-Fi microchip. It also has RSSI to measure the distance and location of devices.

Our device only consists of an ESP8266, buzzer, led and a battery, which keeps the cost of our device very low. In terms of range, we know that the closest signal strength is the distance of 1.5m to 2m, recommended by WHO, which is -50dBm. However, we found that the strength of this signal also depends on the direction of the bracelet. In the extreme case, where the bracelets point in opposite directions, the -50dBm signal will be detected when the devices are between 1m and 1.5m from each other. A controlled test with two devices, where one was kept fixed and the other at different distances, gives us the below graph. The graph in Figure was used to estimate the distance from measuring Wi-Fi signal strength.

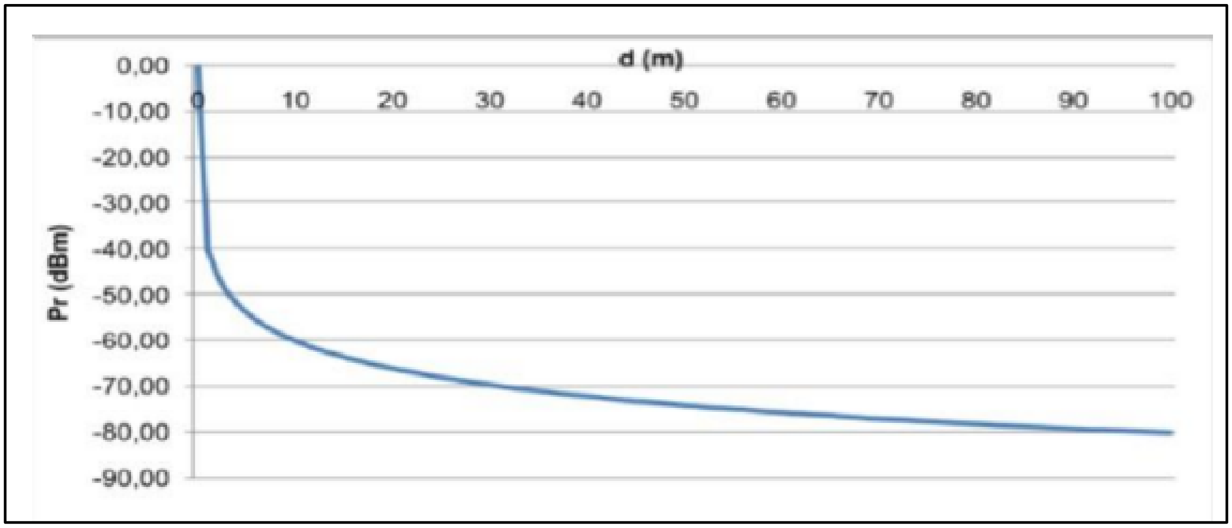


Figure [6]: RSSI x Distance. [27]

We are doing the coding for our device using Arduino IDE software, and we can upload it to our module by directly connecting it or with Wi-Fi. Therefore, it is very convenient. Next, if any components malfunction, we can easily swap them at less cost. In addition, as the devices are decentralized, if any of the devices are corrupted, that would not affect our operations. To keep our response time as low as possible, we used a unique ID and Password for each device. Therefore, our devices can work in synchronization and quickly give us results.

We are using an ultrasonic sensor with Arduino UNO to simulate the system. We are using the Arduino UNO instead of the ESP8266 module here. Because the transmitter and receiver procedure cannot be shown in Proteus, we use an ultrasonic sensor with a potentiometer to simulate the process. Here, whenever someone comes closer than the safe distance (6 feet), our buzzer and led turn on until they move to a distance greater than 6 feet. We are changing the distance by changing the value in the potentiometer.

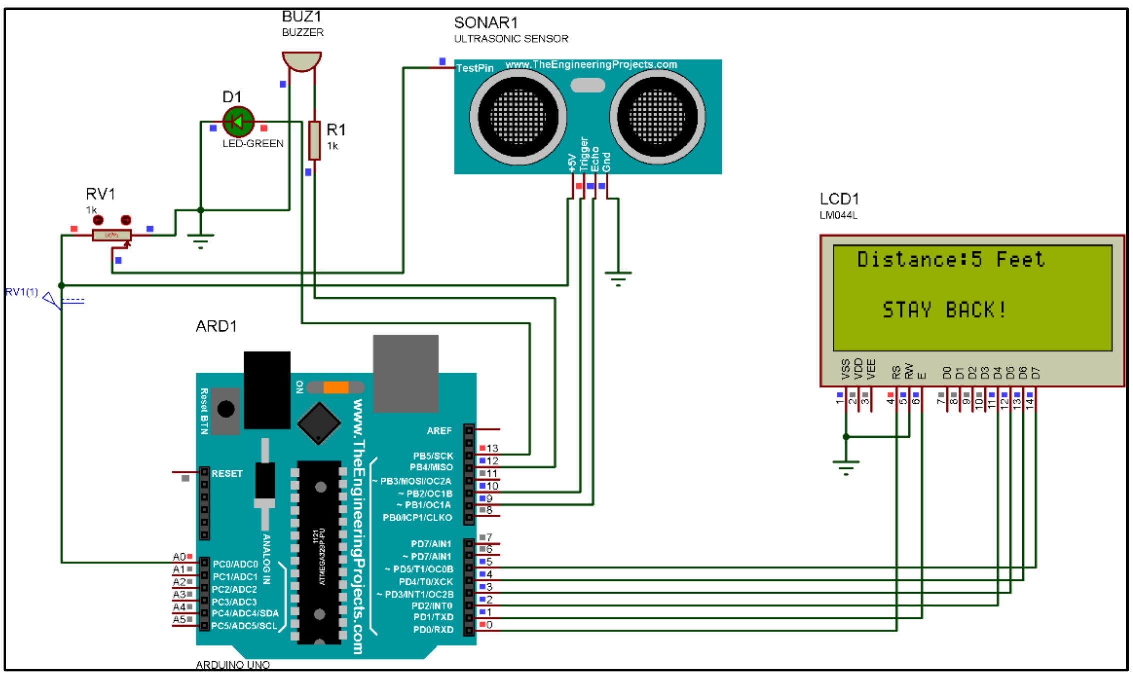


Figure [7]: If distance is less than 6 feet.

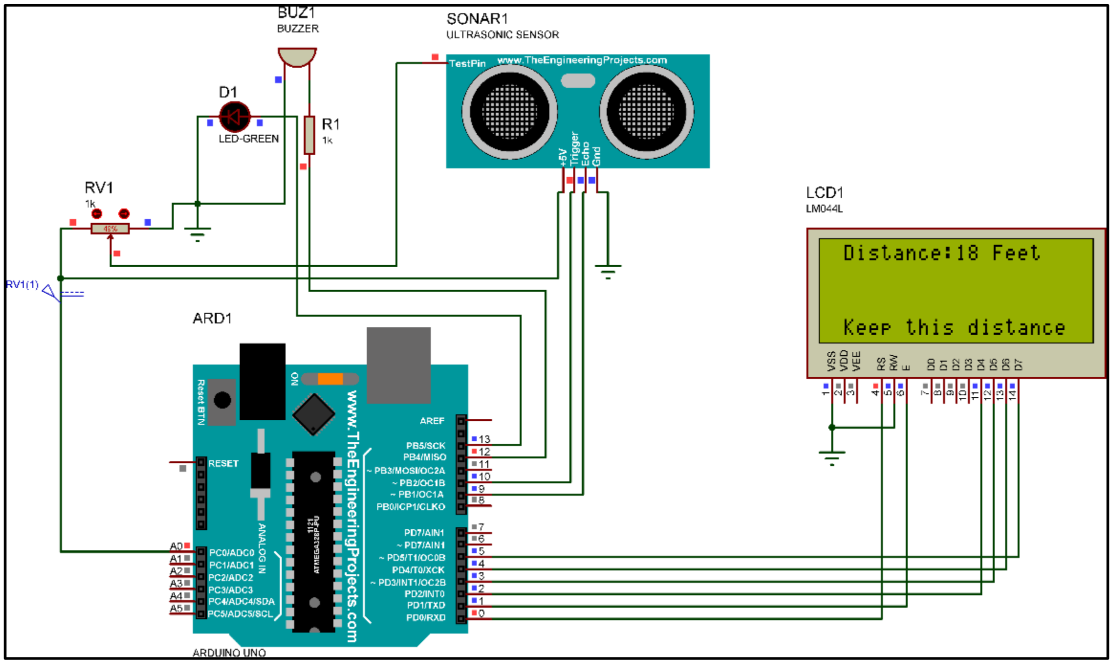


Figure [8]: If distance is more than 6 feet.

2nd Approach:

Mask Detection:

In the second approach, we are using Raspberry Pi 4B Model, Pi camera, LCD, and Machine Learning to run the system with IDLE Software.

Raspberry Pi 4B: We are using Raspberry Pi 4B model because it comes with built-in Wi-Fi and Bluetooth, can multitask efficiently and is super faster. It can run a variety of operating systems. It is capable of playing 1080p MP4 video at 60 frames per second.

Pi camera: Pi Camera has a High-Definition video camera for Raspberry Pi, 5MPixel sensor, max video resolution: 1080p & max frame rate: 30fps, Omni vision OV5647 sensor in a fixed-focus module with replaceable Lens

LCD: We are using LCD to show the output.

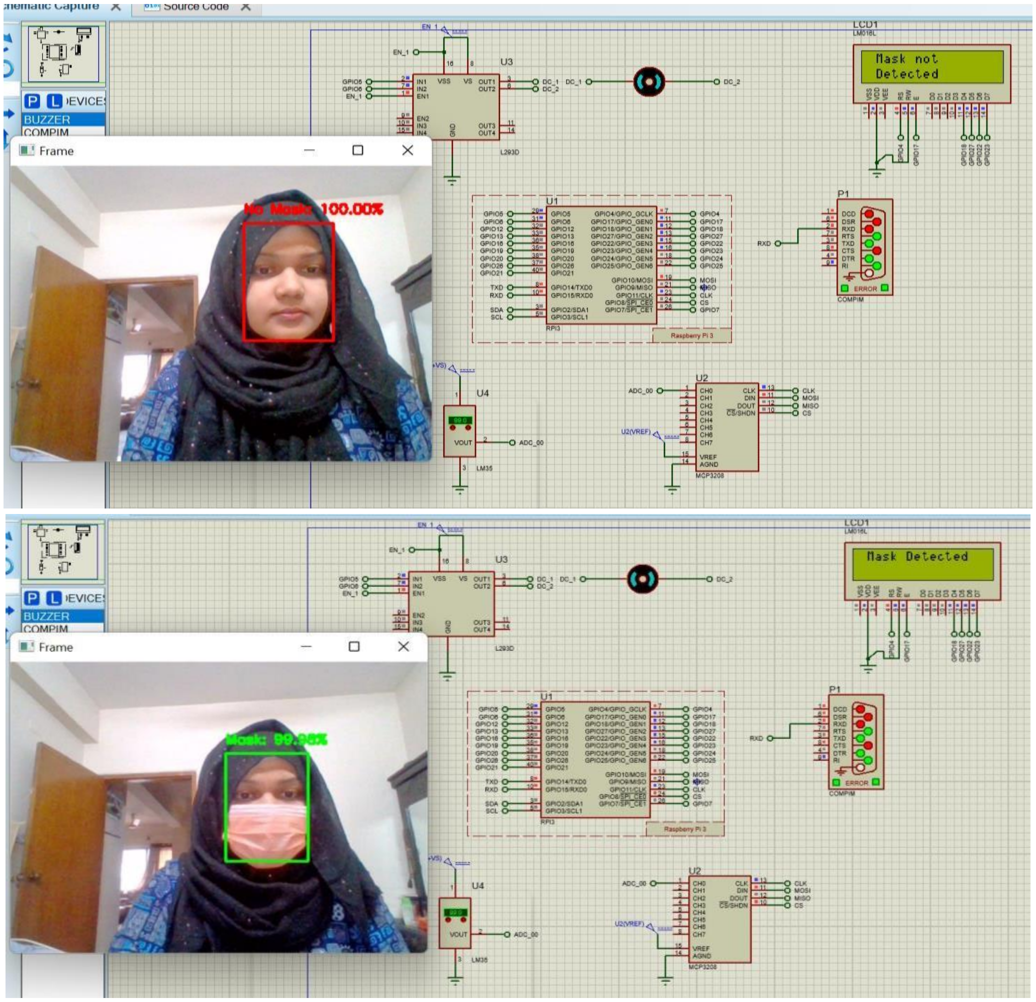


Figure [9]: Proteus implementation of the mask detection sub-system for 2nd approach.

