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Mini Project (18MTMP68) Report on

NON-CONTACT TEMPERATURE DETECTOR & FACE MASK DETECTOR, ATTENDANCE UPDATION SYSTEM USING FACIAL RECOGNITION TECHNIQUE

Submitted in partial fulfilment of the requirements for the Award of Degree of

BACHELOR OF ENGINEERING

In

Mechatronics Engineering

By

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MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING

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CERTIFICATE

This is to certify that the **Mini Project (18MTMP68)** entitled ‘‘**NON-CONTACT TEMPERATURE DETECTOR & FACE MASK DETECTOR, ATTENDANCE UPDATION SYSTEM USING FACIAL RECOGNITION TECHNIQUE**’’ carried out by Mr. **HEGDE SHRAVAN GANESH**, USN **4MT19MT019**, Mr. **YASHAS D**, USN **4MT19MT058**, Mr. **K PRAJITH P AJRI**, USN **4MT19MT023**, Mr. **ROHIT R PATIL**, USN **4MT19MT040,** a Bona fide students of **Mangalore Institute of Technology & Engineering** in partial fulfillment for the award of **Bachelor of Engineering** in **Mechatronics Engineering** of the **Visvesvaraya Technological University, Belagavi** during the year **2021-22**. It is certifiedthat all corrections/suggestions indicated for Internal Assessment have been incorporatedin the Report deposited in the departmental library. The project report has been approvedas it satisfies the academic requirements in respect of Seminar prescribed for the said Degree.

Mrs. Pavitra Kumari	**Dr. M S Ganesha Prasad**	**Dr. M Lokesha**
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Name of the Examiners | Signature with Date

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2.

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DECLARATION

We, Hereby declare that the project work entitled " **Non-contact temperature detector & face mask detector, attendance updation system using facial recognition technique**" is a record of original project work undertaken by us in partial fulfilment of the requirements of the degree of **Bachelor of Engineering** in **Mechatronics Engineering** of Visvesvaraya Technological University, Belagavi during the academic year 2021-22. We have completed this project under the supervision of **Mrs. Pavitra Kumari,** Assistant Professor, Department of Mechatronics Engineering, Mangalore Institute of Technology and Engineering, Moodabidri.

We also declare that, to the best of our knowledge and belief, the work reported herein does not form part of any other thesis or dissertation based on which a degree or award was conferred on an earlier occasion by any student.

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ABSTRACT

As communities are suffering from the COVID19 pandemic, cross-contamination of the virus between the employees is a huge risk factor. To mark the attendance of individual employees, the swiping cards or biometrics are normally in use. This can be an easy medium for the exchange of infection which leads to a widespread of the virus. Adding to this factor, not wearing a mask also contributes to the viral spread. This can be avoided using non- contact temperature assessment device. As a part of an initial inspection at entry points, this can be used to identify people who may have elevated temperatures which is indication of a possibility of a person who may have contracted the COVID-19 infection. This is developed to replace the current method of manual temperature scanning that exposes front line workers directly to possibly infected persons during examination. Apart from detecting the temperature, the system also uses Haar cascade frontal facial algorithm for face recognition and updates the employee attendance. This rules out the spread of virus through swipe of card or biometrics. The system also detects if the employee is wearing a mask and ensures that COVID protocol of essential masking is guaranteed. If the employee has an elevated temperature then, the employee is marked absent in the database. If the employee has temperature within the margin then, the employee is marked present and a sms is sent.

Keywords—Face detection, Attendance system, mask detection, Temperature monitoring, Mobilenet ssd, Haar-cascade frontal facial algorithm.

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CHAPTER 1

INTRODUCTION

Temperature measurement can be part of the evaluation to see if a person has an elevated temperature that might be caused by a COVID-19 infection. The use of "no-touch" or non-contact temperature assessment devices is one method for measuring a person's body temperature. The "Noncontact temperature detector & face mask detector, attendance updation device using facial recognition technology" determines the body's current temperature, marks the attendance automatically, and also maintains the mandatory usage of masks. There are many techniques for measuring a person's temperature. The use of this instrument to calculate a person's surface temperature can be used to mitigate cross-contamination risk and the risk of disease transmission. Although 37°C is usually considered a normal body temperature, some experiments have found that "normal" body temperature will vary from 36.1°C to 37.2°C which is set as the threshold. This instrument will calculate the temperature of the human body from 5 cm away. Cross- contamination is avoided when the instrument is kept at a healthy distance from the measuring body. The monitor will indicate the actual body temperature; if the body temperature reaches 37.2°C, the buzzer will be activated and the LED will flash, showing the danger factor. The attendance is registered in the database using image processing.

To update attendance, the model is trained with the employee images. The employee's expression must be filmed in such a way that all of the employee's facial features are detected. The machine captures a recording, and the face is registered and the attendance database is updated as a result for further processing of steps. The employee's mask can alsobe detected using the same technique.

CHAPTER 2

LITERATURE REVIEW

In the initial stage, research papers were reviewed on the basis of temperature checking using the infrared sensor, and the facial recognition.

(**G Compere and et.al [1]**) A comparison of temperature retrieved from the infrared thermometer and thermal image was studied by G Compere and et.al [1]. The study compared data obtained from a hospital.It was found that measurement of temperature for forehead with an infrared thermometer gives the precise measure. But when both the device were compared the measurement were not comparable and needed further improvement.

(**Guangli Long [2]**) The design of a Non-contact infrared thermometer was studied by Guangli Long [2]. In this study, human body temperature is measured through a Non-contact infrared thermometer. The micro controller displays the measured temperature through LCD and voice broadcast. The error of temperature measurement is not more than 0.2°C. Only a few tests were conducted and the efficiency of the system needs further probe.

(**Mohannad Jabbar Manti & et.al [3]**) developed an open- source Non-contact thermometer using a low-cost electrical component. The system is programmed using Arduino Uno and the device checks the temperature of the human body at the entrance. Contactless distance between the device and the user needs to be increased for effective implementation of the model.

(**Ganesh Nivekar & et.al [4]**) proposed a fuggy logic- based contactless risk dedication and prevention system to prevent COVID-19 suspect at the entrance, using a MLX 90614 IR sensor with a bar for entering if the threshold is not met.

(**Daniel Kwok-Keung Ng & et.al [5]**) A brief report on the normal range of forehead temperature for non- contact, hand held, infrared thermometer was described by Daniel Kwok-Keung Ng & et.al [5].

(**C Hersher & et.al [6]**) But the study was on a limited population Assessment of an infrared non-contact sensor for routine skin temperature monitoring was performed by C Hersher & et.al [6]. This process uses calibrating mechanism & microprocessor for programming. The non-contact Infrared sensor was efficient & accurate in displaying the exact body temperature. For comparison between infrared non-contact & contact sensor, more number of tests should be conducted.

(**Shahravi Shahabuddin & et.al [7]**) developed a real-time internet-based attendance updation system using facial recognition. This study is programmed to mark the attendance of student/company employees.

(**Sarath Chandu Gaddam & et.al [8]**) developed attendance management and security system based on Eigenface algorithm using Arduino uno 2 & Ethernet and an SMS for the attendance updation.

(**Dwi Sunaryono and et.al [9]**) have proposed an android based course attendance system using face recognition techniques. The attendance of the students is marked through android based course attendance system, the proposed system has anaccuracy of 97.29%.

(**B.PruthviRaj Goud & et.al [10]**) developed an open-cv based attendance updation system where the absentees report were sent via an email.

(**Rajkiran Gottumukkal & et.al [11]**) developed an improved face recognition technique based on the modular PCA approach. In this approach, the face image is modified by varying the light effect & taking more samples of a face in various expressions as sub-images. The modular PCA method is better to perform for various expressions of faces. Modular PCA performance is less for large posed face images.

CHAPTER 3

PROBLEM DEFINITION AND OBJECTIVES

3.1 Problem

Temperature measurement can be one part of the assessment to determine if a person has an elevated temperature potentially caused by a COVID-19 infection. One method to measure a person's body temperature is the use of "no-touch" or non-contact temperature assessment devices.

Measuring a person’s temperature can be done in several ways. One method to measure a person’s surface temperature is with the use of this device may be used to reduce cross-contamination risk and minimize the risk of spreading disease.

- Simple human contact spread the virus like COVID-19 Vigorously
- Act like swiping card for attendance can even be determinable.
- Not wearing the mask can spread the virus rapidly
- Need to control the spread by monitoring

3.2 Objectives

The objective of the project aims at providing a solution to this by removing the manual intervention, to reduce the spread of the virus wearing mask is mandatory, the solution also aims at automatically detecting the same. So this device allows the user to know the current temperature of the body.

The automatic temperature scanner is designed and developed to

- Scan the temperature of a human body without direct contact or human intervention.
- Detect face mask and alert if not detected.
- Mark the attendance on the roll.
- Send a sms to the employee.

