A PROJECT REPORT ON

THE SENTINEL: SAFE ENTRY SYSTEM

SUBMITTED BY

GROUP NAME: TEAM MEGATRONICS

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ABSTARCT

The epidemic of the coronavirus COVID-19 is wreaking havoc on the world's health. Wearing a face mask in public places, according to the World Health Organization, is one of the most effective protective techniques. Wearing a face mask in public areas, according to study results, greatly minimizes the chance of transmission. In this paper, a Raspberry Pi powers an IoTenabled smart door that monitors body temperature and detects face masks using a machine learning model. Here we present a hybrid model that uses deep and classical machine learning to detect face masks in conjunction with a temperature sensor to measure the temperature of the person attempting to enter the building, an ultrasonic sensor to dispense sanitizer, and IR sensors to keep track of in and out counts. A buzzer will also be used to let the user know that they are allowed to enter. Any commercial mall, hotel, or apartment entry can benefit from the proposed approach. As a result, a cost-effective and dependable approach of utilizing AI and sensors to create a healthy atmosphere has been developed.

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LIST OF ABBREVIATIONS

Abbreviated Word	**Expansion**
IoT	**Internet of Things**
DC Motor	**Direct Current Motor**
PIR Sensor	**Passive Infrared Sensor**
RPi	**Raspberry Pi**
GPIO	**General Purpose Input/Output**
GUI Design	**Graphical User Interface Design**

CHAPTER I: INTRODUCTION

With its primary origins in Wuhan, China, the coronavirus infection, or COVID-19, has quickly spread to other countries, including India, the second-most populous country in the world with a population of over 140 billion. India had a large population, making it harder to control the coronavirus's spread. Face masks and hand sanitizers are the most reliable ways to stop transmissions. The lowering of disease transmission has benefited from this. Fever, a painful throat, exhaustion, a loss of taste and smell, and nasal congestion are symptoms of coronavirus sickness. Most frequently, it is communicated indirectly through surfaces. Since the final days of the previous year, the SARS-Cov-2 virus (also known as a coronavirus), which causes the novel infectious respiratory ailment Covid19, has had an impact on nearly every aspect of people's lives around the world. The virus can directly assault (from one person to another) via respiratory droplets, and the incubation time was maintained to be extremely long, ranging from 10 to 14 days in severe cases [2]. Governments implemented a range of protection and safety measures, such as social seclusion, the requirement to wear indoor masks, quarantine, limiting citizens' travel within and outside of their home states, self-isolation, and the exclusion and cancellation of significant social gatherings and meetings [10]. The COVID-19 epidemic has an effect on work activities, social relationships, sports of all kinds, as well as off-screen and on-screen enjoyment [4]. People with high body temperatures shouldn't be allowed in public places because they run the risk of getting sick and spreading the virus; masks must be worn. Additionally, temperature and mask checks are necessary at office, retail, mall, and hospital gates.

Every entrance includes a temperature checking system for scanning, but manual temperature monitoring has a number of disadvantages, and individuals are not well trained to use temperature scanner equipment. When interpreting the values, human error is a possibility [2]. People are frequently allowed to enter even after having higher fever readings discovered, and they are also sometimes allowed to enter even if they are not wearing masks. In the absence of supervisors, employees will forego the scanning. In large crowds, a manual scanning procedure is useless. We will offer a fully automated temperature scanner and entry provider system to address this problem. It is a system with multiple uses that is multifunctional [3]. In order to prevent entry if the workers' temperatures are too high or if no mask is found using a machine learning model, the system uses a contactless temperature scanner and a mask detection that is directly coupled with a human barrier. This system also maintains track of how many people are actually inside the building, as well as when they enter and leave at specific times that are managed by infrared sensors. No one will be let inside unless their mask and temperature are scanned. The only person who will be given immediate entrance to the building is the one who successfully completes both requirements [4]. The system uses a temperature sensor, a camera, and a Raspberry Pi system to control the entire process. The temperature sensor measures the forehead's temperature, while the camera is used to look for masks. The raspberry assesses the sensor inputs and decides whether to grant permission or not for the person. In this instance, the system employs a buzzer to cause a motor to open the barrier, allowing the guest to enter the building [5]. Additionally, the system incorporates an automatic sanitising dispenser that is sanitization-controlled by an ultrasonic sensor. The device flashes the red light and forbids entry if it detects a person with a high body temperature or without a mask. Additionally, an IOT device broadcasts the person's face and temperature to a computer, enabling authorities to intervene and test the person for covid. Thus, the system provides a 100% automated system to prevent the spread of COVID.