For our Software simulation process, we are using Raspberry pi 4B Model LCD. We are using the webcam to detect facemasks, which will start video streaming using Machine Learning. If people do not wear a facemask, our system will show “Mask is not detected,” It will not allow them to do the following steps, showing the percentage of “No mask.” If a person wears a facemask, our system will display “Mask detected” and show the accuracy level. Then it will automatically go to the next step.

Temperature Measurement

For our second approach, we have used the same LM35 sensor (For hardware we have used MLX90614). In order to functionally verify our 2nd design approach, we have implemented our system on Proteus software using Raspberry pi as per our system design. All the necessary test results are as follows based on different conditions. When the temperature is below 100 degree Fahrenheit it will show the result as normal temperature as a result the gate will open. In terms of the temperature more than 100 Degree Fahrenheit it will show the result as High temperature so gate will be closed.

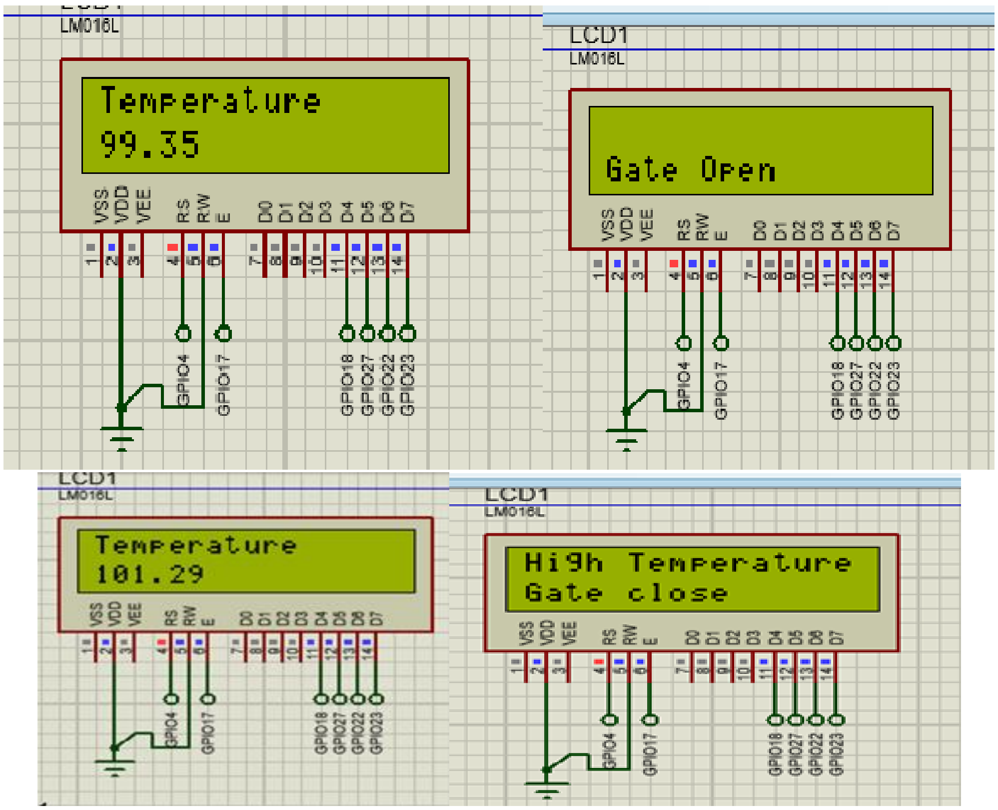


Figure [10]: Proteus implementation of the temperature sub-system for 2^{nd} approach.

Distance Measurement

For our second design, we made a centralized system. To do that, we are using Wi-Fi-enabled ESP32 cam modules. These modules will work alongside our existing Raspberry Pi, which has built-in Wi-Fi. We are using the OV2640 version of the ESP32 module because:

This module is a perfect supplement for projects that need to have much broader FOVs. This module provides a 65-degree FOV.

This module can do on-device machine learning tasks like classification, person detection etc.

Cheapest board with an onboard camera that also has Micro SD card support.

Why we are using YOLOv4:

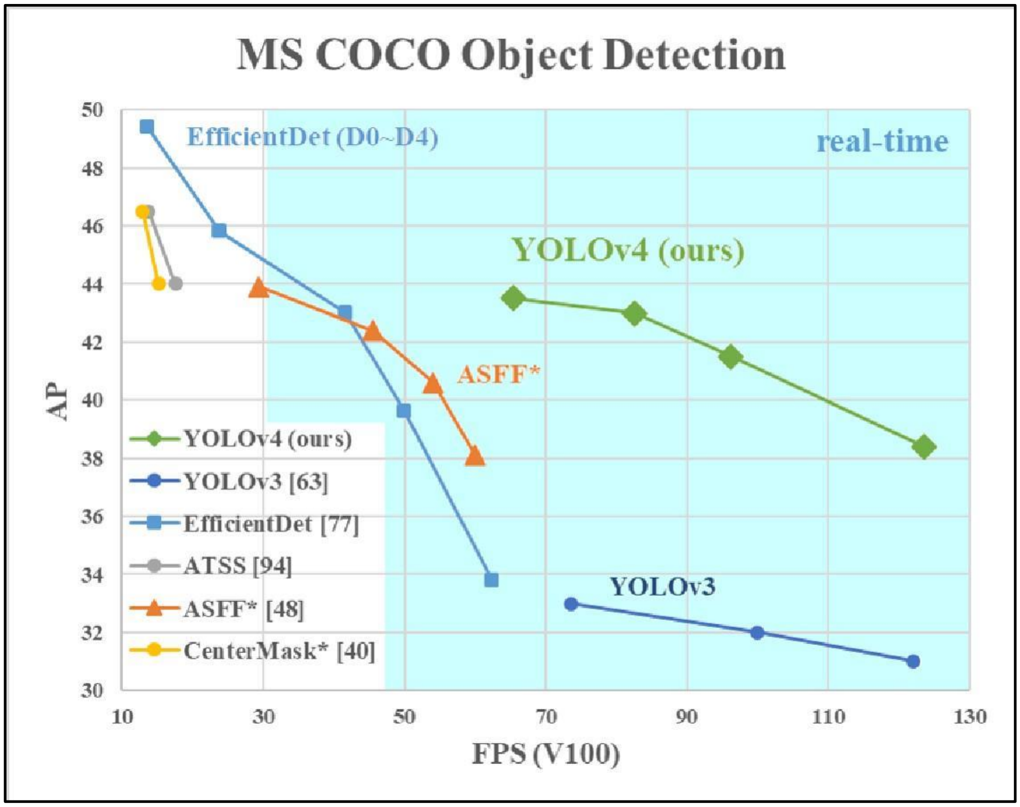


Figure [11]: Graph to compare the FPS and AP of different object detectors. [28]

We can observe that the YOLOv4 runs twice faster as Efficient with comparable performance. At first thought about using YOLOv3, but we decided to go with YOLOv4 because it improves AP (Average precision) and FPS (Frame per second) by 10% and 12%, respectively. In addition, we are using a GTX 1080Ti to run the coding, which will give us a better frame rate. As a result, our system works with less amount of delay.

Now, we are using Microsoft visual studio for our machine learning algorithm working based on Darknet. First, we train the model by using weights. After that, we write the code that makes our python system read data from the video and upload it to an output video. As we can see in figure 9, the raw footage we upload. Next, figure 10 shows us the output video with the violations of social distance that our trained model has found.

Figure [12]: Raw CCTV footage.

Figure [13]: Simulated result.

4.3 Identify optimal design approach

After simulation, many test cases result and undergoing many criteria we came across a point where the decentralized system will be more efficient in all phases. The overall details are shown below with appropriate explanation:

Criteria	1st Approach (Decentralized)	2nd Approach (Centralized)
Cost	8,184 BDT	35,000 BDT
Criticality	Somewhat critical	Very critical
Success rate	High	Medium
Task dependencies	Independent and sequential	Interrelated and integrated
Environment sustainability	High	High
Maintainability	No risks of being stolen.	Being a wireless robot, it might be stolen.

The first method costs roughly 8,184 BDT in total. The entire cost of the second strategy, on the other hand, is roughly 35,000 BDT. As a result, we can see that the first method is more cost-effective than the second method. The first method is decentralized, self-contained, and sequential. The second strategy, on the other hand, is centralized, interconnected, and integrated. As the 1st design is decentralized, therefore, in terms of any failure of any of the sub-systems the chance of identifying the problem and making the solution will be much easier. Whereas, for the 2nd design approach since all the system is interconnected with every subsystem, by chance if any system is not working the whole system will be a big failure. Moreover, identifying the problem will be much more difficult as machine learning is very new for us and solving the problem as quickly as possible will be difficult. In terms of the mask, temperature, and distance monitoring, the first design approach has a better success rate. The success rate of the second design technique, on the other hand, may vary based on a variety of conditions. For different masks, the success rate and accuracy for detecting the mask are up to the mark but sometimes for different masks, the 2nd approach mask accuracy was not that much accurate. Moreover, for the first approach, we can monitor the distance to any room just by wearing the device monitoring devices. On the other hand, for the 2nd approach for each room, there has to be a good camera to monitor the distance which will ultimately increase the budget. Also, it will be difficult to identify who is not following the proper distance. Because the equipment we use does not require any fossil fuels, high-power consumption, or gas leaks that would have a substantial impact on our environment, it is environmentally sustainable. Both methods are favorable to the environment.

Our first system will be installed in front of a door for ease of maintenance. As a result, there is no danger of being stolen. The robot that will be employed in the second approach, on the other hand, is wireless. As a result, it could be stolen at any time. So, the first approach will be appropriate for this requirement.

Based on these factors, we've decided that the first approach is the best option after examining all of the criteria and simulation results.

4.4 Performance evaluation of developed solution

In this segment, different test cases were taken and based on those many results were noted down. For our developed system necessary documents for different subsystem is given below:

Mask and Temperature system:

Data table of test cases for Mask and Temperature sub-system:

Attempt	Temperature (Degree F)	Mask Detection		
		Mask type	Accuracy	Result
1	96°	No mask	×	No mask is detected
2	96°	Covering face with hand	×	No mask is detected
3	97°	Surgical	100%	Thanks for wearing mask
4	98°	Surgical	100%	Thanks for wearing mask
5	95°	Surgical	98%	Thanks for wearing mask
6	96°	Cloth (Red)	99%	Thanks for wearing mask
7	94°	Cloth (Red)	100%	Thanks for wearing mask
8	92°	Cloth (Red)	100%	Thanks for wearing mask
9	95°	Cloth (Black)	97%	Thanks for wearing mask
10	97°	Cloth (Blue)	96%	Thanks for wearing mask
11	96°	Cloth (Orange)	100%	Thanks for wearing mask
12	99°	Cloth (Blue)	99%	Thanks for wearing mask
13	98°	Cloth (Orange)	100%	Thanks for wearing mask
14	96°	Niqab	100%	Thanks for wearing mask
15	96°	Scarf	×	No mask is detected
16	112° (soldering iron)	Surgical	×	Temperature is high, please exit
17	99°	KN95	97%	Thanks for wearing mask
18	95°	KN95	94%	Thanks for wearing mask

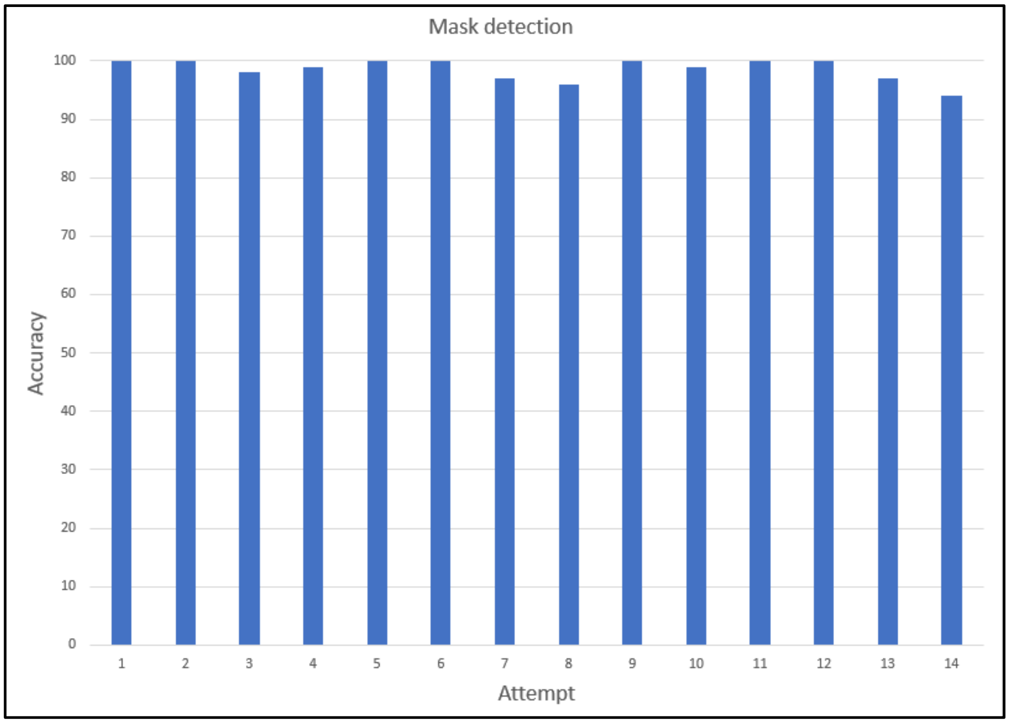


Figure [14]: Mask accuracy vs Attempt no graph.