CHAPTER 4

METHODOLOGY

In the "Non-contact temperature detector & face mask detector, attendance updation system using facial recognition technique" device, Arduino uno is the controller in which all the components are integrated, ultrasonic senor measures the distance of the person from the device, mlx90614 infrared temperature sensor is used to check the body temperature without direct contact, sanitization, attendance updation and mask detection is done withthe facial recognition.

4.1 FlowChart

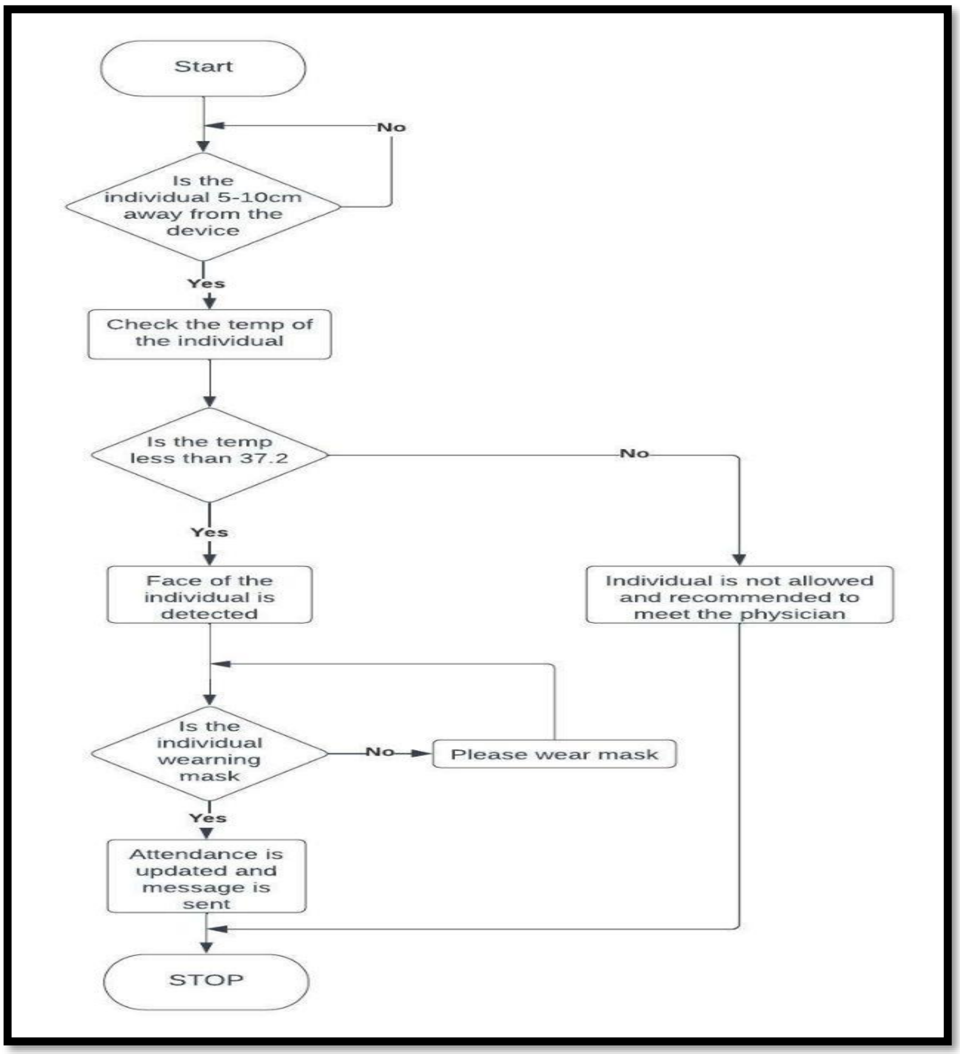

Figure 4.1 Flow Chart

- When the person comes near the entrance gate, an ultrasonic sensor checks whether the person is in the specified range (i.e.5cm).

- Once the person is within the safe area, the infrared temperature sensor checks the temperature of the human body. A threshold of 37.2 °C is set in the device. „

- If the body temperature is normal (<37.2 °C), then the green LED turns on. Identification of the person is done through a camera. Then the system checks if the employee is wearing a mask. If yes, then the attendance is updated and a message is sent to the employee, if no then the monitor displays “Please wear mask”.

- If the body temperature exceeds the threshold value (>37.2 °C), then red LED turns on, access is denied. The employee details are sent to the admin and attendance will be marked as absent.

4.2 Block Diagram

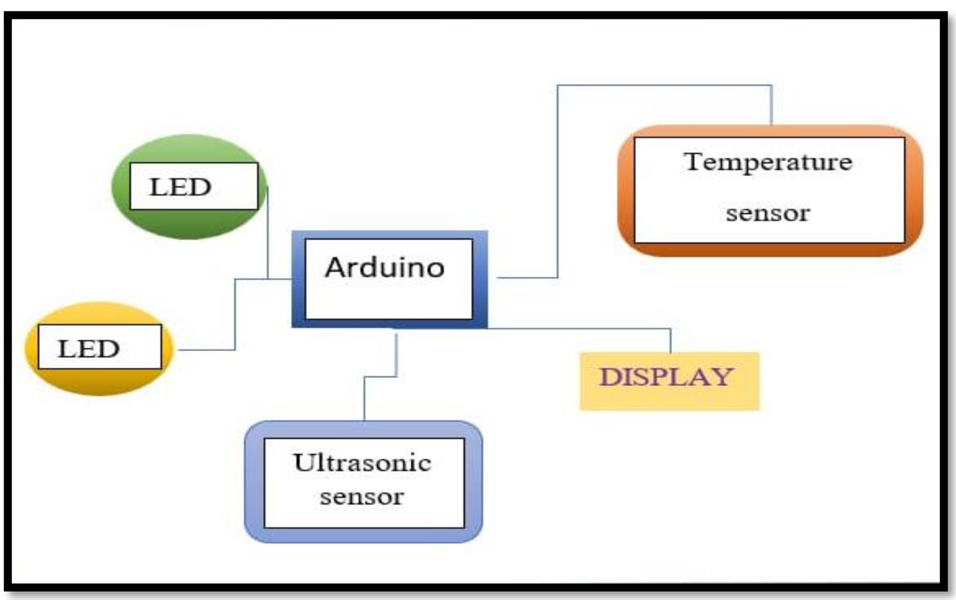

Figure 4.2 (a) Block diagram for temp module

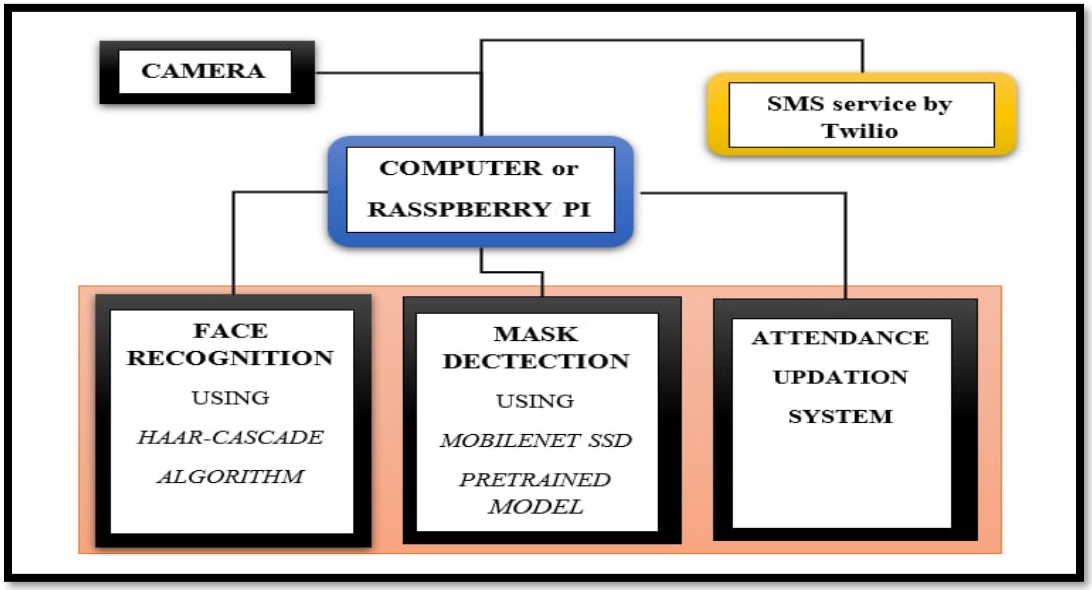

Figure 4.2 (b) Block diagram for Face, Face Mask Detection & Attendance updation

The Arduino uno is integrated with thermal sensor and ultrasonic sensor and is controlled by it. Ultrasonic sensors work by emitting sound waves at a frequency too high for humans to hear. They then wait for the sound to be reflected back, calculating distance based on the time required. Once the waves hit the person and comes back, it checks whether the person is within range as set by in the controller (i.e.5cm) then the signal is sent to the controller stating the person is detected and the infrared temperature sensor is activated.