Because the target objects must come into touch with the required hardware during the data collection stage, Face Recognition in access control has grown in popularity in recent years by using biometric data rather than fingerprint, pattern, signature, etc. The advantage of this system is that it also has a facial recognition feature that can be used without any additional gear. Face recognition is carried out without the need of any hardware when a person is at a specific distance from the camera and their face is recognised using a face detection algorithm. These systems can be utilised for security purposes such as human verification and crime prevention. The rest of the section is organized as follows, section 2 reviews previous related works. Section 3 explains the proposed methodology. section 4 elaborates the experimental results and its discussion. Section 5 gives the conclusion and future work.

Fig 1.1: Planned Design

CHAPTER II: LITERATURE REVIEW

Some of the components pertinent to our planned study can be found in a number of already published studies. To the best of our knowledge, there is currently no solution that addresses each of these factors individually in order to accomplish this aim while also enabling low-cost IOT devices.We talk about some of the already-present components in this section.

B Varshini, H R Yogesh, Syed Danish Pasha, Maaz Suhail, V Madhumitha, and Archana Sasi presented a Smart Doors System that detects users from COVID 19 by enabling the (IoT) technology, uses a machine learning model for Face Mask Recognition, monitors temperature, and keeps track of people who enter/leave the building using IOT, while mask detection is used to identify whether or not people near the camera are wearing To protect the rules and safety of inside workers during this COVID-19, the door will be opened if someone wearing a mask is seen, and it will remain closed if they are not.

The intelligent door control system built around face detection and recognition was proposed by San San Naing, Thiri Oo Kywe, and Ni Ni San Hlaing. This system comprises of two components: facial detection and automatic door opening. This method doesn't need any form of cards, keys, etc. The face is detected and recognized, data is extracted, and a database check ensures that the person is authorised before opening the door.

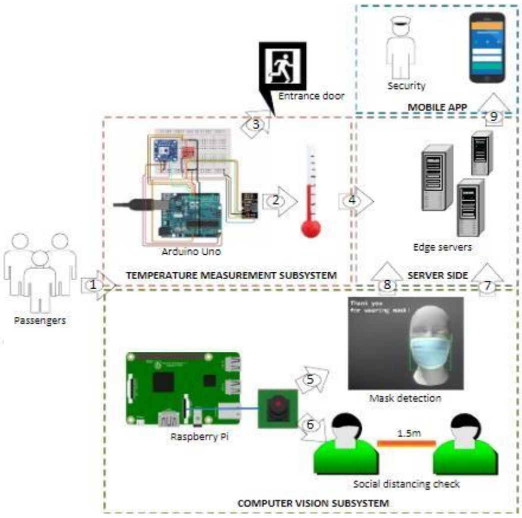


Fig 2.1 Product Working overview

An economical IoT-based solution was introduced by Dr. Saranya C.P., Akshay B.M., Den Leo Sunil, Madhan S., and Vanaja R. in their research work to boost Covid-19 entrance safety. They covered a number of pertinent elements, including: Mask detection, automatic hand sanitising, and contactless temperature sensing. The automatic hand sanitising system is accomplished by the DC motor coupled with the PIR sensor and Raspberry Pi. The contactless temperature sensing subsystem relies on the Raspberry Pi using temperature sensor, while mask detection is accomplished by leveraging computer vision techniques on camera-equipped Raspberry Pi. No one will be allowed in without a temperature check, hand sanitization, and mask scan. Only those who immediately meet the requirements set forth by the system are permitted entry; otherwise, if any condition is violated, the buzzer will notify security.

Safa Teboulbi, Seifeddine Messaoud, Mohamed Ali Hajjaji, and Abdellatif Mtibaa concentrated on developing an embedded vision system that could detect social distance and face masks. The VGG, ResNet Classifier, and MobileNet pretrained models are utilised. It was discovered when people disregarded social conventions or did not wear masks. The chosen model had a 100% confidence score following the deployment and implementation of the models. Precision, recall, F1-score, support, sensitivity, specificity, and accuracy are used to evaluate the system's performance and show how practical applicability.

CHAPTER III: METHODOLOGY

The Sentinel Entry System functions in a variety of ways. This system technique uses an advanced concept that combines all features, such as temperature monitoring, total person count, mask detection, sanitising, and facial recognition.