$$\text{Average Accuracy} = \frac{\mathbf{100+100+98+99+100+100+97+96+100+99+100+100+97+94}}{\mathbf{14}}$$

$$= \mathbf{98.57\%}$$

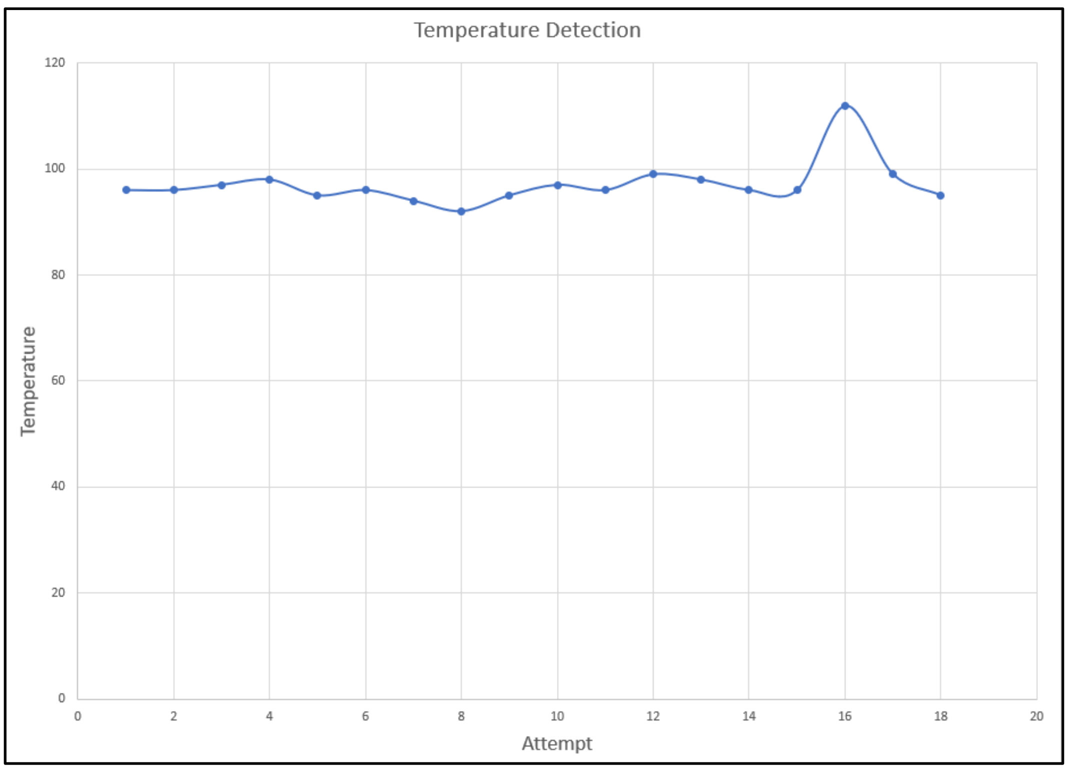


Figure [15]: Temperature vs Attempt no graph.

Distance measurement system:

Data table for distance measurement:

Session No.	Test cases	Interaction time needed (second)	Distance (Feet)	Posture	Buzzer	Vibrating motor
1	1	9	7ft to 1ft	Front facing	✓	✓
	2	8	7ft to 1ft	Upward direction	✓	✓
	3	8.26	7ft to 1ft	Straight	✓	✓
2	1	13s	6ft to 1ft	Front facing	✓	✓
	2	12.17	6ft to 1ft	Upward direction	✓	✓
	3	13.41	6ft to 1ft	Straight	✓	✓
3	1	4	3ft to 1ft	Front facing	✓	✓
	2	5.26	3ft to 1ft	Upward direction	✓	✓
	3	5	3ft to 1ft	Straight	✓	✓
4	1	2	2ft to 1ft	Front facing	✓	✓
	2	3.2	2ft to 1ft	Upward direction	✓	✓
	3	4.3	2ft to 1ft	Straight	✓	✓

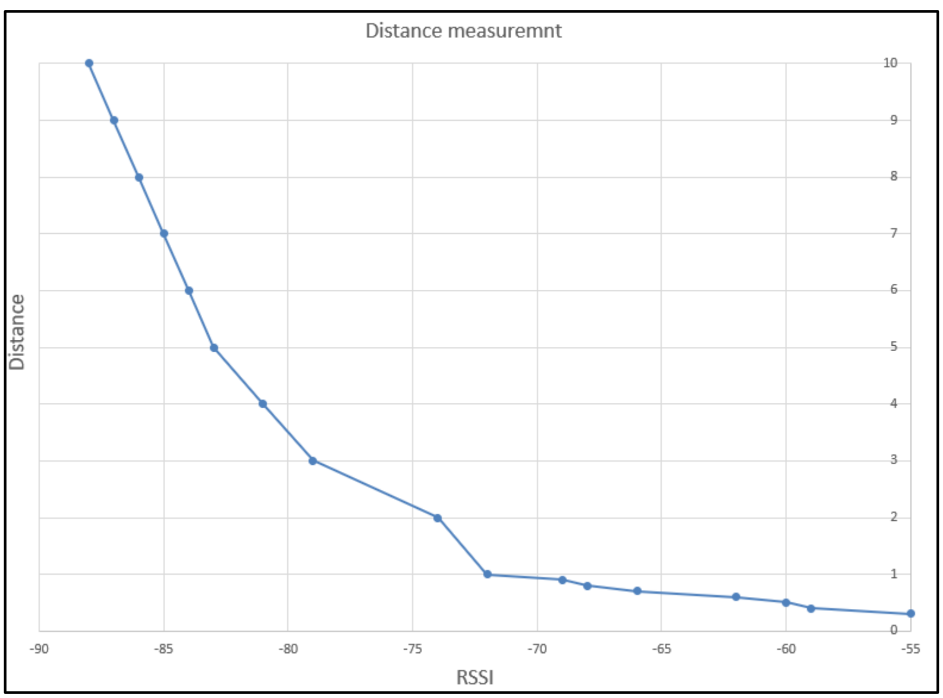


Figure [16]: Distance vs RSSI.

4.5 Conclusion

After examining all of the factors, the most appropriate option is a decentralized system, which is based on a number of factors such as cost, efficiency, usability, manufacturability, and impact. As a result of this feature, adopting the project's hardware will be considerably more user-friendly and completely trustworthy in terms of combating the Covid-19 spread.

Chapter 5: Completion of Final Design and Validation [CO8]

5.1 Introduction

On the previous chapter, we chose our optimal design and implemented the system. As we were implementing the project we decided to go with some design changes that would make our design more efficient and sophisticated. In this chapter, the changes made to complete the design of prototype has been presented.

5.2 Completion of final design

Firstly, we changed the Arduino UNO with Arduino NANO as it does not hamper with the performance of our system. We also replaced the ESP8266 node MCU module with ESP8266 12-E module which is smaller in size but does the same work without any performance drop. Furthermore, we inserted a vibrator in the wearable device instead of a led as the vibration would be able to alert people more sufficiently than the led.

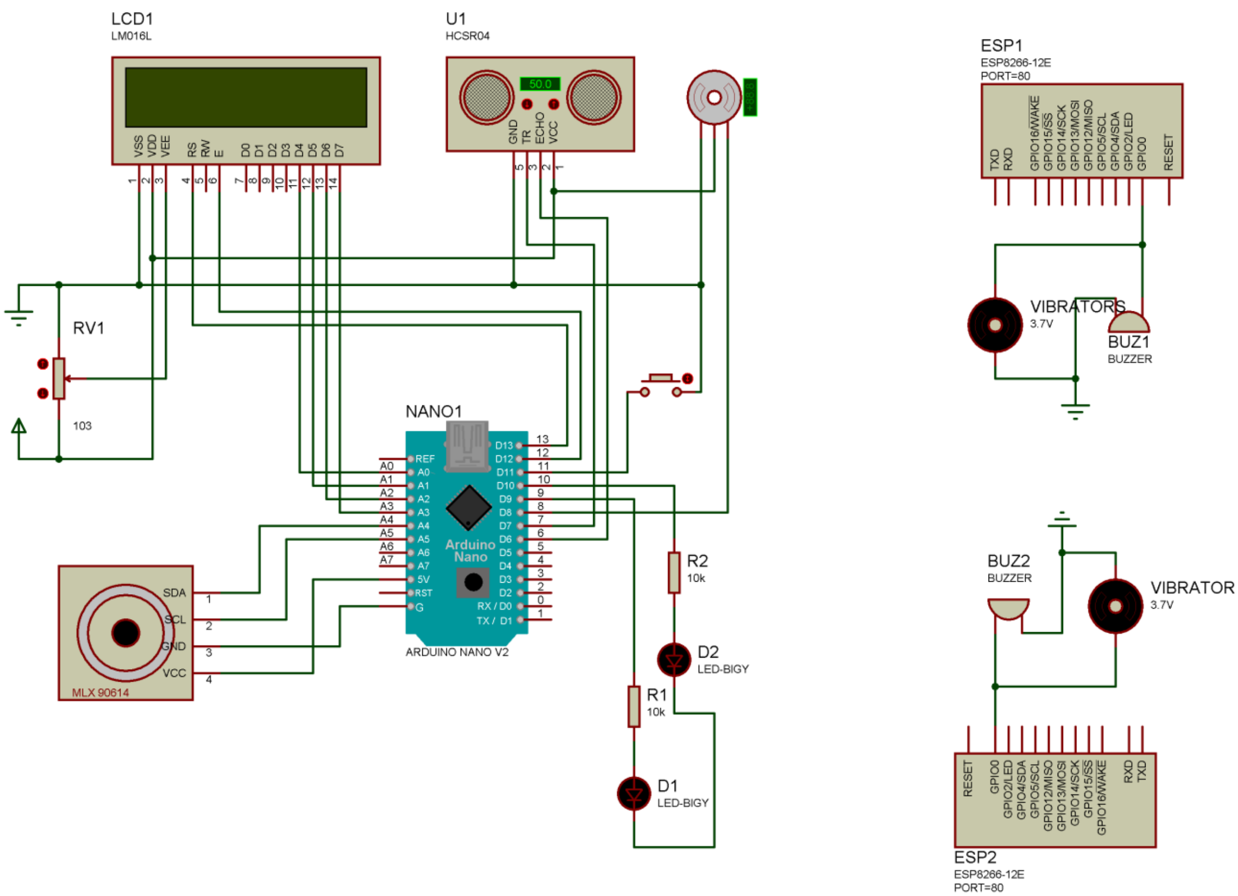


Figure [17]: Proteus implementation of the final prototype system.

In order for our mask and temperature system to work without any issues like wire entanglement or short circuit issue, we designed a PCB to connect all the devices together.

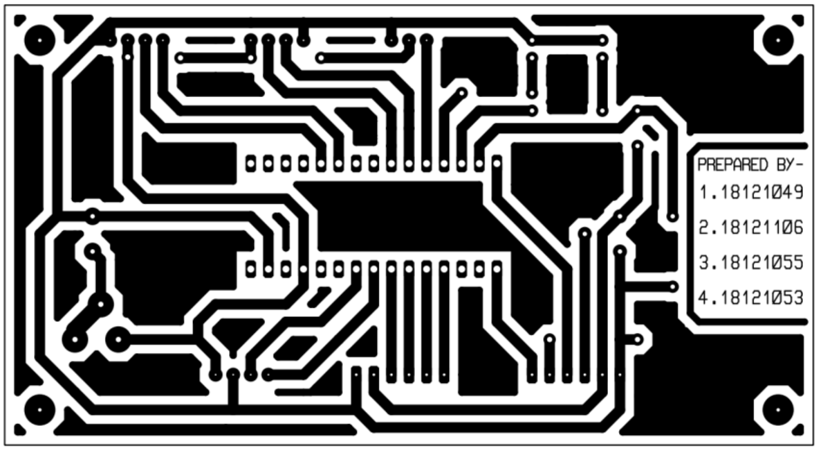


Figure [18]: PCB design of the Mask and Temperature sub-system.