Infrared temperature sensor measures temperature by sensing the infrared energy which the person with a temperature above absolute zero (0°K) will radiate. In the simplest configuration, a lens will focus the infrared radiation onto a detector which in turn will convert this energy into an electronic signal. After compensating for the ambient temperature this signal will be displayed as a temperature reading. This setup enables temperature measurement from a certain distance without requiring contact to the object. The threshold of 37.2°C is set in the controller.

If the temperature measured is less than the threshold value then the person access will be granted, the green LED turns on, the gate will be opened, and the attendance of the person will be marked in the database.

If the temperature measured exceeds the threshold value then the access of the person will be denied, the gate remains closed, buzzer will be activated and the attendance of the personwill be marked as absent in the database.

Using the system webcam face and facemask is detected. Once the person is detected in the camera, it will match the captured face in the database where the company's or industry's staff member’s facial images are pre uploaded in the database, if the captured face matches with the face in the database then the persons attendance will be marked present.

CHAPTER 5

SYSTEM REQUIREMENT

General

The main components of the non-contact temperature detector & face mask detector, attendance updation system using facial recognition technique are

- Arduino Uno
- MLX 90614 IR Temperature sensor
- Ultrasonic sensor

5.1 Arduino

5.1.1 Working

Arduino UNO is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that can be integrated into a variety of electronic projects.

Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

All of these tools take the messy details of microcontroller programming and wrap it up in an easy-to-use package. Arduino also simplifies the process of working with microcontrollers, but it offers some advantage for teachers, students, and interested amateurs over other systems. Inexpensive - Arduino boards are relatively inexpensive compared to other microcontroller platforms. The least expensive version of the Arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than \$50.

Cross-platform - The Arduino Software (IDE) runs on Windows, Macintosh OSX, and Linux operating systems. Most microcontroller systems are limited to Windows. Simple, clear programming environment - The Arduino Software (IDE) is easy-to-use for beginners, yet flexible enough for advanced users to take advantage of as well. For teachers, it's conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with how the Arduino IDE works.

Open source and extensible software - The Arduino software is published as open source tools, available for extension by experienced programmers. The language can be expanded through C++ libraries, and people wanting to understand the technical details can make the leap from Arduino to the AVR C programming language on which it's based. Similarly, you can add AVR-C code directly into your Arduino programs if you want to.

Open source and extensible hardware - The plans of the Arduino boards are published under a Creative Commons license, so experienced circuit designers can make their own version of the module, extending it and improving it. Even relatively inexperienced users can build the breadboard version of the module in order to understand how it works and save money.

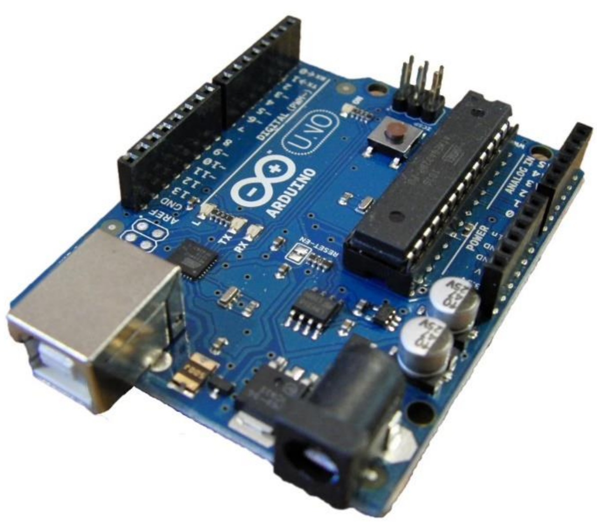

Fig 5.1 Arduino Uno Module

5.2MLX 90614 IR Temperature Sensor

5.2.1 Working

The MLX90614 is an infrared thermometer for non-contact temperature measurements. The thermometer comes factory calibrated with a digital SMBus output giving full access to the measured temperature in the complete temperature range(s) with a resolution of 0.02°C.The MLX90614 sensor can measure the temperature of an object without any physical contact with it. This is made possible with a law called Stefan-Boltzmann Law, which states that all objects and living beings emit IR Energy and the intensity of this emitted IR energy will be directly proportional to the temperature of that object or living being. So the MLX90614 sensor calculates the temperature of an object by measuring the amount of IR energy emitted from1 it.

According to Stefan–Boltzmann's law, the temperature of an object can be estimated from the knowledge of its emissive power. Although radiation can occur over a wide range of wavelengths, the peak value of the most commonly desired temperature ranges is in the area of the spectrum corresponding to the infrared radiation. In infrared thermography, this feature is used for multiple purposes, namely, as a health indicator in medical applications or as a fault detection in mechanical or electrical maintenance. Among the existing non-contact body temperature sensors, one of the most popular is that belonging to the MLX90614 family; an infrared thermometer that has a small size, low cost, and high accuracy. It can be easily connected to a processor, such as Arduino, for measuring the temperature of an object at a distance.

Due to its low noise amplifier, 17-bit ADC, and powerful digital signal processor (DSP) unit, a thermometer with high accuracy and resolution can be achieved. The thermometer comes factory calibrated with a digital PWM and System Management Bus (SMBus) output. As a standard, the 10-bit PWM is configured to continuously transmit the measured temperature in a range between−20◦C and 120◦C, witha resolution of 0.02◦C. The microcontrollers have an I2C communication way to connect with external peripherals; the MLX 90614 thermometer also includes I2C communication lines to be able to connect this sensor with the microcontroller, without any additional circuit.The sensor operates with a 3.3 V DC supply. If the micro controller operates with a 5 V DC, then it is necessary to pull up resistors between SDA and SCL lines to the +3.3 V DC line.

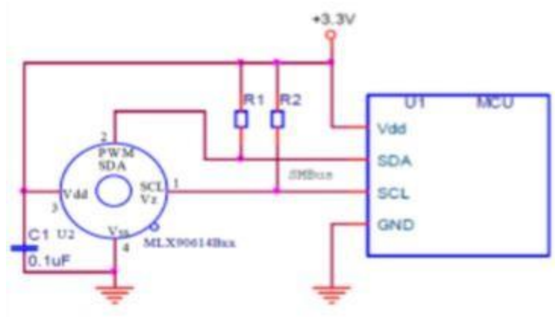

Figure 5.2 MLX 90614 IR Temperature Sensor Circuit *(Courtesy: theoryCIRCUIT.COM)*

In Figure 5.2, the internal configuration of the MLX90614 sensor is reported. It is made up of a silicon chip with a fine micro mechanized membrane that is sensitive to infrared radiation, together with the necessary hardware to amplify and digitize the signal and then compute the temperature. The set includes a low noise amplifier, a 17-bit ADC converter, a digital signal processor (DSP), and an ambient temperature compensation.

The user can configure the digital output to be pulse width modulation (PWM). As a standard, the 10-bit PWM is configured to continuously transmit the measured temperature in range of -40 to 120°C, with an output resolution of 0.14°C.

Arduino boards have I2C communication lines, which are easy to connect to I2C by cable. The sensor must be connected as indicated in Figure 12. In order to provide a +3.3 V power supply from the Arduino board to the sensor, 4.7 KΩ resistors are used to realize pull up on the I2C lines.

5.2.2 Specification

- Operating Voltage: 3.6V to 5V (available in 3V and 5V version)
- Supply Current: 1.5mA
- Object Temperature Range: -70° C to 382.2°C
- Ambient Temperature Range: -40° C to 125°C
- Accuracy: 0.02°C
- Distance between object and sensor: 2cm-5cm (approx.)

Figure 5.3 MLX 90614 IR Temperature Sensor *(Courtesy: Robokits.com)*

5.3 Ultrasonic Sensor

5.3.1 Working

Ultrasonic sensors work by emitting sound waves at a frequency too high for humans to hear. They then wait for the sound to be reflected back, calculating distance based on the time required. This is similar to how radar measures the time it takes a radio wave to return after hitting an object.

For instance, while radar, or even light-based sensors, have a difficult time correctly processing clear plastic, ultrasonic sensors have no problem with this. In fact, they're unaffected by the color of the material they are sensing.

On the other hand, if an object is made out of a material that absorbs sound or is shaped in such a way that it reflects the sound waves away from the receiver, readings will be unreliable. An ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).

In order to calculate the distance between the sensor and the object, the sensor measures the time it takes between the emissions of the sound by the transmitter to its contact with the receiver. The formula for this calculation is D = ½ T x C (where D is the distance, T is the time, and C is the speed of sound.

Ultrasonic sensors work by sending out a sound wave at a frequency above the range of human hearing. The transducer of the sensor acts as a microphone to receive and send the ultrasonic sound. Our ultrasonic sensors, like many others, use a single transducerto send a pulse and to receive the echo. The sensor determines the distance to a targetby measuring time lapses between the sending and receiving of the ultrasonic pulse. To detect transparent and other items where optical technologies may fail, ultrasonic sensors are a reliable choice.