3.1 TEMPERTURE DETECTION SYSTEM

On the Raspberry Pi, the MLX90614 temperature sensor is connected to the GPIO pin, and the necessary code is written for it. The output is in Celsius, and a

3.2 TOTAL COUNT OF PEOPLE

IOT is used to track the number of persons who enter and depart the room as well as their entry and exit times using infrared sensors. The Internet of Things (IoT) technology is utilised to monitor the temperature and count the number of people.

3.3 AUTOMATIC SANITIZATION DISPENSER

A person placing his hand below the dispenser nozzle activates the system's ultrasonic sanitising dispenser, which is a distinct component. When an item is detected, the sensor outputs

3.4 ENTRY SYSTEM – BARRIER GATE

If the individual's temperature is normal after being detected, a buzzer beep will sound, and the barrier gates will be opened by a servo motor, signalling that the person is permitted to enter the building. The device flashes the red light and forbids entry if it determines that a person has a high body temperature. Additionally, the person's temperature and face are sent to a server via IOT, enabling authorities to test the person for covid and take action. As a result, the system offers a fully automated system to stop COVID from spreading.

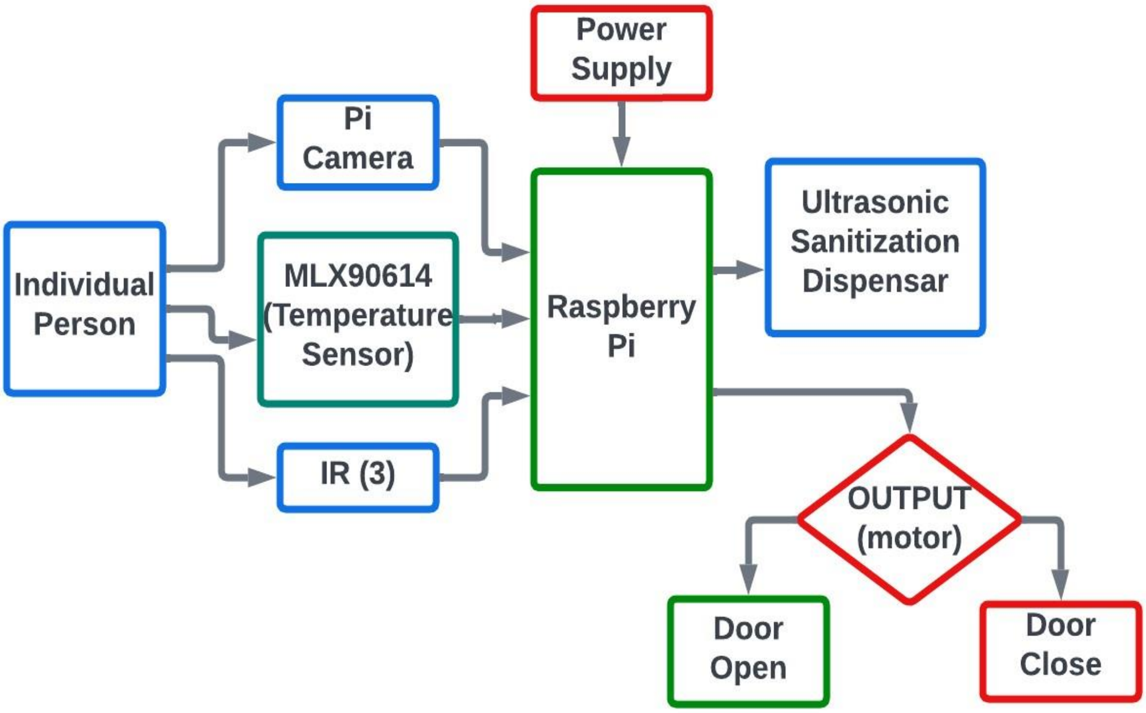


Fig 3.1: Overview of connection structures

The overview of the connecting structures that make up the solution is shown in the block diagram. Anybody trying to enter the facility must first pass-through infrared sensors that keep track of and regulate the precise number of persons entering and leaving each room. This makes use of the MLX90614 body temperature sensor. If the individual's body temperature is too high, the door won't open; if it is normal, the door will open and move on to the facial recognition stage. A Raspberry Pi single-board computer and a Raspberry Pi Camera are used to carry out this task. After that, the user can make advantage of the automatic cleaning system. This IoT-based solution is utilised to guarantee the regulations and security for indoor employees during COVID-19.