A box has been made to hold all the circuitry inside and a user friendly outlook of the system.

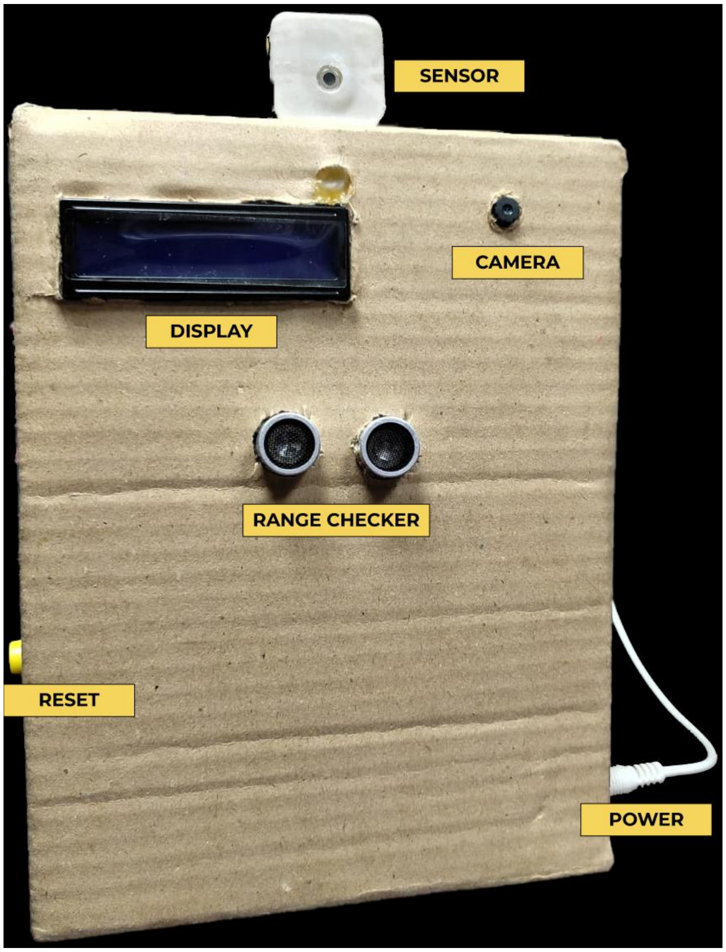


Figure [19]: Complete Mask and Temperature sub-system.

A 3D design for the wearable watch was designed with the measurements of components kept in mind. We kept some holes on both sides of the watch for the signal from the ESP8266 module to pass through efficiently. Moreover, we made the upper and bottom part less thick than the middle part so that the signal can easily pass through.

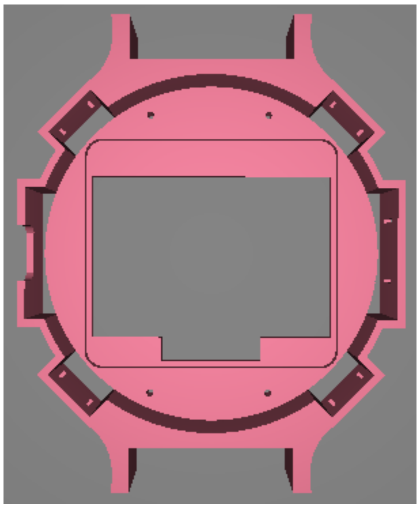
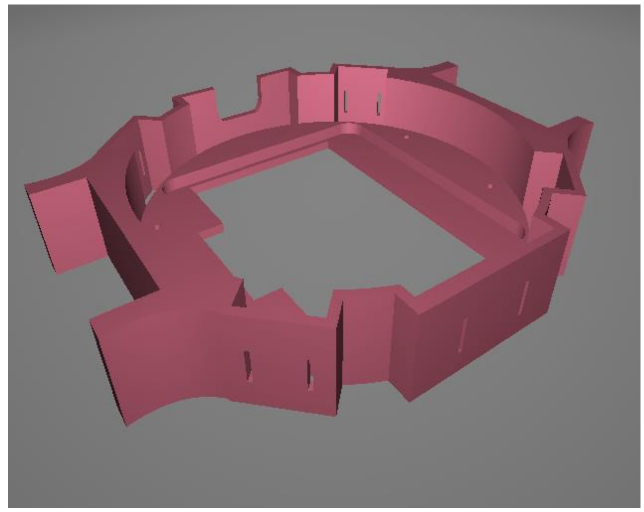
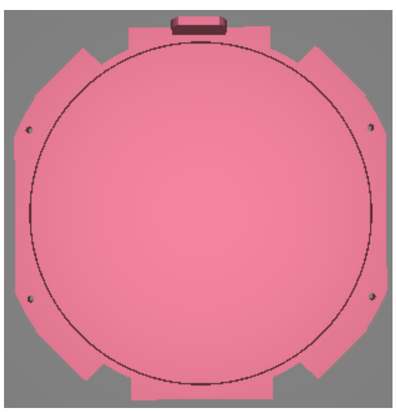
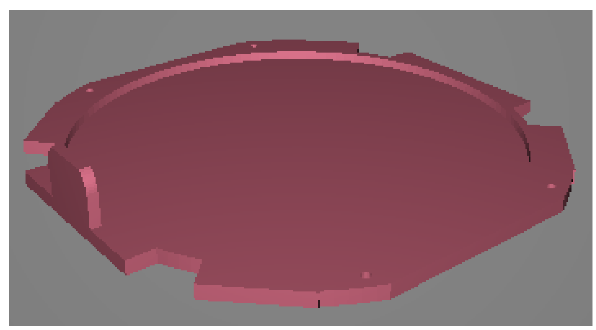
Middle Part	**Middle Part**
	
Bottom and Upper Part	**Bottom and Upper Part**
	

Figure [20]: 3D design of the wearable watch for distance measurement system.

After printing the 3D shell of the wearable watch, we carefully put all the components inside and used glue gun to keep the components clamped.

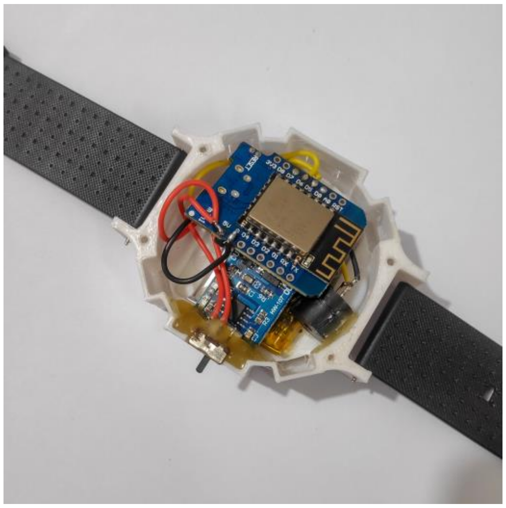
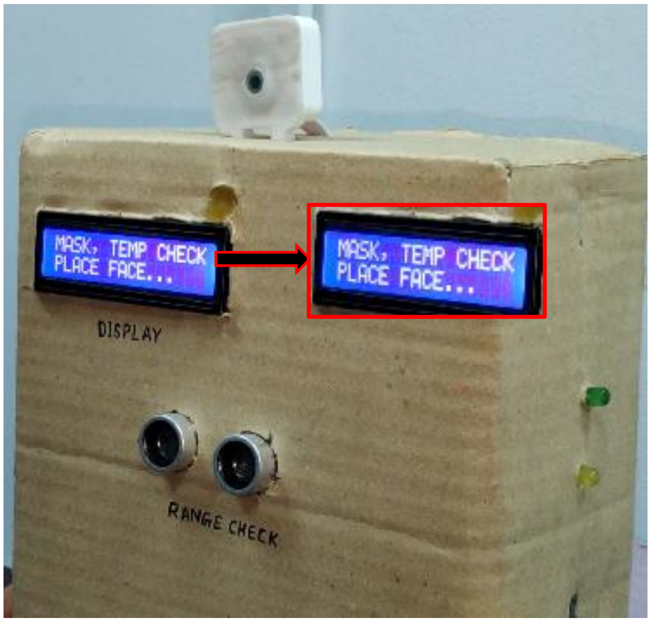
Inside view	**Outside view**
	

Figure [21]: Complete distance monitoring sub-system.

5.3 Evaluate the solution to meet desired need

The solution we developed comprises of two separate sub-systems. For the Mask and Temperature sub-system, we use an Arduino NANO that sits on top of the PCB. Then we connect the LCD, Ultrasonic Sensor (HC-SR04), MLX90614, ESP32-CAM and power supply port on the PCB. We used flat ribbon cable instead of using jumper wires as they are more durable and less likely to disconnect from the setup. We used the ultrasonic sensor here to initialize the system. The threshold is set to 20cm. So, when someone comes in that distance our system initializes and the MLX90614 sensor starts checking the temperature. Once temperature reading is taken, the result is shown in the display. If the temperature value is greater than 100°F, the system shows “Temperature is high! Please exit.” and the system resets and the door is remained closed. But, If the temperature is normal (below 100°F), the system shows the temperature value and goes to the mask detection system. Now, in the mask checking phase, the ESP32-CAM starts running the machine learning algorithm on the camera feed and detects if the person is wearing a mask or not. The machine learning algorithm has been trained with thousands of pictures from the internet with different types of masks and also with no mask and also with several ways people may try to bypass the system. Next, when if mask is not detected, the door will remain closed and system will show “Please wear a mask” and reset. Similarly, if the temperature of the person is normal and he or she is wearing a mask, the door will open showing the message “Thank you for wearing a mask”. The whole working procedure of mask and temperature system is shown below:

<table>
<tr>
<td>Step 1: Place face close to the system.

</td>
<td>Step 2: Reading the temperature value.

</td>
</tr>
<tr>
<td>Step 3 (case 1): Showing the measured temperature. (Normal Temperature)

</td>
<td>Step 3 (case 2): Showing the measured temperature. (High Temperature)

</td>
</tr>
</table>

Step 3 (case 2): The system tells the person with high temperature to exit the premises. The system resets and gate does not open.

Step 4: Checking if the person is wearing mask.

Step 5 (case 1): If the person is not wearing a mask, The green led is off and the door will not open.

Step 5 (case 2): If the person is wearing a mask, The green led is turned on and the door opens.

Figure [22]: Working procedure of Mask and Temperature system.

Once they enter the premises after going through mask and temperature sub-system, they need to take a wearable device and wear it in the hand and then enter the premises. After they wear it, they will turn it on using a switch on the side of the wearable device. The device has a buzzer and vibrator installed inside which will alert the person wearing the band if they break the safety distance protocol of 3.3 feet. The buzzer and vibrator will keep alerting them continuously until they go to a distance greater than 3.3 feet. The whole process of our system works as we expected it to so the desired need is fulfilled. The whole working procedure of distance monitoring system is shown below:

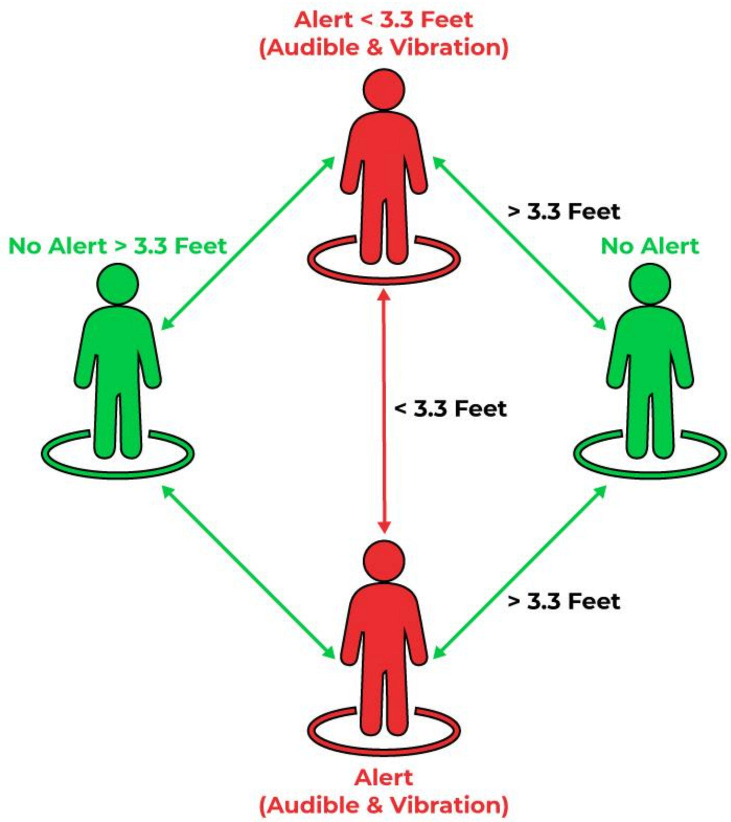


Figure [23]: Working procedure of Distance measurement wearable devices.