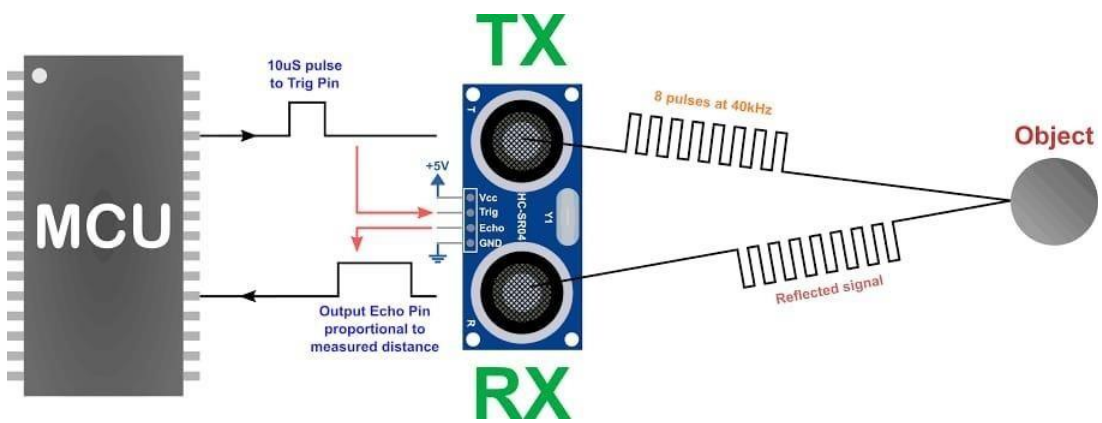

Figure 5.4 Ultrasonic Sensor Working *(Courtesy: Beijingultrasonic.com)*

HC-SR04 distance sensor is commonly used with both microcontroller and microprocessor platforms like Raspberry pi, ARM, PIC, Arduino uno etc. The following guide is universally since it has to be followed irrespective of the type of computational device used.

Power the Sensor using a regulated +5V through the Vcc and Ground pins of the sensor. The current consumed by the sensor is less than 15mA and hence can be directly poweredby the on board 5V pins (If available). The Trigger and the Echo pins are both I/O pins and hence they can be connected to I/O pins of the microcontroller. To start the measurement, the trigger pin has to be made high for 10uS and then turned off. This action will trigger an ultrasonic wave at frequency of 40Hz from the transmitter and the receiver will wait for the wave to return. Once the wave is returned after it getting reflected by any object the Echo pin goes high for a particular amount of time which will be equal to the time taken for the wave to return back to the sensor.

5.3.2 Specifications

- Power Supply − +5V DC
- Quiescent Current − <2mA
- Working Current − 15mA
- Effectual Angle − <15°
- Ranging Distance − 2cm – 400 cm/1″ – 13ft
- Resolution − 0.3 cm
- Measuring Angle − 30 degree

Figure 5.5 Ultrasonic Sensor Module *(Courtesy: Hackster.io)*

CHAPTER 6

IMPLEMENTATION

6.1 Literature review

In the initial stage we reviewed eleven research papers on temperature checking using the infrared sensor, and the facial recognition.

6.2 Programming part of the prototype

Stage 1

After doing the research, we started working on the programming part of the prototype, Firstly the programming of mlx temperature sensor was done to check the temperature of the human body, once the temperature programming was done. To keep a safe distance from the sensor due to the covid scenario, the temperature scanning distance had to be increased, so next the ultrasonic programming was done to increase the scanning distance, after verifying the correct and safer distance of the system from the measuring body the distance of minimum 5cm was set according to the temperature to be scanned and the distance ranged up to 35cm, and a threshold of 37.2°C was set in the controller for the infrared sensor(anything above 37.2°C is considered to be a risk factor), during the integration of mlx infrared sensor and the ultrasonic senor, firstly the ultrasonic senor will be activated and will check for the distance of the measuring body (5cm), if the body isstanding far from the sensor, it would display "come front " in the OLED display, if the body is standing to close to the sensor it would display "go back" in the OLED display and if the body is standing in the specified range i.e. 30-35cm. then the message will be displayed stating "wait the temperature is being scanned", then if the body is detected by the ultrasonic sensor then the signal would be passed on to the controller and the controller would activate the mlx infrared sensor, the infrared sensor will scan the temperature of the human body and will check for the threshold temperature.

Stage 2

As in the last phase the temperature sensor had a threshold value of 37.2°C, and was only displaying the temperature value, so to indicate the risk factor, we installed the buzzer in the system, programming of the buzzer was done thereafter, integrating the buzzer programming to the temperature sensor, it made it easier to understand the person who has an elevated temperature and indicate the risk factor.

Then to make it more easier we thought of adding the LED’s (Red and Green LED) Red LED indicates the risk factor where the green LED indicates the normal temperature, the programming of the LED’s was done and integrated both LED’s and the buzzer with the MLX 90614 IR temperature sensor

Stage 3

In this stage we move on to face detection. Here we use the HAAR cascade frontal facial algorithm to detect the face of the employee. It is an Object Detection Algorithm used to identify faces in an image or a real time video. The algorithm uses edge or line detection features proposed by Viola and Jones in their research paper “Rapid Object Detection using a Boosted Cascade of Simple Features” published in 2001. The algorithm is given a lot of positive images consisting of faces, and a lot of negative images not consisting of any face to train on them. The algorithm creates a dataset of the person with 30 images which is used in creation of the database. The repository has the models stored in XML files, and can be read with the Open CV methods. These include models for face detection, eye detection, upper body and lower body detection, license plate detection etc. Below we see some of the concepts proposed by Viola and Jones in their research. A sample calculation of Haar value from a rectangular image section has been shown here. The darker areas in the haar feature are pixels with values 1, and the lighter areas are pixels with values 0. Each of these is responsible for finding out one particular feature in the image. Such as an edge, a line or any structure in the image where there is a sudden change of intensities. For ex. in the image above, the haar feature can detect a vertical edge with darker pixels at its right and lighter pixels at its left. The objective here is to find out the sum of all the image pixels lying in the darker area of the haar feature and the sum of all the image pixels lying in the lighter area of the haar feature. And then find out their difference. Now if the image has an edge separating dark pixels on the right and light pixels on the left, then the haar value will be closer to 1. That means, we say that there is an edge detected if the haar value is closer to 1. In the example above, there is no edge as the haar value is far from 1. With this feature the face is recognized and can be updated to the database.

Stage 4

In this last stage of the project we worked on the face mask detection and sms alert system. For the face mask detection we use the Mobilenet-SSD. It is an object detection model that computes the bounding box and category of an object from an input image. In the Proposed System, we are going to detect objects in real time with the help of Mobilenet-SSD model in fast and efficient way. We will create the Python script for object detection using deep neural network with Open CV 3.4.

Working of the system is as follow:

Input will be given through real time video by camera or webcam, based on streamlined MobileNet Architecture which uses depth-wise separable convolutions to build light weight deep neural Networks. The input video divided into frames and pass it to MobileNet layers. [4] Each feature value is determined as a difference between the amount of pixel intensity under the bright region and the pixel intensity under the dark area. Every one of the possible sizes and area of the image is utilized to compute these elements. An image may contain irrelevant features and few relevant characteristics that can be used to detect the object.

The job of the MobileNet layers is to change over the pixels from the input image into highlights that describe the contents of the image. Then it passes to MobileNet-SSD model to determine the bounding boxes and corresponding class (label) of objects. After that the only last step is to show or display the Output.

For the sms service we are using the twilio. Twilio uses Amazon Web Services to host its communication infrastructure via APIs. Twilio follows a set of architectural design principles to protect against unexpected outages and received praise for staying online during the widespread Amazon Web Services outage in April 2011.

Rather than using industry standard protocols such as SIP for call control Twilio uses a customized markup language known as TwIML to allow for direct integration with its services. Twilio and the customer typically exchange TwIML documents via HTTP Webhook. Here we are using it for the prototype and project purposes, in real time any communication companies can be used.

6.3 Wiring up

Once we collected all the components from the market, connection to the controller of the sensors and display was made. As to integrate the programming with the hardware components, and check the working of each component according to the objective of the project we connected them as per the circuit we designed and tested it. And the same wiring setup is shown in the below fig 6.3 for reference.