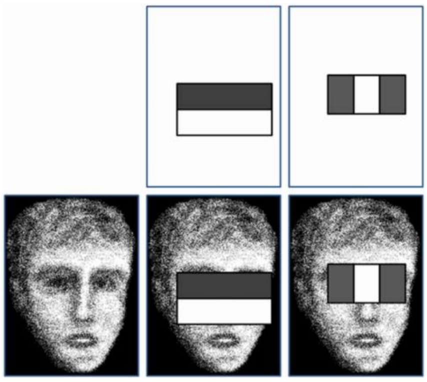
3.5 FACE RECOGNITION MODEL

The most popular technique in the field of computer vision used for face detection on the image is the Viola-Jones algorithm (also known as Haar cascades). The Viola-Jones algorithm may be trained to recognise a variety of things, including cars, buildings, culinary utensils, fruits, and more, in addition to detecting faces in photos.

A variety of Haar-like features are employed to calculate the image at various scales and positions for each sub-window. The image to be used is divided into several types of sub-windows. The Adaboost algorithm is used to choose the key characteristics. A cascade of classifiers is then used to check each sub-window for the presence or absence of a face.

A series of classifiers with properties reminiscent of Haar are used in the detection process. Thus, it is also called the Haar Cascades based detector.

characteristics = sum(pixels in the black area) - sum (pixels in the white area)



Because the bridge is lighter than the surrounding area, there will be more features when we calculate the second image features in the figure above. However, if we continue to add the same features to the head of the face, we will see fewer features. We also see more details in the third image since it can identify the eye region because it is darker than the area below it.

CHAPTER IV: RESULTS AND DISCUSSION

4.1 CIRCUIT DESIGN

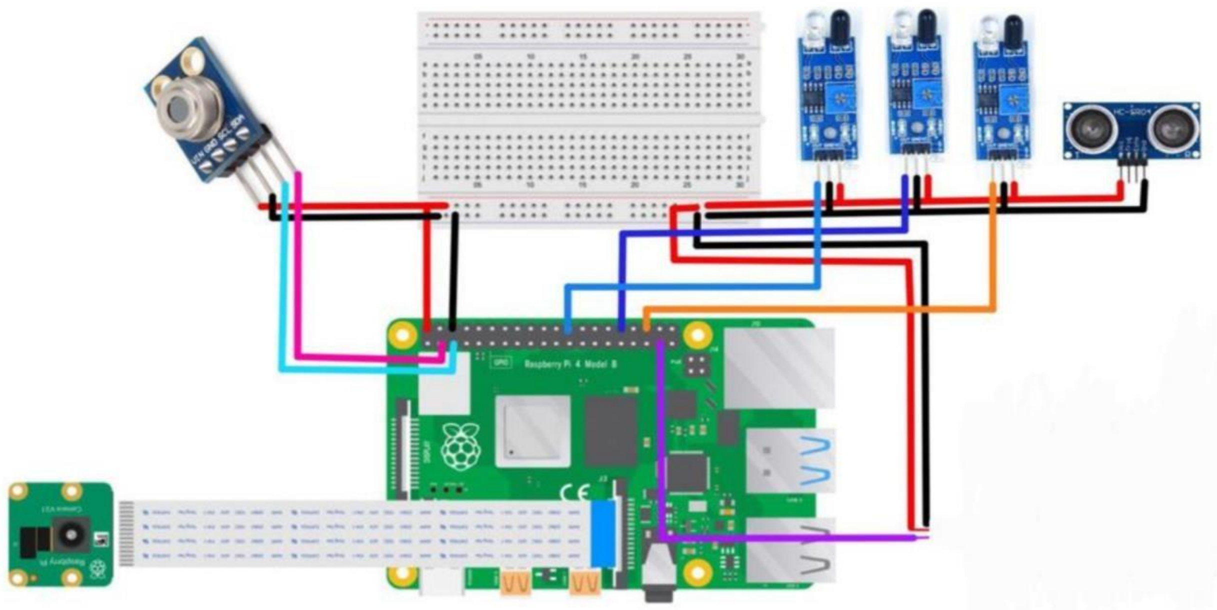
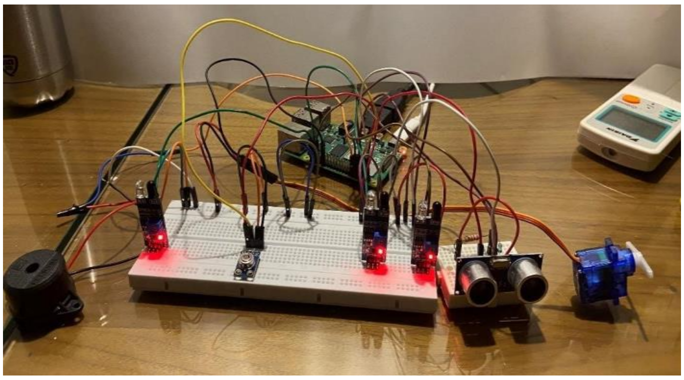