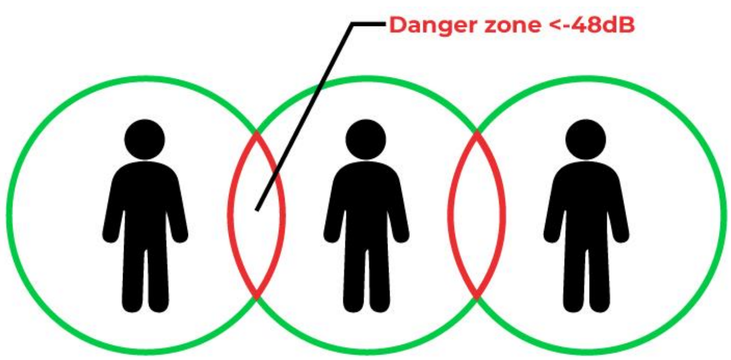


Figure [24]: Signal zone of the wearable devices.

5.4 Conclusion

To sum it up, it can be seen that the final design satisfies all the requirements effectively. Some delays can be seen in the distance sub-system as the Wi-Fi signal sometimes fails to detect for a few seconds. But the delay is considerably low. And our mask system also correctly detects mask and no mask of a person most of the time. The temperature system sometimes shows wrong value if the person is not within a close distance. But if the person is within the correct distance, then the temperature detection is quite effective. Thus, with many trials and debugging we achieved the desired result of our prototype system.

Chapter 6: Impact Analysis and Project Sustainability [CO3, CO4]

6.1 Introduction

There are always some concerns about how the public will appreciate it to launch a new initiative. Compromising is a mandatory aspect of solving such conflicts to satisfy the stakeholders. This is a challenging stage as this will involve societal, cultural, and environmental changes, raising concerns among the people. Their feedback is vital for the development of this project.

6.2 Assess the impact of solution

People will get used to wearing masks: As this system is very strict about wearing masks, people will get used to wearing masks everywhere, ensuring their safety from being infected by COVID-19.

People will be aware of their health condition: Whenever someone tries to enter an office, bank or university, they have to go through a three-step safety monitoring system. After going through this system, they will be able to know their body temperature, which will be helpful for their health and safety.

It will encourage people to maintain a safe distance: This system also ensures safe distance. After using these systems, people will get habituated to maintaining a safe distance, ensuring their safety from being infected by COVID-19.

This system will work as a barrier to stopping COVID-19: This system ensures health safety; that is why we can claim that if we use this system, the rate of being affected by COVID-19 will decrease very soon. Moreover, this system will help people become more habituated to maintaining these safety precautions in their daily lives.

6.3 Evaluate the sustainability

This project has gained the attention of safety, health, and environmental professionals. This system makes the people aware of maintaining safety precautions and assures that each individual maintains it. This system will work for 10-15 hours continuously, and that is why a microprocessor will be used in this project, which can take long-term stress and function properly. This system will monitor a specific zone, so in rush hour, people will be in a hurry and in that case, there might be a hassle in the line to overcome this issue. We have built this system so that it will do its work as fast as possible without any hassle in the queue. This system does not require much space, and it does not cause any pollution such as air, noise, etc. So, this system is environmentally friendly. Moreover, this system is budget-friendly so that every institution and organization can afford it. This system is a must to fight against COVID-19 and ensure safety precautions to protect ourselves and our loved ones at a low cost.

6.4 Conclusion

To clarify, developing something is an uncertain initiative as the feedback from users may vary and thus, it will create a massive problem in managing the project. There will be a bright future for this project if everything goes efficiently. This will allow making necessary plans and upgrades to the system in future.

Chapter 7: Engineering Project Management [CO11, CO14]

7.1 Introduction

Project management is a crucial aspect of any project. Planning the entire progress with a designed plan helps organize the whole project and works like a backbone. To maintain the project smoothly, assigning specific responsibilities helps outcome issues and risk factors. Teamwork is the key to solving associated risks and generating constant accurate outcomes.

7.2 Define, plan and manage engineering project

400P

ID	Task Name	Duration	Start	Finish	Responsible
1	**400P**	**85 days**	**Sat 7/3/21**	**Thu 10/28/21**	
2	Finalize the title	4 days	Sat 7/3/21	Wed 7/7/21	All
3	Submit summary concept note	6 days	Thu 7/8/21	Thu 7/15/21	All
4	Progress presentation 01	4 days	Tue 7/6/21	Fri 7/9/21	All
5	Multiple Designs, Methodology	15 days	Sat 7/10/21	Thu 7/29/21	All
6	Project Plan	5 days	Fri 7/30/21	Thu 8/5/21	Ashfak, Abir
7	Budget	5 days	Fri 7/30/21	Thu 8/5/21	Tanjila, Jim
8	Impact, Expected outcome, sustainability	10 days	Fri 8/13/21	Thu 8/26/21	Tanjila, Jim
9	Applicable Standards, Risk Management, Safety consideration	10 days	Fri 8/13/21	Thu 8/26/21	Ashfak
10	Background Research, References	10 days	Fri 8/13/21	Thu 8/26/21	Abir
11	Prepare concept note	35 days	Sat 7/10/21	Thu 8/26/21	All
12	Progress presentation 02	5 days	Fri 8/27/21	Thu 9/2/21	All
13	Prepare project proposal note	23 days	Fri 9/3/21	Tue 10/5/21	All
14	Progress presentation 03	5 days	Wed 10/6/21	Tue 10/12/21	All
15	Progress presentation 04	5 days	Wed 10/13/21	Tue 10/19/21	All

Figure [25]: Table of work distribution for 400P.

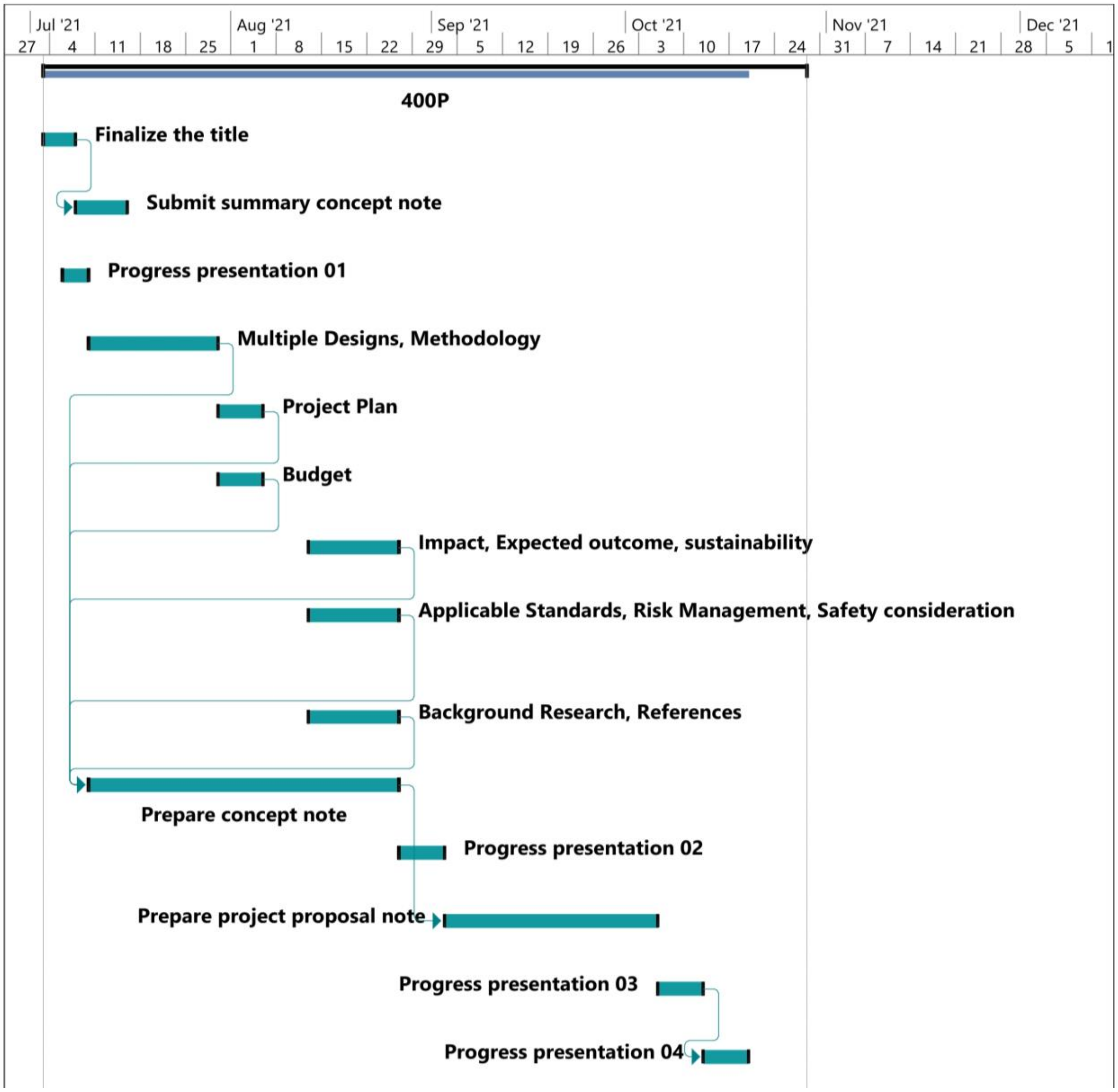


Figure [26]: Gantt chart of 400P.

400D

ID	Task Name	Duration	Start	)ctob 3
1	**400 D**	**99 days**	**Thu 10/21/21**	
2	Analyzing Multiple Design To Determine Optimal Design	11 days	Thu 10/21/21	
3	Component Selection	6 days	Tue 11/2/21	
4	Progress Presentation	2 days	Tue 11/9/21	
5	Buying Components	6 days	Fri 11/12/21	
6	Component Testing	10 days	Fri 11/19/21	
7	Simulate in Proteus Software	14 days	Tue 11/30/21	
8	Prototype Design	36 days	Wed 12/15/21	
9	Design Report Submission	6 days	Fri 12/17/21	
10	Final Presentation	6 days	Fri 12/24/21	
11	Designing user interface	10 days	Fri 12/31/21	
12	Programming and Implementation	25 days	Mon 1/3/22	

Figure [27]: Table of work distribution for 400D.