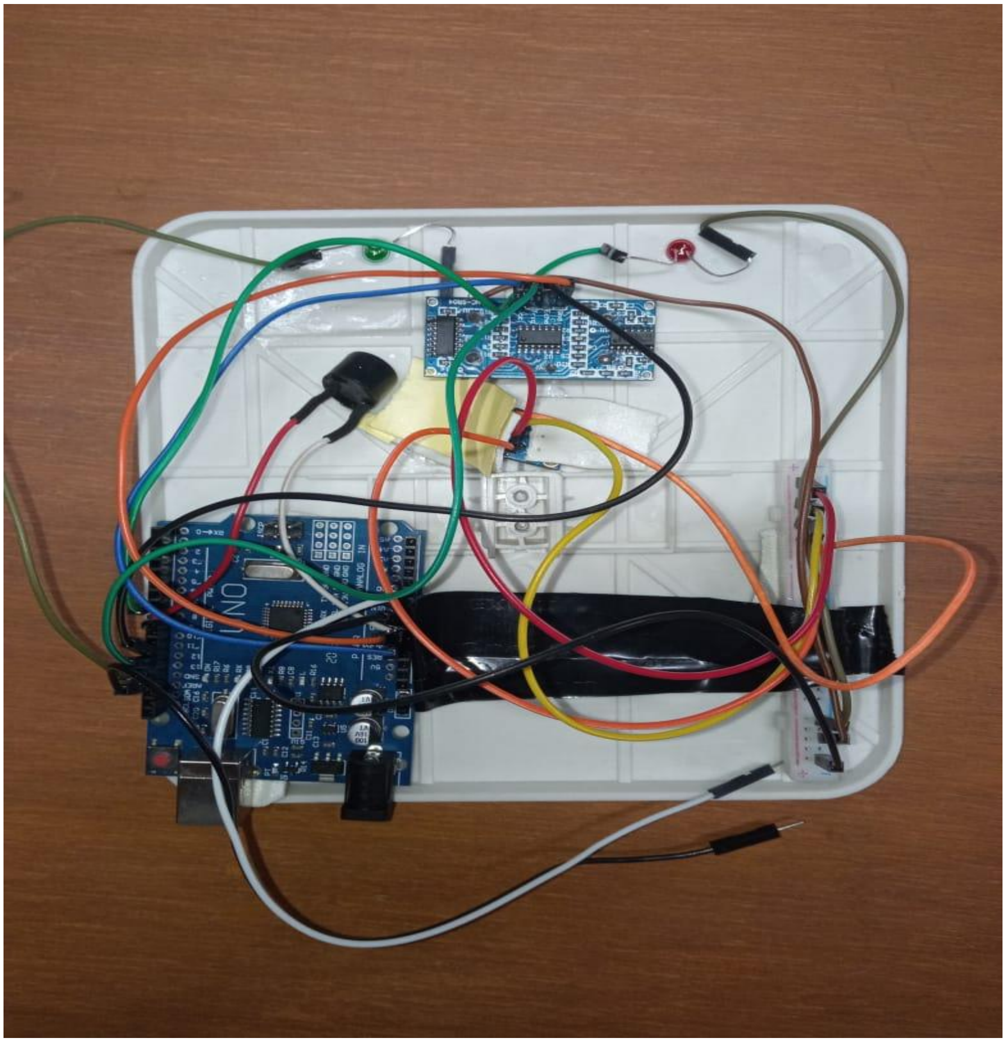

Figure 6.3 Wiring circuit.

6.4 Design and development of the Prototype

6.4.1 Prototype development of Temperature monitoring system

To build the prototype we started working on the development of the project, firstly we connected the temperature sensor to the ultrasonic sensor in accordance to achieve the required output of project i.e. To check who has an elevated temperature and indicate the risk factor, the hardware body was prepared, then the mlx 90614 IR sensor and the ultrasonic sensor were integrated with the help of the Arduino uno controller. Once the sensors were installed then the buzzer was attached to the controller with the temperature senor to indicated the risk factor by turning on, after that to indicate the temperature and to easily understand we installed the LED's to the system i.e. Red LED and the Green LED, Green to indicate the normal temperature and the Red to indicate the risk factor.

Figure 6.4 Temperature monitoring device

6.5 Conceptualized Design

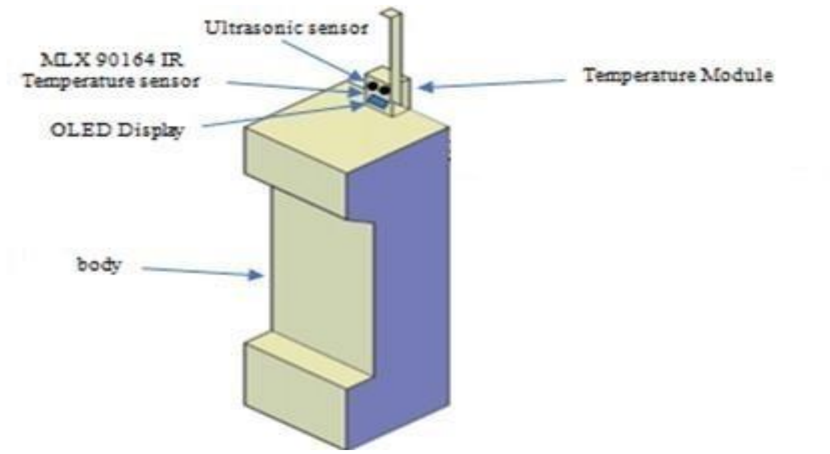

Figure 6.5 CAD Model

6.6 Design and Development of the Model

Once all the components were equipped with the respective sensors and working was successful, we combined all the components i.e. Temperature monitoring system with the gating system and built the final model Non-contact temperature monitoring device.

Figure 6.6 Working Model

CHAPTER 7

OUTCOMES

Create a database containing all of the candidate's images. Put all of the images in one folder and include the location path directory in the source code implemented using Python. All of the images are renamed with the candidate's name. The model is then trained with these images for identifying the employee when a scan is performed. If the face matches, it will show the name of that person on the screen, once the face is matched with the image in the database it will also for the face mask, then the employee data will be saved. After recognizing the employee, the system measures the body temperature and the same is displayed as shown in Fig. 7.1. If the temperature is below the defined threshold then the attendance is updated in the database with their ID, name and current time as shown in Fig.

7.2. If the person's temperature is above the threshold an SMS with the employee name, time, date and his/her temperature value will be sent to the physician as shown in Fig. 7.3 to perform the preliminary checkup of the employee. The developed device as shown in Fig. 7.4 dispenses sanitizer, scans temperature without any direct contact, detects employeeas shown in Fig. 7.5 and also if the employee is wearing mask as shown in Fig. 7.6 and alerts the user to wear a mask, if not and automatically updates the attendance.