Fig 4.1: Circuit overview

4.2 EXPERIMENTATION AND RESULTS

The main objective of the developed technology is to stop COVID-19 from spreading in public areas like offices and shopping centres. The system's hardware testing screenshots are included in this part. When an object or person approaches the entry, the first IR Sensor activates and alerts the entire system. The device may then keep track of a person's body temperature before doing database recognition and face and mask detection. If the temperature sensor detects that the subject's body temperature is below the predetermined threshold, the Pi cam turns on and checks to see if they are wearing a mask. If the mask is recognised, the count increases by one and the door automatically opens; if not, the individual is not permitted and the count remains constant. Similar to that, if a second person passes past the second IR sensor, it measures their body temperature; if they pass, the count goes up by one and they are permitted. The third IR sensor detects someone moving through the exits, the door opens, and the count is decreased by one.

Now, the Raspberry Pi sends the outputs of the sensor values it has recorded to the display monitor so users may see the appropriate values. When a channel is created on ThingSpeak, the necessary data is simultaneously shown on the screen and stored in the cloud for future record-keeping. This allows the doctors to retrieve the necessary data for later analysis while also displaying it on the screen and storing it in the cloud. Other users and scholars can quickly evaluate the data from the cloud. Now, the Face Recognition is done used the video stream data captured and stored in the database which is then used at the time of recognition. The model fetches the database for the person which comes at the entry gate and identifies his name and displays it on the screen as shown in output. Then this collects the attendance (Date, Time and Temperature at entry and exit) and sends it to the cloud for storing.