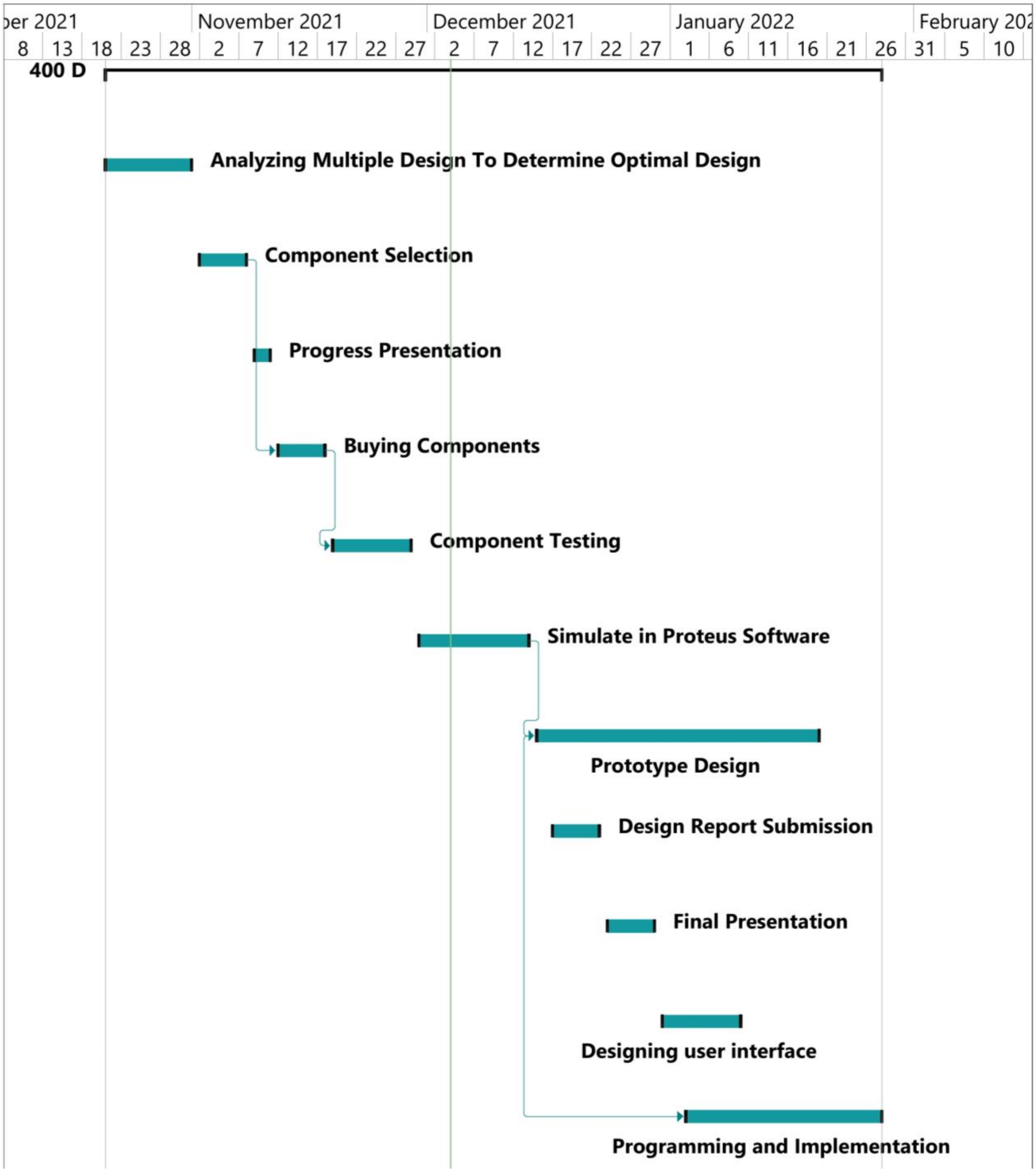


Figure [28]: Gantt chart of 400D.

400C

a) Initial plan:

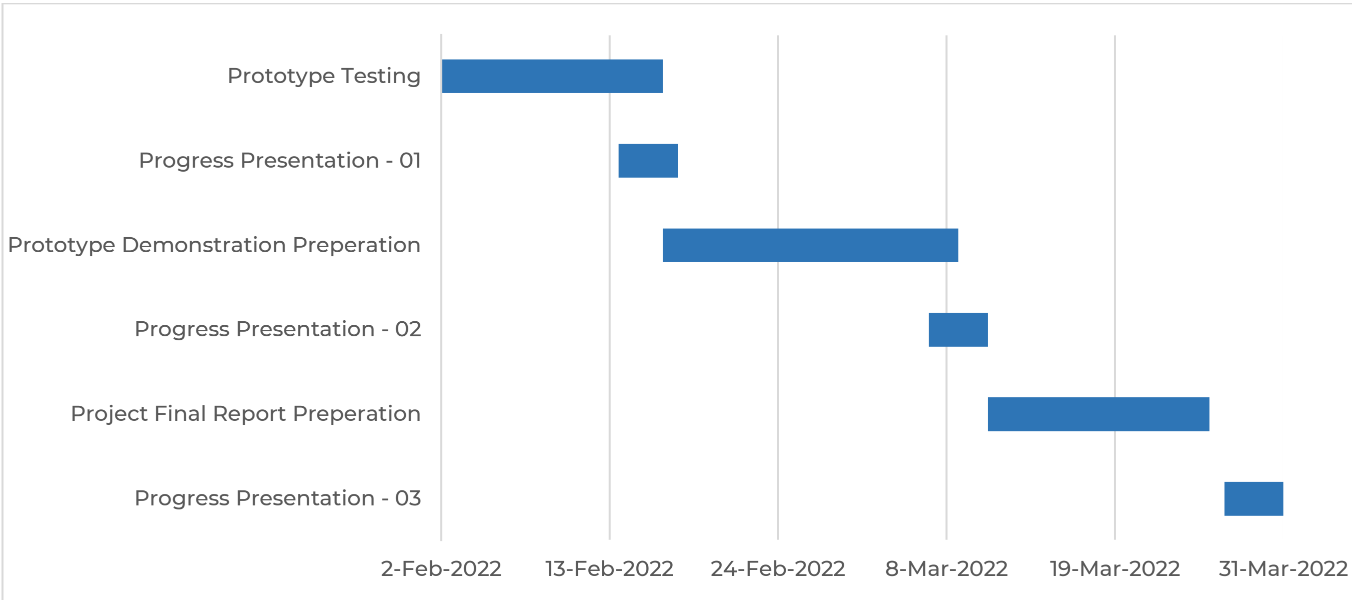


Figure [29]: Initial Gantt chart of 400C.

b) Updated plan:

ID	Task Name	Duration	Start	Finish	Responsible
1	**400 C**	**96 days**	**Sat 2/5/22**	**Thu 5/12/22**	
2	Temperature and Mask detection optimal code	10 days	Sat 2/5/22	Tue 2/15/22	Jim, Tanjila
3	Social Distance optimal code	10 days	Sat 2/5/22	Tue 2/15/22	Ashfak, Abir
4	Troubleshooting	5 days	Tue 2/15/22	Sun 2/20/22	All
5	Component Testing	5 days	Sun 2/20/22	Fri 2/25/22	All
6	Programming and Implementation	15 days	Fri 2/25/22	Sat 3/12/22	All
7	Progress Presentation	4 days	Thu 3/10/22	Mon 3/14/22	All
8	Complete sub systems	10 days	Sat 3/12/22	Tue 3/22/22	All
9	Set all of the sub system together	15 days	Tue 3/22/22	Wed 4/6/22	All
10	Completion of Prototype	15 days	Thu 3/31/22	Fri 4/15/22	All
11	Prototype Testing	10 days	Sat 4/16/22	Tue 4/26/22	All
12	Prototype Demonstration Preparation	6 days	Wed 4/27/22	Tue 5/3/22	All
13	Project Final Report	79 days	Thu 2/10/22	Sat 4/30/22	All
14	Project Showcase	8 days	Wed 5/4/22	Thu 5/12/22	All

Figure [30]: Table of work distribution for 400C.

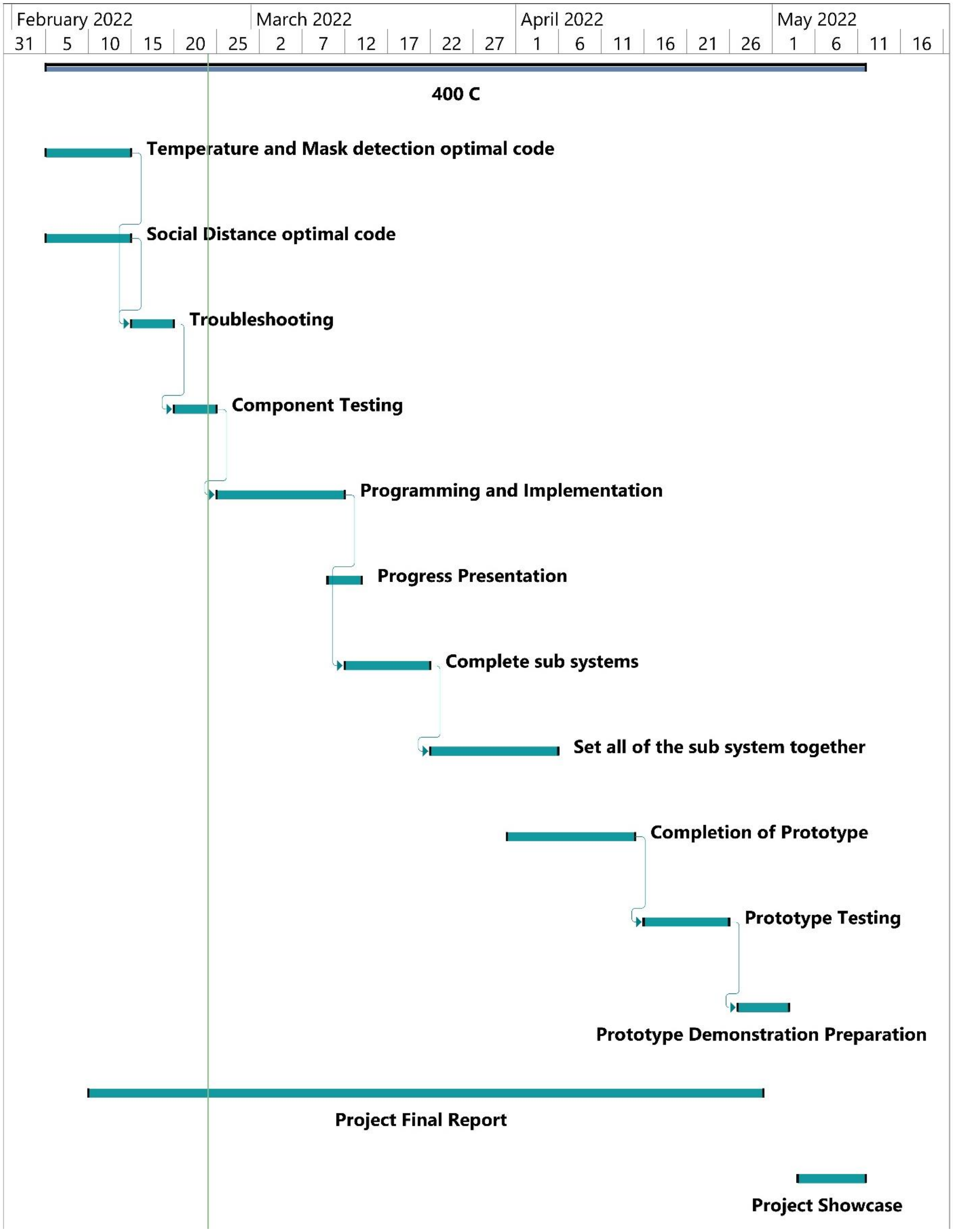


Figure [31]: Gantt chart of 400C.

7.3 Evaluate project progress

Project management is mandatory to maintain a constant outcome by completing tasks. All the tasks are assigned in a planned manner. Initially, a plan is made with an estimation. But, the initial plan does not go as planned, and the program needs to be updated throughout the project timeline. Sometimes, it becomes imminent to bring some changes in the project plan. Therefore, a revised plan was designed with a new timeline that provides more accurate project progress.

Additionally, the workload is distributed among all four members of the group, making it easier and more accurate. Moreover, a backup plan is compulsory to manage resources, so if a risk occurs, we can overcome it. We also made a risk management analysis where we added all the risk factors that may hamper the project's progress. Many components were damaged throughout the project, and some troubleshooting was also done. But these constraints did not impede our progress as a contingency plan was already made. Risk Management and Contingency Plan.

Risk is an uncertain moment, where it could bring multiple unknown consequences. Various risks such as design malfunction, short circuit by accident, damage of any expensive components, server jam, etc. might occur if there is an accident. So, in order to manage such risks, we are dividing our responsibility on particular issues.

Risk Response Matrix:

Risk Event	Responsibility	Contingency Plan	Trigger
Interface Problems	Mitigate: Test Prototype to find the problem	Stop the system and solving it as much as possible	Not solved within 1 hour
System Failure	Mitigate: Test Prototype to find the problem	Recheck connections and restart the system, otherwise reinstall OS.	Not solved within few hours
User backlash	Mitigate: Prototype demonstration and try to find the optimal solution	Reallocating all resources and getting the best improvised decision	Unable to manage resources and budget
Equipment malfunction	Mitigate: Select a reliable vendor providing a warranty	Component replacement	Equipment fails

7.4 Conclusion

In conclusion, project management works as a backbone for any project. An organized project plan helps us progress and work on solutions as soon as an error occurs. So, risk management is an integral part of project management. Lastly, improvising the project management plan as the project progresses is crucial in achieving a great project at the end.

Chapter 8: Economical Analysis [CO12]

8.1 Introduction

Economic analysis essentially entails the evaluation of costs and benefits. It starts by ranking projects based on economic viability to aid better allocation of resources. It aims at analyzing the welfare impact of a project. It could also be an investigation into a manufacturing process or an industry. The goal of the analysis is to identify how well the economy or a component of it is performing. An economic examination of a corporation, for example, focuses mostly on how much profit it generates. Furthermore, it also allows estimating the business outcomes through data driven techniques, convenient decision making and shows the best way to utilize resources.