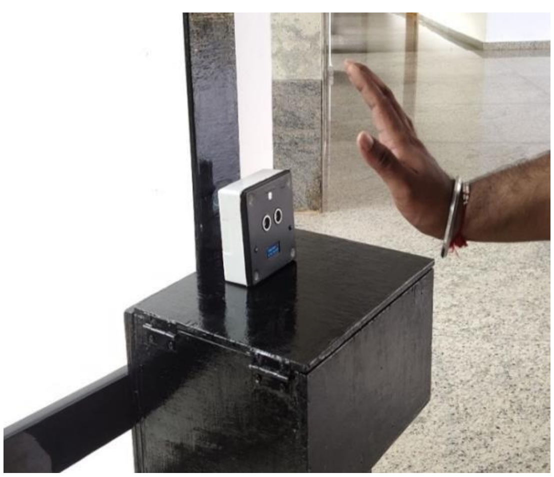

Fig. 7.1(a). Employee scanning his palm temperature measurement

Fig. 7.1(b). Employee Temperaturedisplay

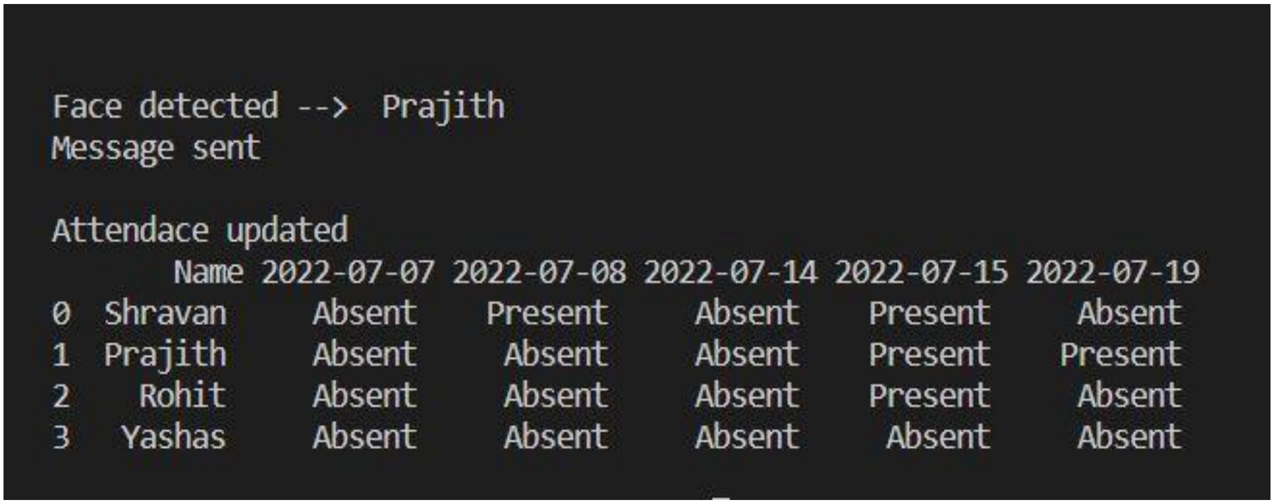

Fig. 7.2. Attendance updation in the database

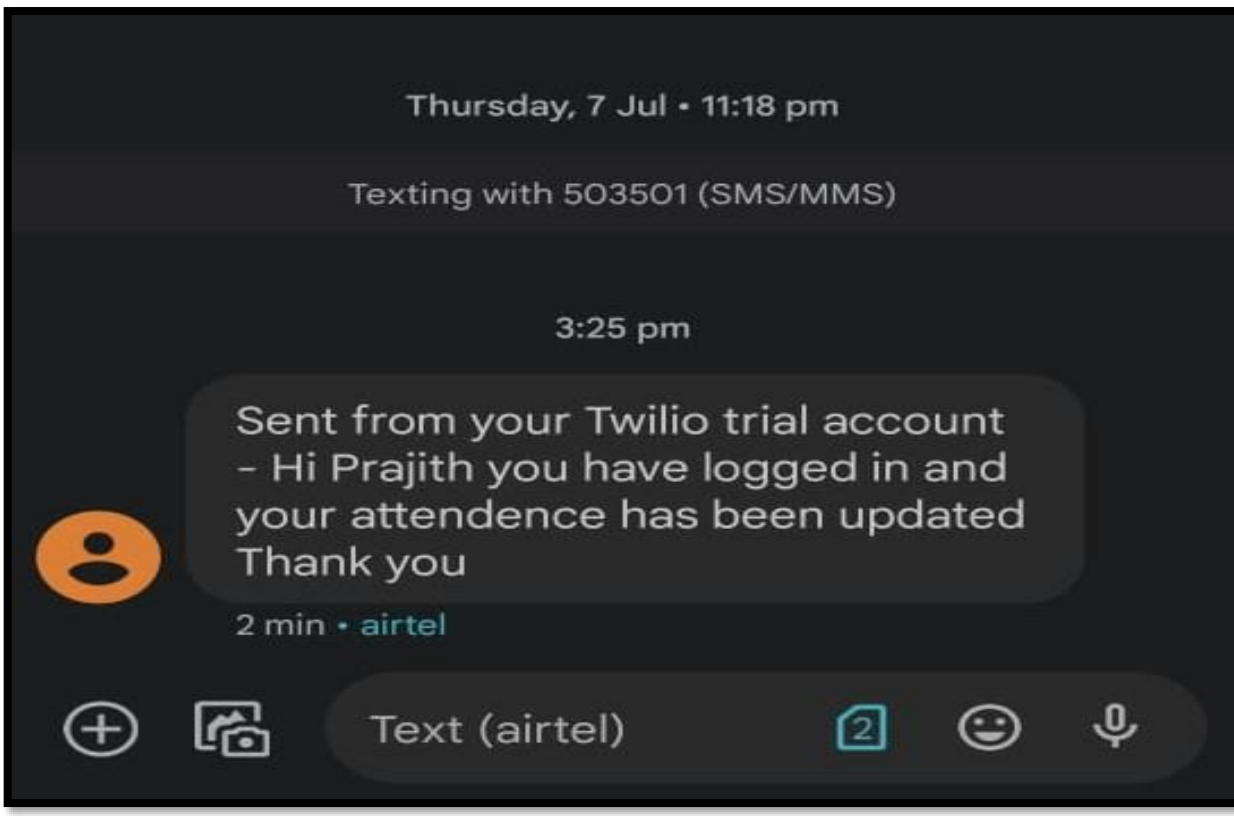

Fig. 7.3. Intimation to Employee via SMS

Fig. 7.4. Working model

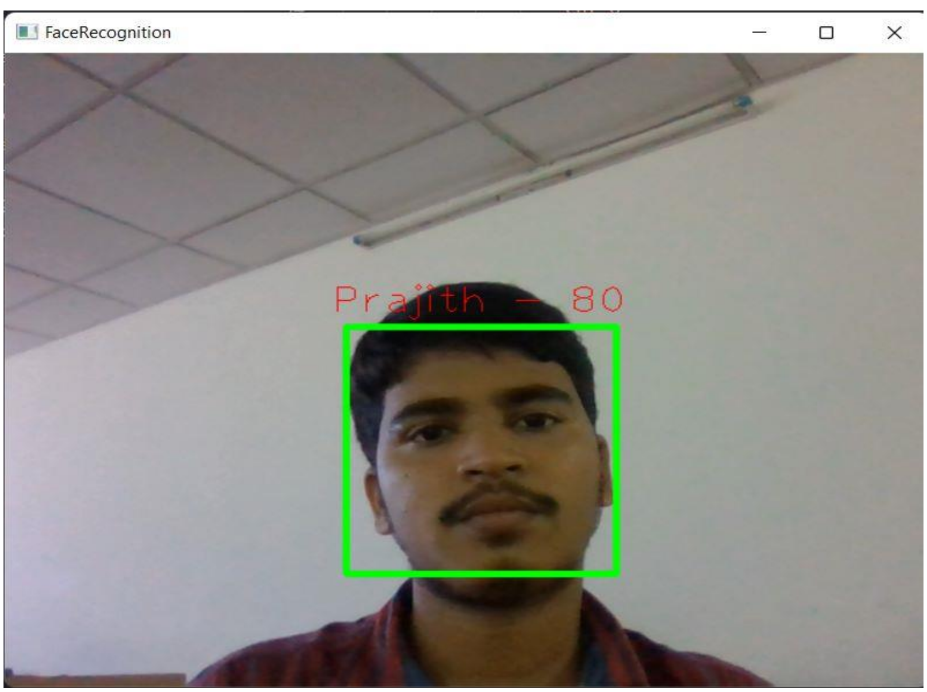

Fig. 7.5. Employee Identification

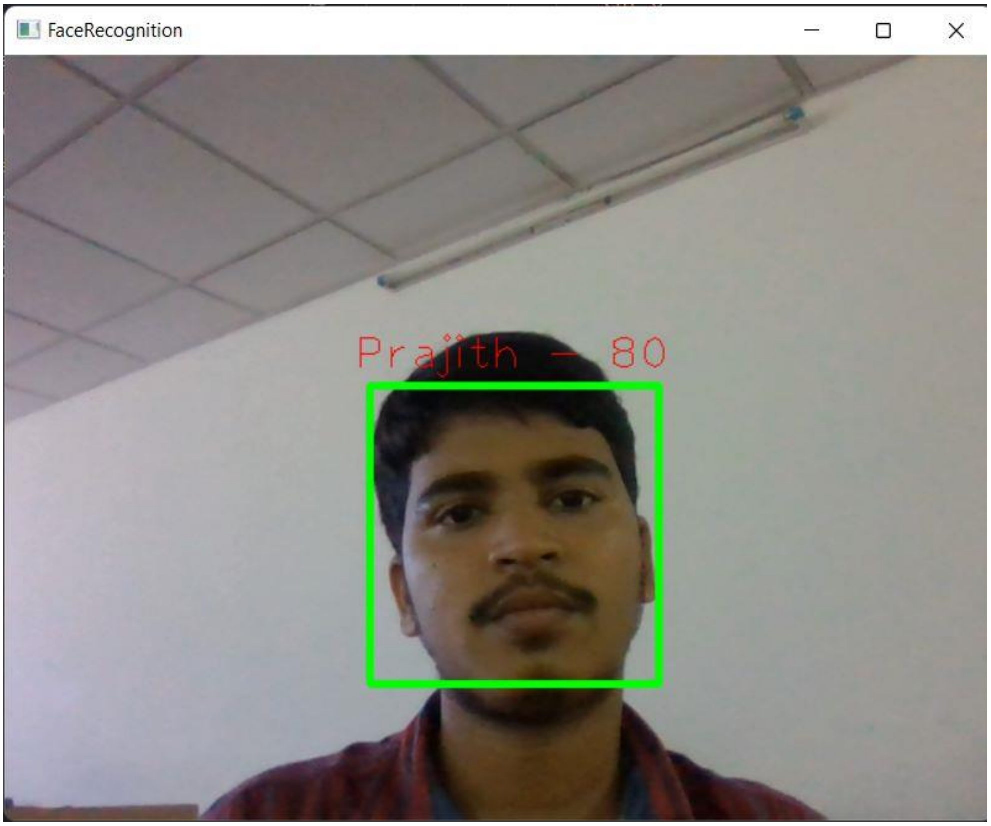

Fig. 7.6. Face mask detection

TABLE 7.1. COMPARISON OF THE TEMPERATURE VALUES OF THE DEVELOPED PROTOTYPE AGAINST THE TRADITIONAL HAND HELD DEVICE

Test No.	Non-contact temperature monitor(°C)	Handheld thermometer(°C)	Error
1	33.8	33.9	0.1
2	33.3	33.4	0.1
3	34.5	34.4	-0.1
4	34.2	34.3	0.1
5	38.2	38.4	0.2

TABLE 7.2. EFFICIENCY OF THE HAAR CASCADE FRONTAL FACIAL ALGORITHM USED IN THE MODEL

No. of tests conducted	No. of True positives	Efficiency in %
95	**93**	**97.89**

The face detection using Haar cascade frontal facial algorithm method provides 97.89% efficiency at varied lighting conditions as shown in Table 7.2. The system restricts entry of employees with elevated temperature and directs them for medical help. The comparison between Non- contact temperature monitor and hand held thermometer is shown in Table 7.1.The temperature scanning system has an error of ±0.2°C when compared to hand held infrared thermometer systems.