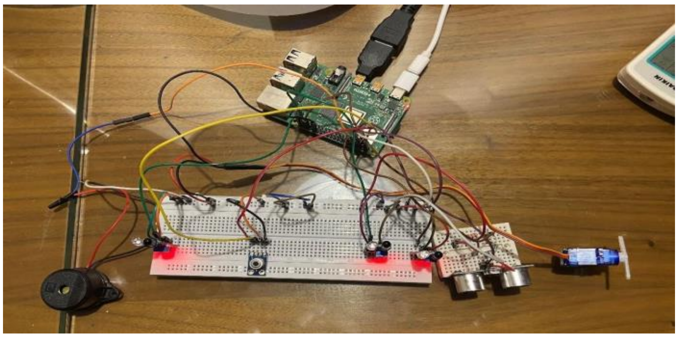


Fig 4.2: Real Time Hardware Assembly

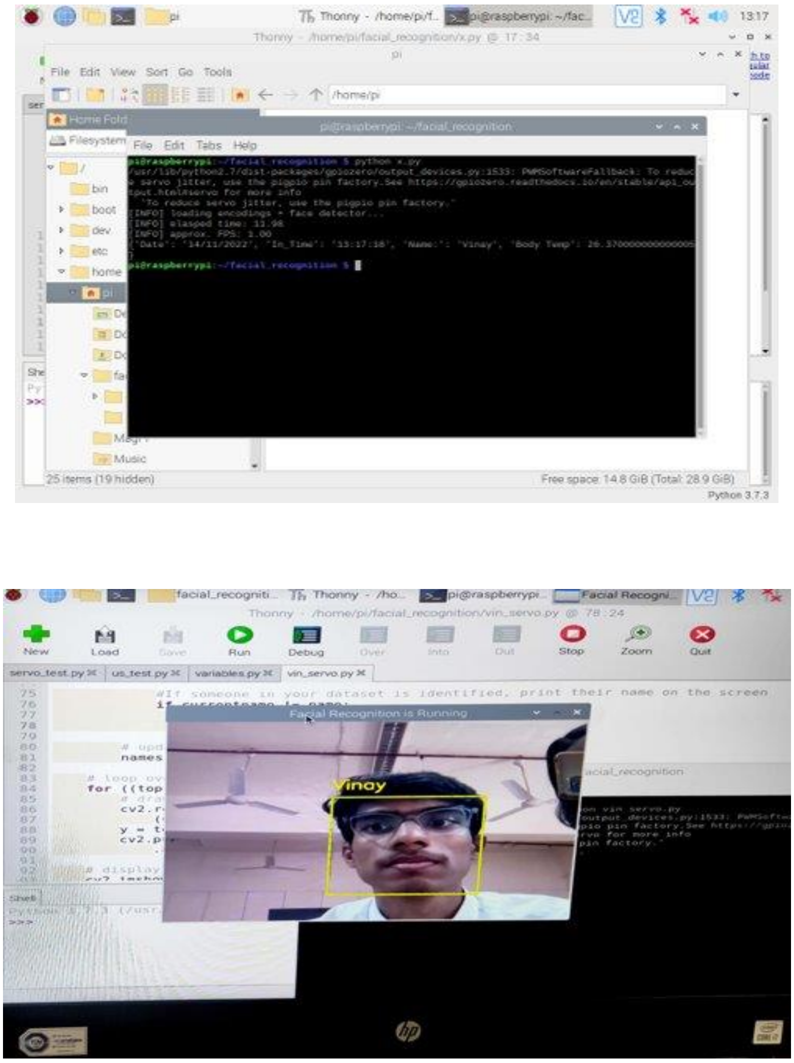
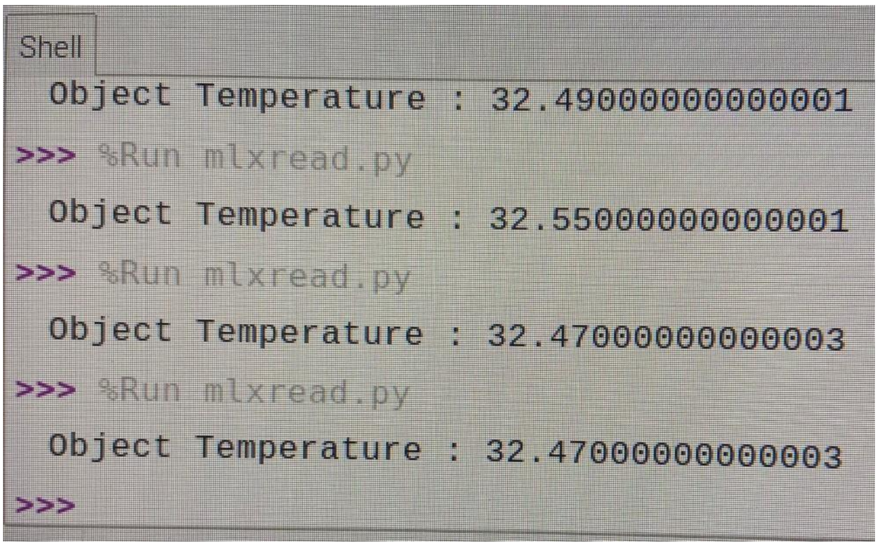


Fig 4.3: Face Recognition Model Results

4.3 OBSERVATION TABLE WITH READINGS



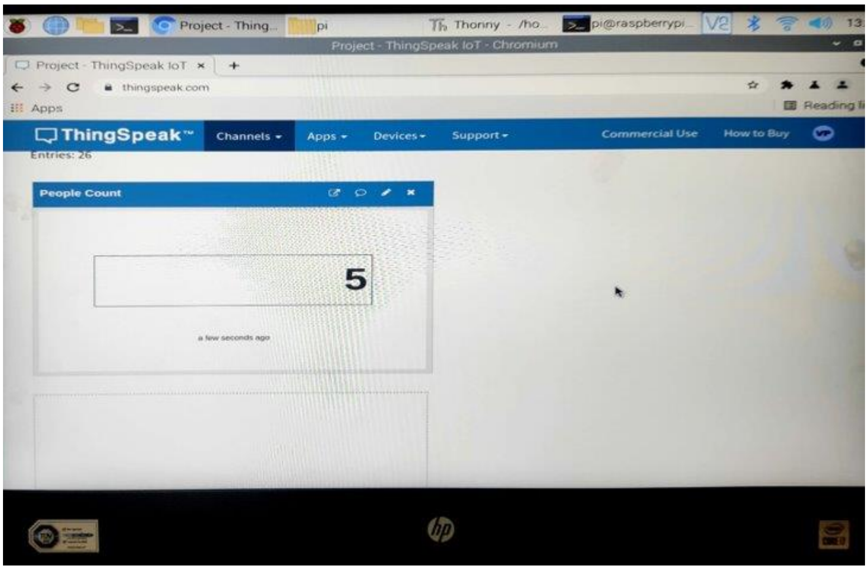


Fig 4.4: Observations on serial window

Fig 4.5: Prototype Design

CHAPTER V: CONCLUSION

Face masks and hand sanitizers are the most effective tools for reducing transmissions of Covid Diseases, on which our approach is built. As a result, we developed our project, which includes a temperature detection system, face recognition technology, an automatic sanitizer dispenser, and a person counter for entry and leave.