8.2 Economic analysis

Economic analysis is a method for aiding in improved resource allocation, resulting in more significant investment revenue and the optimum use of resources. The goal of economic analysis for a project is to offer a clear picture of the current state of the economy to determine whether it operates effectively and how profitable the project is. What effect, if any, does or will the present economic situation have on the production of the project commercially? Because an automated indoor Covid-19 safety system is being developed in this project, establishing such a system necessitates extensive resource management. This allows for an efficient means of achieving the desired result. The project's total cost will decrease significantly if mass-produced because the prototype has many components that can be replaced for a more cost-effective system. As this project is automated, low to no maintenance is required.

8.3 Cost benefit analysis

Economic analysis has several different methods to choose from. Cost-benefit analysis tries to determine the feasibility of a project. The cost is compared against the project's potential benefits for this analysis. The comparison is relative to costs versus outcomes of different courses of action. Cost-effective does not imply that we need to do the project for as low a cost as possible. The effectiveness of the project is the crucial element. So, a low price does not necessarily mean greater effectiveness. When you have several ways of accomplishing a task, we need this cost-benefit analysis method to find the cheapest way to complete the project. Each component has some advantages and disadvantages to work effectively and efficiently. To complete each task, there are several components available in the market. We need to choose the cost-efficient one that works efficiently with other components to give the best outcome. This management process is a must to ensure that the end product ensures customer satisfaction. For the first approach, Arduino Nano will be needed. For the second approach, a Raspberry Pi will be needed. Arduino Nano is cheaper than Raspberry Pi. Arduino Nano is powerful enough to run this system. So, there is not any logic to use Raspberry Pi instead of using Arduino Nano. Also, the accuracy rate of the 2nd approach is slightly lower than the 1st approach. Moreover, YOLOV4 will be needed for the 2nd approach to monitor distance. For implementing this method many high resolution cameras will be needed for the best output. Also a powerful computer will be needed to operate this sub-system. Which will make this project costly. Moreover, this system will not be able to detect specifically that person who is not maintaining safety rules. On the other hand, the distance monitoring system of the first approach will be able to detect specific people at a very low budget. The total cost for implementing the 1st approach will be around 8,184 BDT and for implementing the 2nd approach the total cost will be around 35,000 BDT. So, here we can see that the 1st approach will give us better output at a low budget. A supporting table containing core components of 1st approach is given for further analysis:

Components	Price	Strength	Weakness
Arduino Nano	650	1. Central processing unit for the system. 2. Easy swappable. 3. Low cost. 4. Small in size.	1. Medium processing power.
MLX90614	1,480	1. Non-contact temperature sensor. 2. Small size and low cost. 3. Easy to integrate. 4. Sleep mode for reduced power consumption.	1. Sometimes, if a person is very close to the sensor, it gives high temperature value.
ESP32-Cam Wi-Fi+ Bluetooth Camera	1,250	1. High potential to scan an individual's face.	1. Expensive repair. 2. Sensitive to overvoltage.
ESP8266 Wi-Fi Module (2pcs)	820	1. Low cost. 2. More compatible development environments. 3. Flexible design and enhanced function.	1. It contains only one analog pin.
Ultrasonic sensor	100	1. Not affected by color or transparency of objects. 2. Can be used in dark environments. 3. Not highly affected by dust, dirt, or high-moisture environments.	1. Limited testing distance.

Another table containing core components of 2nd approach is given for further analysis:

Components	Price	Strength	Weakness
Raspberry Pi 4 Computer (8GB)	15,000	1. Powerful processing unit. 2. Future proof performance. 3. Supports display ports (HDMI)	1. Expensive repair. 2. More delay to fix the problem.
Raspberry Pi 7inch HDMI Touchscreen LCD with Case	7,490	1. Wide dimension. 2. Better visible. 3. Lightweight. 4. Future proof.	1. Might break for careless activity. 2. Expensive repair. 3. More delay to fix the problem.
MLX90614	1,480	1. Non-contact temperature sensor. 2. Small size and low cost. 3. Easy to integrate. 4. Sleep mode for reduced power consumption.	1. Sometimes, if a person is very close to the sensor, it gives high temperature value.
Raspberry Pi Camera 5MP	880	1. Small and lightweight camera module. 2. It offers higher resolution.	1. If objects come closer, then they will be blurry and out of focus.
SIREN Horn Buzzer	269	1. With the metal base, this speaker is very easy to install. 2. Easy to replace.	1. Very loud sounds cause sound pollution.
Wi-Fi 360 Degree CC Camera (4 Pcs)	10,000	1. 360-degree panoramic camera view. 2. 1.7mm fisheye HD lens.	1. Only 2 MP resolution.

Here, all of the selected modules have been analyzed with respect to price and both their advantages and disadvantages. This will definitely help in both performance evaluation and management strategies showing scopes of new vision of resources of an organization at present and future respectively.

8.4 Evaluate economic and financial aspects

The prototype version of the project is fully ready. It is working according to our expectations. If any educational institutions, industry or office demands for this system then we will prepare this system according to their requirements. For that, we will need a suitable fund. If our government takes necessary steps to implement this system in all governmental offices and if they ask for our help then we will help them to build this system as much as we can. To achieve the desired outcome a prototype is implemented and has a certain budget which is given below:

Real implementation budget			
Sl No.	**Component**	**Price**	**Purchasing Link**
1	Arduino Nano	650	Purchasing Link
2	MLX90614	1,480	Purchasing Link
3	ESP32-Cam Wi-Fi+ Bluetooth Camera	1,250	Purchasing Link
4	ESP8266 Wi-Fi Module (2pcs)	820	Purchasing Link
5	Servo Motor (SG90)	195	Purchasing Link
6	Ultrasonic sensor	100	Purchasing Link
7	Buzzer (2 Pcs)	30	Purchasing Link
8	16x2 LCD	265	Purchasing Link
9	LED (10 Pcs)	50	Purchasing Link
10	Vibrating Motor (2 Pcs)	800	Purchasing Link
11	TP4056 Charging Module (2 Pcs)	60	Purchasing Link
12	Power Adapter	750	Purchasing Link
13	Push button	5	Purchasing Link
14	Battery (2 Pcs)	70	Purchasing Link
15	Connecting wires	270	Purchasing Link
16	Resistor (10k, 220)	29	Purchasing Link
17	PCB	500	Purchasing Link
18	3D printed case (2 Pcs)	700	Purchasing Link
19	Miscellaneous	160	
Total		**8,184**	

8.5 Conclusion

The performance of a system is insufficient to build a project. An economic perspective is required to comprehend how the project will function in the now and in the future. When the project is launched, the financial analysis evaluates the resources required. As a result, economic analysis assists us in managing the project and ensuring that it runs smoothly.

Chapter 9: Ethics and Professional Responsibilities [CO13, CO2]

9.1 Introduction

As an engineer, to become a skilled and mature practitioner in every perspective of Engineering, the necessity of focusing on the Ethical and Professional responsibilities in engineering situations and making informed judgments is very important. Under these circumstances, one must consider the impact of engineering solutions in terms of (1) global impact, (2) economic impact, (3) environmental impact, and (4) societal impact. These ethical matters are the right thing to do from the moral or societal standard point of view. The professional issue is that one must do it right and the right things to do based on training as a practicing engineer from the technical point of view.

9.2 Identify ethical issues and professional responsibility

When it comes to constructing any creative engineering project, doing it in an ethical/honest manner is always a top priority to make it more professional and trustworthy to the general public. In that instance, maintaining integrity should always be the priority in completing any critical report related to the project from the beginning of the project. As a result, in both writing the essay and constructing the project, we have done our best to follow all of the ethical rules and norms of behavior.

Ethical and professional responsibilities in terms of Project design, Implementation and writing report:

As we all know, the primary goal/purpose of any engineering project is to create a long-term, dependable, and highly efficient hardware setup that can transform people's perspectives and make their daily lives easier and smoother. However, to make these people's lives easier, engineers should remember ethical rules and obligations so that people may continue to trust the projects that new engineers or entrepreneurs aim to construct or supply them. Using cheap products can reduce costs, but quality work should be maintained. The context is as follows:

- This project is totally environment friendly as the equipment being used does not require any fossil fuel, high-power consumption, or gas leakage that will significantly impact our environment.
- Another point is that these projects will ensure equity so that each individual must follow the three subsystems of our project. Otherwise, they will face difficulties as our system will detect whoever is not maintaining the rules and regulations.
- Taking adequate security measures so that hackers cannot break into our system.
- To maintain the engineering ethical standard, the work was divided to make our work effective and more descriptive for each part. We also focused on remaining loyal to ourselves by not copy-pasting from the internet in writing reports. All the tasks were done by ourselves with accurate information and brainstorming, and appropriate research.

9.3 Apply ethical issues and professional responsibility

Maintaining equity: One of the critical rules for engineers and other entrepreneurs is to focus on quality-based components in all areas where the product/project is provided. If this procedure is not performed correctly, the general public will lose faith in the project's implementation, and our entire effort will go unnoticed. As a result, if we can ensure equity in product supply, people will continue to trust us, and thus our project will be able to minimize the Covid-19 spread across the country.

Project efficiency: Keeping all of the project's equipment in good working order is necessary to run it properly. Because the entire project is dependent on each piece of equipment, if any of the components fail, the whole project may be halted. We are particularly developing these structures, and we believe it is critical to assess all risks related to future designs and constructions. These factors will need to be explored in greater depth before implanting on a larger scale.

Relationships between clients and stakeholders must be maintained: As previously stated, retaining the general public's faith in the implementation of this project is critical to its success, as the project we aim to develop can create a significant impact in a positive way in order tackle this deadly virus. In that scenario, we must keep our professionalism so that the general public maintains their faith in us and is encouraged to implement our project in their sectors.

Project optimization: Given that we live in a competitive society, it is only natural that this project will improve over time with more complex algorithms and components. As a result, it is the sole responsibility of engineers and entrepreneurs to work on optimization from time to time so that consumers can receive the best results in their field projects. As a result, the relationship between stakeholders and consumers will be preserved, and they will continue to believe in us, which will be highly advantageous to the project's future.

9.4 Conclusion

The project we're working on is essentially a new and unique technology that has the potential to make a change in terms of fighting against the Covid-19 situation. However, as an engineer and an entrepreneur, it is our exclusive responsibility to uphold all ethical and professional norms of conduct that an engineer should follow. If these codes are followed, people will be more encouraged to apply this project for their daily needs. It will also strengthen the interaction between clients and stakeholders, eventually benefiting our project's recognition.

Chapter 10: Conclusion and Future Work

10.1 Project summary/Conclusion

We have finalized an approach that fulfills all the requirements, objectives, constraints, and specific conditions. Both designs have been tested for various cases to find their functionality and the optimal solution. Multiple test cases were performed at individual subsystems. There was some problem while implementing each component. Later on, after some analysis and research were done to receive desired output. Finally, the entire system is integrated using a PCB to manage all the wires. All references have been included in the report for the background studies.

10.2 Future work

There are many things to be considered, as there is no limit for a better system. But all of them cannot be included using a prototype. So, some of the future works are given below:

- Sanitize the wearable devices using a washing drawer.
- Introducing an app which will send all the health data monitored by the system.
- Using update and latest medical tools or sensors for more accurate results.
- Implementing pulse rate and heart rate monitoring system.

Chapter 11: Identification of Complex Engineering Problems and Activities

11.1: Identify the attribute of complex engineering problem (EP)

A. Attributes of Complex Engineering Problems (EP)

	Attributes	Put tick (√) as appropriate
P1	Depth of knowledge required	√
P2	Range of conflicting requirements	
P3	Depth of analysis required	√
P4	Familiarity of issues	√
P5	Extent of applicable codes	
P6	Extent of stakeholder involvement and needs	√
P7	Interdependence	√

11.2: Provide reasoning how the project address selected attribute (EP)

A. Attributes of Complex Engineering Problems (EP)

- **P1 Depth of knowledge required**: For this project, we have gone through in-depth Knowledge which we have gained from our academic courses. Also, we have gone through some activities beyond the introductory instructional level which was also needed for this project.

- **P3 Depth of analysis required**: We have done depth analysis to find out the optimal solution for this project. Also, we had to find out which component will be the best and cost-effective for this project.

- **P4 Familiarity of issues**: Covid-19 is an unknown virus for all of us. Suddenly it came into our life. We were not aware of this deadly virus. Generally, we were not familiar with this type of virus.

- **P6 Extent of stakeholder involvement and needs**: As the project is to ensure the safety of the people in the country, we have many stakeholders who will want to install this device on their premises. Normally, there are two types of stakeholders. 1. Internal, 2. External. Internal stakeholders are people or groups within the core team. For example, Project Supervisor, Team members, project-related people, etc. External stakeholders are people or groups who are outside of the business. For example, users, suppliers, buyers, and investors. In our case, general people are the primary users here.