CHAPTER 8

CONCLUSION

The developed device finds greatest prevalence as the world is fighting against the pandemic COVID-19. While vaccinating and social distancing is the key, the role of proper screening and sanitizing is being professed by the World Health Organization and has predominantly aided in the fight against the pandemic. The developed model prevents exposing the frontline health workers to infected persons and also aids in reducing the risk to employees through swiping cards or marking biometric attendance. The product is also cost effective in comparison to the market contenders and a great value addition to developing countries and small organizations since the product is affordable and scalable.

CHAPTER 9

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ANNEXURE

Non-Contact Temperature Detection, Face Mask Detection, and Attendance Updation System using Facial Recognition Technique

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***Abstract*—as communities are suffering from the COVID-19 pandemic, cross-contamination of the virus between the employees is a huge risk factor. To mark the attendance of individual employees, the swiping cards or biometrics are normally in use. This can be an easy medium for the exchange of infection which leads to a widespread of the virus. Adding to this factor, not wearing a mask also contributes to the viral spread. This can be avoided using non-contact temperature assessment device. As a part of an initial inspection at entry points, this can be used to identify people who may have elevated temperatures which is indication of a possibility of a person who may have contracted the COVID-19 infection. While the device dispenses sanitizer on arrival, this is developed to replace the current method of manual temperature scanning that exposes front line workers directly topossibly infected persons during examination. Apart from detecting the temperature, the system also uses HOG algorithmfor face recognition and updates the employee attendance. Thisrules out the spread of virus through swipe of card or biometrics. The system also detects if the employee is wearing amask and ensures that COVID protocol of essential masking is guaranteed. If the employee has an elevated temperature then, the employee is referred to the on-campus physician, the appointment for which is automatically made using the system generated SMS for preliminary evaluation. If the employeeneeds further evaluation the physician updates the same in the database for processing medical leave.**

Keywords—Face detection, Attendance system, mask detection, Temperature monitoring, gating system, sanitizer dispenser.

I. INTRODUCTION

Temperature measurement can be part of the evaluation to see if a person has an elevated temperature that might be caused by a COVID-19 infection. The use of "no-touch" or non-contact temperature assessment devices is one method for measuring a person's body temperature. The "Non-contact temperature detector & face mask detector, attendance updation device using facial recognition technology" determines the body's current temperature, marks the attendance automatically, and also maintains the mandatory usage of masks. There are many techniques for measuring a person's temperature. The use of this instrument to calculate a person's surface temperature can be used to mitigate cross- contamination risk and the risk of disease transmission. Although 37°C is usually considered a "Natural" body temperature, some experiments have found that "normal" body temperature will vary from 36.1°C to 37.2°C which is set as the threshold. This instrument will calculate the temperature of the human body from 30 to 35cm away. Cross-contamination is avoided when the instrument is kept at a healthy distance from the measuring body. The monitor will indicate the actual body temperature;if the body temperature reaches 37.2°C, the buzzer will be activated and the LED will flash, showing the danger factor.The gate opens and closes based on the temperature reading, and the attendance is registered in the database using image processing. The physician will then be contacted for further intervention.

To update attendance, the model is trained with the employee images. The employee's expression must be filmed in such a way that all of the employee's facial features are detected. The machine captures a recording, and the face is registered and the attendance database is updated as a result for further processing of steps. The employee's mask can also be detected using the same technique. The sanitizer will be dispensed into the palms, which will serve to prevent the transmission of the infection.

II. LITERATURE SURVEY

A comparison of temperature retrieved from the infrared thermometer and thermal image was studied by G Compere and et.al [1]. The study compared data obtained from a hospital. It was found that measurement of temperature for forehead with an infrared thermometer gives the precise measure. But when both the device were compared the measurement were not comparable and needed further improvement. The design of a Non-contact infrared thermometer was studied by Guangli Long [2]. In this study, human body temperature is measured through a Non-contact infrared thermometer. The micro controller displays the measured temperature through LCD and voice broadcast. The error of temperature measurement is not more than0.2°C. Only a few tests were conducted and the efficiency ofthe system needs further probe. Mohannad Jabbar Manti & et.al [3] developed an open- source Non-contact thermometerusing a low-cost electrical component. The system is programmed using Arduino Uno and the device checks the temperature of the human body at the entrance. Contactless distance between the device and the user needs to be increased for effective implementation of the model. Ganesh

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Nivekar & et.al [4] proposed a fuggy logic- based contactless risk dedication and prevention system to prevent COVID-19 suspect at the entrance, using a MLX 90614 IR sensor with a bar for entering if the threshold is not met. A brief report on the normal range of forehead temperature for non-contact, hand held, infrared thermometer was described by Daniel Kwok-Keung Ng & et.al [5] but the study was on a limited population Assessment of an infrared non-contact sensor for routine skin temperature monitoring was performed by C Hersher & et.al [6]. This process uses calibrating mechanism & microprocessor for programming. The non-contact Infrared sensor was efficient & accurate in displaying the exact body temperature. For comparison between infrared non-contact & contact sensor, more number of tests should be conducted.

Shahravi Shahabuddin & et.al [7] developed a real-time internet-based attendance updation system using facial recognition. This study is programmed to mark the attendance of student/company employees. Sarath Chandu Gaddam & et.al [8] developed attendance management and security system based on Eigenface algorithm using Arduino uno 2 & Ethernet and an SMS for the attendance updation. Dwi Sunaryono and et.al [9] have proposed an android based course attendance system using face recognition techniques. The attendance of the students is marked through android based course attendance system, theproposed system has an accuracy of 97.29%. B.PruthviRaj Goud & et.al [10] developed an open-cv based attendance updation system where the absentees report were sent via anemail. Rajkiran Gottumukkal & et.al [11] developed an improved face recognition technique based on the modular PCA approach. In this approach, the face image is modified by varying the light effect & taking more samples of a face in various expressions as sub-images. The modular PCA method is better to perform for various expressions of faces. Modular PCA performance is less for large posed face images.

III. METHODOLOGY

In the "Non-contact temperature detector & face mask detector, attendance updation system using facial recognition technique" device, Arduino uno is the controller as shown in Fig. 1. An ultrasonic sensor measures the distance of the person from the device, MLX90614 Infrared temperature sensor is used to check the body temperature without direct contact. Attendance updation and mask detection are done with the HOG facial recognition technique.

The image or HD video is captured at a simple 5MP or 1080p resolution at 30 frames per second. When an individual is recognized by the camera, the captured face matches the face in the database, which contains pre-trained facial images of the employees, and the person will have access to the temperature assessment if the captured face matches the face in the database. Ultrasonic sensors are used to adjust the distance of the employee to the safe distance from the scanner. It calculates the distance based on the timeit takes for the sound to be reflected. When the wave reaches the person and return, it scans to see if they are within the controller's fixed range (i.e. 30-35cm). If they are, a signal is transmitted to the controller indicating that the person has been identified, and the infrared temperature sensor is turned on. The infrared temperature sensor detects the infrared energy emitted by a human with a temperature above absolute zero (0 °K). In the simplest setup, a lens will direct infrared radiation onto a detector, which will then convert this energy into an electronic signal. This signal will be displayed as a temperature reading after it has been compensated for the ambient temperature. This setup allows temperature to be measured from a distance without having to touch the object. In the controller, a temperature thresholdof 37.2°C has been set. The servo motor will open and close the gate based on the measured temperature threshold, and LEDs will turn on. A message is sent to the server using the GSM module. The Arduino uno Camera Board connects directly to the Arduino uno's CSI connector. The flow chart in fig. 2. explains the work flow of the proposed system.