A temperature sensor coupled to a Raspberry Pi is used in the contactless temperature sensing subsystem, while a camera-equipped Raspberry Pi is used for mask recognition and an automatic hand sanitizer is created utilising a DC motor, a PIR sensor, and a Raspberry Pi.

The availability of smart technology and recent advancements call for the creation of new models that will help developing nations meet their needs. This will lessen the need for employees while also adding another line of defence against the spread of the Covid-19 illness. The model uses a Raspberry Pi-based real-time deep learning system to track the number of people within a facility, determine temperature, and detect face masks. The device performs exceptionally well when it comes to temperature monitoring and facial detection; the trained model had a 91 percent accuracy rate.

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APPENDIX

PIR Sensor Data Sheet:

VISHAY. www.vishay.com

TSSP40..

Vishay Semiconductors

IR Sensor Module for Reflective Sensor, Light Barrier, and Fast Proximity Applications

FEATURES

- Presence sensor: up to 2 m distance, find more info at: www.vishay.com/doc?49009
- Light barrier: up to 12 m distance, TSAL6200 with I_F = 50 mA, find more info at: www.vishay.com/doc?49650
- Fast proximity: up to 2 m range at 5 ms response time, find more info at: www.vishay.com/doc?82741
- Supply voltage: 2.5 V to 5.5 V
- Material categorization: for definitions of compliance please see www.vishay.com/doc?99912

e3 RoHS COMPLIANT HALOGEN FREE GREEN (5-2008)

LINKS TO ADDITIONAL RESOURCES

Product Page, 3D Models, Calculators, Marking, Packages, Holders, Bends and Cuts

MECHANICAL DATA

Pinning:

1 = OUT, 2 = GND, 3 = V_S

ORDERING CODE

TSSP40.. - 2160 pieces in tubes

DESCRIPTION

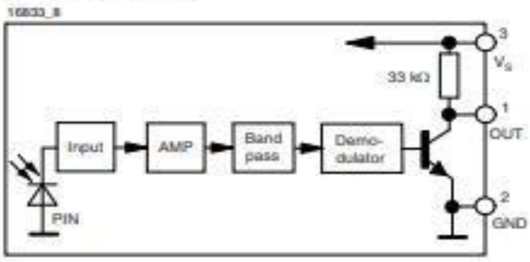
The TSSP40.. series are compact infrared detector modules for presence and fast proximity sensing applications. They provide an active low output in response to infrared bursts at 940 nm. The frequency of the burst should correspond to the carrier frequency shown in the parts table.

This component has not been qualified according to automotive specifications.

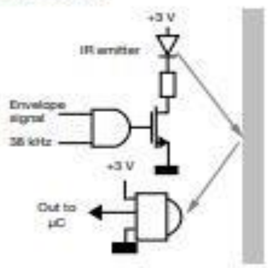
APPLICATIONS

- Reflective sensors for hand dryers, towel or soap dispensers, water faucets, toilet flush
- Vending machine fall detection
- Security and pet gates
- Person or object vicinity switch
- Fast proximity sensors for toys, robotics, drones, and other consumer and industrial uses

BLOCK DIAGRAM



PRESENCE SENSING



Rev. 2.3, 02-Aug-2021 1 Document Number: 82458

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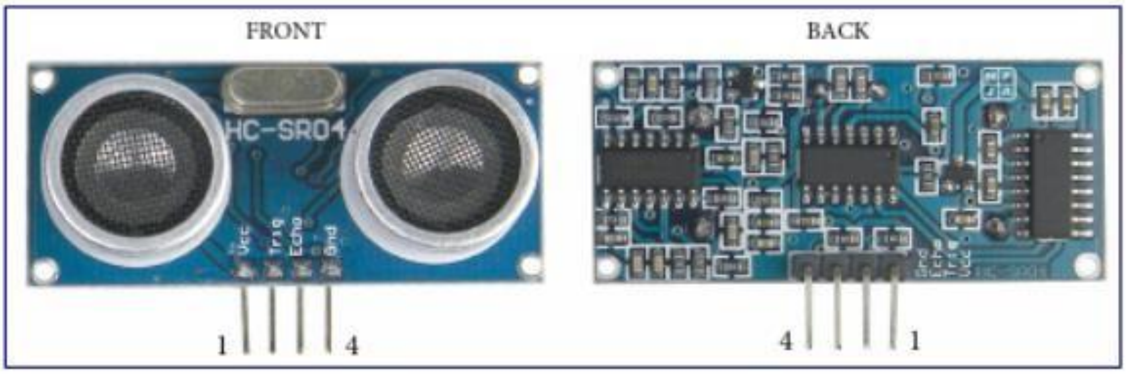
Ultrasonic Sensor Datasheet:

3. Product Views



4. Module Pin Asignments

	Pin Symbol	Pin Function Description
1	VCC	5V power supply
2	Trig	Trigger Input pin
3	Echo	Receiver Output pin
4	GND	Power ground

5. Electrical Specifications

WARARNING
Do Not connect Module with Power Applied! Always apply power after connecting Connect "GND" Terminal first

Electrical Parameters	HC-SR04 Ultrasonic Module
Operating Voltage	5VDC
Operating Current	15mA
Operating Frequency	40KHz
Max. Range	4m
Nearest Range	2cm
Measuring Angle	15 Degrees
Input Trigger Signal	10us min. TTL pulse
Output Echo Signal	TTL level signal, proportional to distance
Board Dimensions	1-13/16" X 13/16" X 5/8"
Board Connections	4 X 0.1" Pitch Right Angle Header Pins

2

MLX90614 Temperature sensor Datasheet:

Melexis
Microelectronic Integrated Systems

MLX90614 family

Single and Dual Zone
Infra Red Thermometer in TO-39

Features and Benefits

- Small size, low cost
- Easy to integrate
- Factory calibrated in wide temperature range:
  - -40 to 125 ˚C for sensor temperature and
  - -70 to 380 ˚C for object temperature.
- High accuracy of 0.5°C over wide temperature range (0..+50°C for both Ta and To)
- High (medical) accuracy calibration
- Measurement resolution of 0.02°C
- Single and dual zone versions
- SMBus compatible digital interface
- Customizable PWM output for continuous reading
- Available in 3V and 5V versions
- Simple adaptation for 8 to 16V applications
- Power saving mode
- Different package options for applications and measurements versatility
- Automotive grade

Applications Examples

- High precision non-contact temperature measurements;
- Thermal Comfort sensor for Mobile Air Conditioning control system;
- Temperature sensing element for residential, commercial and industrial building air conditioning;
- Windshield defogging;
- Automotive blind angle detection;
- Industrial temperature control of moving parts;
- Temperature control in printers and copiers;
- Home appliances with temperature control;
- Healthcare;
- Livestock monitoring;
- Movement detection;
- Multiple zone temperature control – up to 100 sensors can be read via common 2 wires
- Thermal relay/alert
- Body temperature measurement

Ordering Information

Part No.	Temperature Code	Package Code	- Option Code
MLX90614	E (-40°C to 85°C) K (-40°C to 125°C)	SF (TO-39)	- X X X (1) (2) (3)

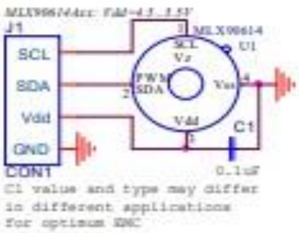
(1) Supply Voltage/ Acccuracy
- A - 5V
- B - 3V
- C - Reserved
- D - 3V medical accuracy

(2) Number of thermopiles:
- A – single zone
- B – dual zone

(3) Package options:
- A – Standard package
- B – Reserved
- C – 35° FOV

Example:
MLX90614ESF-BAA

1 Functional diagram



MLX90614 connection to SMBus

Figure 1 Typical application schematics

2 General Description

The MLX90614 is an Infra Red thermometer for non contact temperature measurements. Both the IR sensitive thermopile detector chip and the signal conditioning ASSP are integrated in the same TO-39 can.
Thanks to its low noise amplifier, 17-bit ADC and powerful DSP unit, a high accuracy and resolution of the thermometer is achieved.
The thermometer comes factory calibrated with a digital PWM and SMBus (System Management Bus) output.
As a standard, the 10-bit PWM is configured to continuously transmit the measured temperature in range of -20 to 120 ˚C, with an output resolution of 0.14 ˚C and the POR default is SMBus.

3901090614
Rev 003

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Data Sheet
03/Oct/2007