- **P7 Interdependence**: We have divided our project into three sub-systems.
  1. Mask Detection
  2. Temperature Measurement
  3. Safe Distance Monitoring
  As our project is divided into three sub-problems. That is why it is fulfilling this attribute.

11.3 Identify the attribute of complex engineering activities (EA)

B. Attributes of Complex Engineering Activities (EA)

	Attributes	Put tick (√) as appropriate
A1	Range of resource	√
A2	Level of interaction	
A3	Innovation	
A4	Consequences for society and the environment	√
A5	Familiarity	√

11.4 Provide reasoning how the project address selected attribute (EA)

B. Attributes of Complex Engineering Activities (EA)

A1: Range of resources: In order to achieve our main goal (mask, temperature and distance measurement) and to make the prototype almost the necessary products were available. For our prototype design some products were purchased by us, and some were collected from the thesis lab of the EEE department. Based on the resources we made our budget accordingly and made a timed project plan to establish our desired result and also did software simulation with proper resources.

A4: Consequences for society and the environment: By building our system it will create a good impact on the society as well as the environment. As our project is environment friendly, by ensuring mask, temperature and distance monitoring, corona will not be able to spread in a large way. As a result, people will be much safer from one another and less people get affected by corona.

A5 Familiarity: We all faced Covid-19 all of a sudden which was not previously seen by anyone. Due to this issue a lot of people are getting affected by corona and dying at a significant rate. This mainly spreads if a corona affected people come across a normal human by sneezing, or touching.

So, our system will make sure that no contact will be made among humans by maintaining proper mask, temperature and distance monitoring.

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FYDP (C) Spring 2022 Summary of Team Log Book/ Journal

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General Notes:

1. In addition to detail journal/logbook fill out the summary/key steps and progress of your work
2. Reflect planning assignments, who has what responsibilities.
3. The logbook should contain all activities performed by the team members (Individual and team activities).

Date/Time/Place	Attendee	Summary of Meeting Minutes	Responsible	Comment by ATC
03.02.2022 (All FYDP committee and students)	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	Introductory session of EEE400 (C)		
10.02.2022 (Meeting with the ATC members)	1.Prof. Dr. AKM Abdul Malek Azad (ATC Chair) 2. Md. Nahid Haque Shazon (ATC Member) 3.Afrida Malik (ATC Member) **Students** 4.Ashfak 5.Tanjila 6.Jim 7.Tanvir	1. Modification of Project Plan. 2. Modification of budget. 3. Have to start working on the final report. 4. Updates of circuit/simulation and field work.		1. Have to create a google drive. 2. Have to submit the logbook before every meeting. 3. Every meeting should be recorded. 4. Reconsider optimal solution. 5. Have to use Raspberry pi for mask detection.
15.02.2022 (Meeting with group members) Recording	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	1. Modification of Project Plan. 2. Modification of budget. 3. Have to start working on the final report. 4. Updates of circuit/simulation and fieldwork. 5. Create and upload simulation videos and meeting recordings in google drive.	Task 1: Ashfak Task 2: Tanjila and Jim Task 3: All Task 4: All Task 5: All	
20.02.2022 (Meeting with group members) Recording	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	1. Modification of Project Plan. 2. Modification of budget.	Task 1: **Completed** Task 2: **Completed** Task 3: **Partially Completed.**	

		3. Work on the final report. 4. Updates of circuit/simulation and fieldwork.	Task 4: **Partially Completed.** Task 5: **Completed**	
24.02.2022 (Meeting with the ATC members)	1.Prof. Dr. AKM Abdul Malek Azad (ATC Chair) 2. Md. Nahid Haque Shazon (ATC Member) 3.Afrida Malik (ATC Member) **Students** 4.Ashfak 5.Tanjila 6.Jim 7.Tanvir	1. Modification of Project Plan. 2. Modification of budget. 3. Work on the final report. 4. Updates of circuit/simulation and fieldwork.		1) Have to send the mail on Tuesday within 9PM. 2) This week's mail was sent late. 3) Give an update of the Arduino method within next week. 4) Check typos. 5) All students should work on Arduino problems in the thesis lab. 6) Complete Temperature detection sub system. 7) Train the mask detection AI for at least 2 masks.
25.02.2022 (Meeting with group members) Recording	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	1. Modification of Project Plan. 2. Modification of budget. 3. Work on the final report. 4. Updates of circuit/simulation and fieldwork.	Task 1: Ashfak Task 2: Tanjila and Jim Task 3: All Task 4: All	
01.03.2022 (Meeting with group members) Recording	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	1. Modification of Project Plan. 2. Modification of budget. 3. Work on the final report. 4. Updates of circuit/simulation and fieldwork.	Task 1: **Completed** Task 2: **Completed** Task 3: **Partially Completed.** Task 4: **Partially Completed.** **(Ashfak & Tanvir absent because of COVID vaccination)**	
03.03.2022 (Meeting with the ATC members)	1.Prof. Dr. AKM Abdul Malek Azad (ATC Chair)	1.Work on the final report progress 2.Updates of circuit/simulation and fieldwork.		1)Comment on the logbook regarding ashfak and abir was not present in the thesis lab

	2. Md. Nahid Haque Shazon (ATC Member) 3.Afrida Malik (ATC Member) **Students** 4.Ashfak 5.Tanjila 6.Jim 7.Tanvir	3.Modification of budget.		2)Work on the progress of the report(any update will work) 3)Send progression presentation slide on 20th march 4)Work on mask detection on the laptop and show results on 31st march(at least 2 masks).
06.03.2022 (Meeting with group members) (Offline Meeting)	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	1.Work on the final report progress 2.Updates of circuit/simulation and fieldwork. 3.Modification of budget. 4.Update logbook. 5.Prepare presentation slide 6.Complete Mask and temperature subsystem.	Task 1: All Task 2: All Task 3: Jim, Tanjila Task 4: Abir, Jim Task 5: All Task 6:All	
17.03.2022 (Meeting with group members) (Offline Meeting)	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	Distribution of final report chapter: 1.Chapter 3 2.Chapter 8 3.Chapter 9 4.Chapter 10 5.Prepare slides.	Task 1: Tanjila Task 2: Ashfak Task 3: Jim Task 4: Abir Task 5: All	
21.03.2022 (Meeting with group members) (Offline Meeting)	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	1.Complete slide for progress presentation.	Task 1: Completed	

23.03.2022 (Meeting with group members) (Offline Meeting)	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	1.Modification of slides according to ATC comments.	Task1: All	Address the following comments: 1. There is no sound in the distance measurement video. 2. Make the objectives more technical. For example: Help Bangladesh regain its prior economic status- this does not concern your project directly. 3. Check if any important part of the final report is omitted in the slide. 4. Focus on the hardware progress. 5. Spend one slide to explain why you chose this design as the optimal one. 6. Add a slide demonstrating the working procedure of the mask detection sub-system with 2 masks.
24.03.2022 (All FYDP committee and students)	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	1.Progress Presentation	Task 1: Completed	
25.03.2022 (Meeting with group members) (Offline Meeting)	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	1.Work on the final report progress 2.Updates of circuit/simulation and fieldwork. 3.Modification of budget. 4.Update logbook. 5.Prepare presentation slide 6.Complete Mask and temperature subsystem.	Task 1: Partially Completed. Task 2: Partially Completed. Task 3: Partially Completed. Task 4: Completed. Task 5: Completed Task 6: Partially Completed.	

27.03.2022 (Meeting with group members) (Offline Meeting)	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	1.Complete Mask and temperature subsystem.	Task 1: Partially completed.	
30.03.2022 (Meeting with group members) Recording	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	1.Chapter 3 2.Chapter 8 3.Chapter 9 4.Chapter 10	Task 1: Completed. Task 2: Completed. Task 3: Completed. Task 4: Completed.	
31.03.2022 (Meeting with the ATC members)	1.Prof. Dr. AKM Abdul Malek Azad (ATC Chair) 2. Md. Nahid Haque Shazon (ATC Member) 3.Afrida Malik (ATC Member) **Students** 4.Ashfak 5.Tanjila 6.Jim 7.Tanvir	1. Complete Chapter 2 2. Complete Chapter 4 3. Complete Chapter 5 4. Complete Chapter 8 5. Complete Distance Monitoring Sub-system. 6. Modification of Mask & Temperature Sub-system.		1. Modification of Mask & Temperature Sub-system. 2. Add a gantt chart for 400P and 400D. 3. Update figure numbers properly. 4. Add cost benefit analysis for chapter 8. 5. Have to submit the design report within 5th April. 6. Have to submit slides for the mock presentation within 17th April.
2.04.2022 (Meeting with group members) (Offline Meeting)	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	1. Complete Chapter 2 2. Complete Chapter 4 3. Complete Chapter 5 4. Complete Chapter 8 5. Complete Distance Monitoring Sub-system. 6. Modification of Mask &	Task 1: Tanjila Task 2: Jim Task 3: Ashfak Task 4: Tanvir Task 5: Tanvir & Ashfak Task 6: Ashfak, Tanjila & Jim	

		Temperature Sub-system.		
5.04.2022 (Meeting with group members) (Offline Meeting)	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	1. Complete Chapter 2 2. Complete Chapter 4 3. Complete Chapter 5 4. Complete Chapter 8 5. Complete Distance Monitoring Sub-system. 6. Modification of Mask & Temperature Sub-system.	Task 1: Partially Completed Task 2: Incomplete Task 3: Completed Task 4: Completed Task 5: Partially Completed Task 6: Completed	
7.04.2022 (Meeting with the ATC members)	1.Prof. Dr. AKM Abdul Malek Azad (ATC Chair) 2. Md. Nahid Haque Shazon (ATC Member) 3.Afrida Malik (ATC Member) **Students** 4.Ashfak 5.Tanjila 6.Jim 7.Tanvir	1. Complete Chapter 2 2. Complete Chapter 4 3. Complete Chapter 5 4. Complete Chapter 8 5. Complete Distance Monitoring Sub-system. 6. Modification of Mask & Temperature Sub-system. 7. Preparing slides for the mock presentation.		1.Chapter 8 should be completed properly. 2. Have to submit slides for the mock presentation within 17th April. 3. Have to make a video for the whole system. 4. Proper field work should be done.
11.04.2022 (Meeting with group members) (Offline Meeting)	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	1. Complete Chapter 2 2. Complete Chapter 4 3. Complete Chapter 5 4. Complete Chapter 8 5. Complete Distance Monitoring Sub-system.	Task 1: Tanjila Task 2: Jim Task 3: Ashfak Task 4: Tanvir Task 5: Tanvir & Ashfak Task 6: Ashfak, Tanjila & Jim Task 7: All	

		6. Modification of Mask & Temperature Sub-system. 7. Preparing slides for the mock presentation.		
16.04.2022 (Meeting with group members) (Offline Meeting)	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	1. Complete Chapter 2 2. Complete Chapter 4 3. Complete Chapter 5 4. Complete Chapter 8 5. Complete Distance Monitoring Sub-system. 6. Modification of Mask & Temperature Sub-system. 7. Preparing slides for the mock presentation.	Task 1: Completed Task 2: Completed Task 3: Completed Task 4: Completed Task 5: Completed Task 6: Completed Task 7: Completed	
20.04.2022 (Meeting with group members)	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	1. Trial for upcoming mock presentation.	Task 1: Completed by all.	
21.04.2022 (Meeting with the ATC members)	1.Prof. Dr. AKM Abdul Malek Azad (ATC Chair) 2. Md. Nahid Haque Shazon (ATC Member) 3.Afrida Malik (ATC Member) **Students** 4.Ashfak 5.Tanjila 6.Jim 7.Tanvir	1. Modification of slides for upcoming final presentation. 2. Have to edit the video.		1. Have to send modified slides within 25th April.

23.04.2022 (Meeting with group members) (Offline Meeting)	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	1. Modification of slides for upcoming final presentation. 2. Have to edit the video.	Task 1: All Task 2: Ashfak	
24.04.2022 (Meeting with group members)	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	1. Modification of slides for upcoming final presentation. 2. Have to edit the video. 3. Trial for upcoming final presentation.	Task 1: Completed by all. Task 2: Completed Task 3: Completed by all.	
27.04.2022 (Meeting with group members) (Offline Meeting)	1.Ashfak 2.Tanjila 3.Jim 4.Tanvir	1. Trial for upcoming final presentation.	Task 1: Completed by all.	
28.04.2022 (All FYDP committee and students)	1.Prof. Dr. AKM Abdul Malek Azad (ATC Chair) 2. Md. Nahid Haque Shazon (ATC Member) 3.Afrida Malik (ATC Member) **Students** 4.Ashfak 5.Tanjila 6.Jim 7.Tanvir	1. Final project presentation and project demonstration.	Task 1: **Successfully completed by all.**	