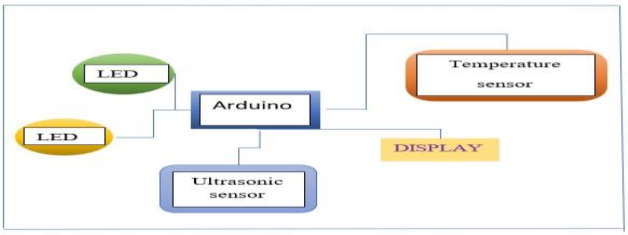


Fig 1. Block Diagram of the system

- When the person comes near the entrance gate, the sanitizer will be dispensed into their palms.
- Identification of the person is done through a camera.
- An ultrasonic sensor checks whether the person is in the specified range (i.e. 30-35cm).
- If the person is away (>35cm) or too near (<30cm) from the temperature scanner, an audio message prompting the employee to be in the safe range
- Once the person is within the safe area, the infrared temperature sensor checks the temperature of the human body. A threshold of 37.2 °C is set in the device.
- If the body temperature is normal (<37.2 °C), then the green LED turns on.
- Then the system checks if the employee is wearing a mask. If yes, then the attendance is updated and the employee gets an access to the office.
- If the body temperature exceeds the threshold value (>37.2 °C), then red LED turns on, access is denied. The employee details are sent to the admin and attendance willbe marked as referred to physician in the database. An intimation would also be sent to the physician for preliminary consultation. The physician will update the course of action in the database.

The Histogram of Oriented Gradients algorithm is used for facial recognition; it is a function descriptor that is often used to extract features from image data. It is commonly used for object detection in computer vision tasks. HOG focuses on the object's structure. It extracts knowledge about the magnitude and orientation of the edges.

IV. Outcomes & DISCUSSION

Create a database containing all of the candidate's images. Put all of the images in one folder and include the location path directory in the source code implemented usingPython. All of the images are renamed with the candidate's name. The model is then trained with these images for identifying the employee when a scan is performed. If the face matches, it will show the name of that person on the screen, once the face is matched with the image in the database it will also

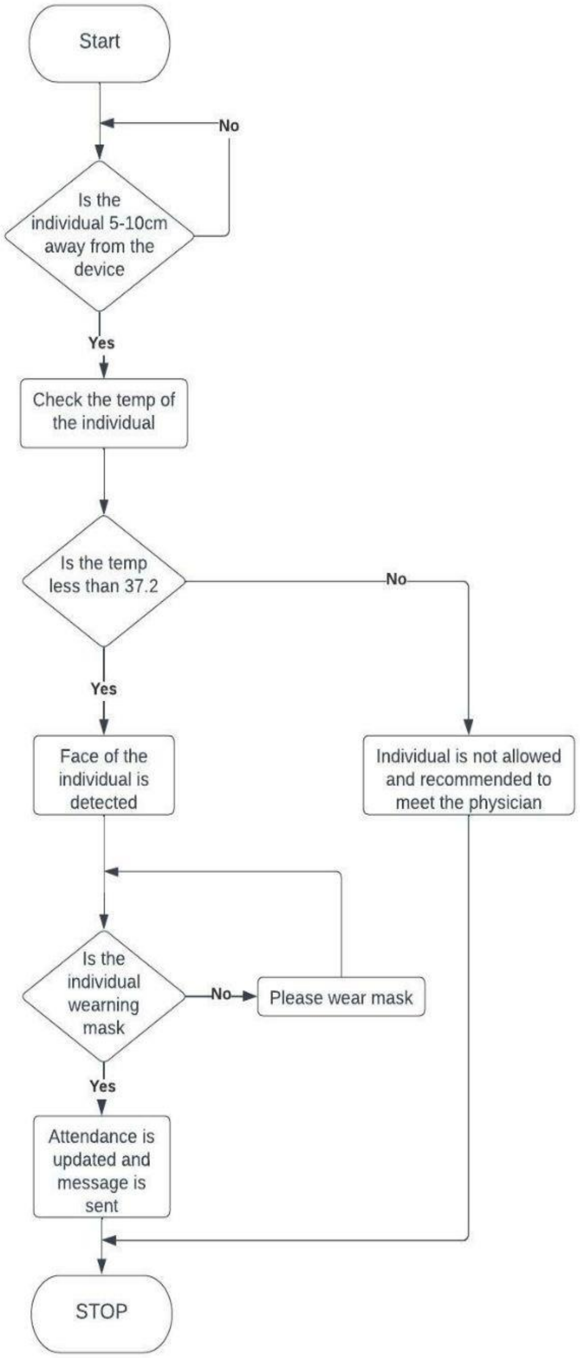
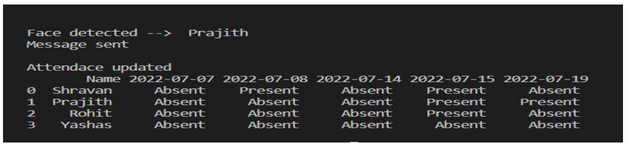


Figure 2. The Flowchart of the proposed model

check for the face mask, then the employee data will be saved. After recognizing the employee, the system measures the body temperature and the same is displayed as shown in Fig. 3. If the temperature is below the defined threshold thenthe attendance is updated in the database with their ID, nameand current time as shown in Fig. 4. If the person's temperature is above the threshold an SMS with the employee name, time, date and his/her temperature value will be sent to the physician as shown in Fig. 5 to perform the preliminary check up of the employee.

Fig. 3. Employee Temperature display along with the indicator LED



Face detected --> Prajith
Message sent

Attendace updated

	Name	2022-07-07	2022-07-08	2022-07-14	2022-07-15	2022-07-19
0	Shravan	Absent	Present	Absent	Present	Absent
1	Prajith	Absent	Absent	Absent	Present	Present
2	Rohit	Absent	Absent	Absent	Present	Absent
3	Yashas	Absent	Absent	Absent	Absent	Absent

Fig. 4.Attendance updation in the database

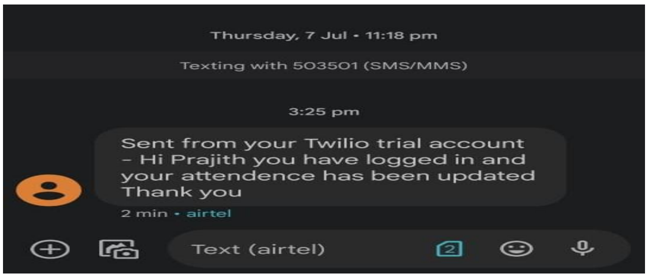


Fig. 5. Intimation to Employee via SMS

Fig. 6. Working model

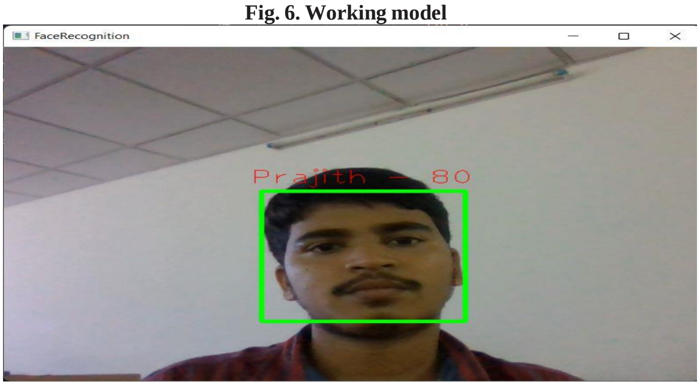


Fig. 7. Employee Identification

TABLE I. EFFICIENCY OF THE HOG ALGORITHM USED IN THE MODEL

No. of tests conducted	No. of True positives	Face detection efficiency
95	93	97.89

Fig. 8. Face mask detection

The developed device as shown in Fig. 6 dispenses sanitizer, scans temperature without any direct contact, detects employee as shown in Fig. 7 and also if the employee is wearing mask as shown in Fig. 8 and alerts the user to wear a mask, if not and automatically updates the attendance.

TABLE II. COMPARISON OF THE TEMPERATURE VALUES OF THE DEVELOPED PROTOTYPE AGAINST THE TRADITIONAL HAND HELD DEVICE

Test No.	**Non-contact temperature monitor(°C)**	**Hand held thermometer (°C)**	**Error**
1	33.8	33.9	0.1
2	33.3	33.4	0.1
3	34.5	34.4	-0.1
4	34.2	34.3	0.1
5	38.2	38.4	0.2

The face detection using HOG algorithm method provides 96.67% efficiency at varied lighting conditions as shown in Table I. The system restricts entry of employees with elevated temperature and directs them for medical help.The comparison between Non-contact temperature monitor and hand held thermometer is shown in Table II. The temperature scanning system has an error of ±0.2°C when compared to hand held infrared thermometer systems.

V. CONCLUSION

The developed device finds greatest prevalence as the world is fighting against the pandemic COVID-19. While vaccinating and social distancing is the key, the role ofproper screening and sanitizing is being professed by the World Health Organization and has predominantly aided in the fight against the pandemic. The developed model prevents exposing the front line health workers to in infectedpersons and also aids in reducing the risk to employees through swiping cards or marking biometric attendance. Theproduct is also cost effective in comparison to the market contenders and a great value addition to developing countriesand small organizations since the product is affordable and scalable.

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