Contactless Entry System For Covid-19 Prevention Using Hybrid Architecture

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Abstract:** **The outbreak of the COVID-19 pandemic has brought the entire world to a standstill. The pandemic caused by the SARS-CoV-2 virus affects the respiratory tracks and spreads rapidly when it comes in contact. Though the Vaccines are now available, the cure took significant time and the pandemic has severely impacted our lives. As prevention is always a better step than to find a cure, the objective of this project is to showcase some preventive measures which will allow residential societies, institutes and organization to prevent contact between the security personnel and the person entering or exiting the premises. The controller uses Raspberry Pi, temperature sensor, mask detection and QR code to get the details of the individual. The main feature is that it will allow the use of mobile phones rather than pen and paper to provide entry details thus further preventing the spread of the virus. Usage of this standalone system did prove to be effective as it was able to monitor the temperature, detect the mask and register the names of individuals entering the premises without any human intervention and the data stored was logged digitally, which can be further analyzed if needed.

***Keywords:**Covid-19, Prevention, Mask, Temperature, Sensor, Security, Raspberry, QR code.*

1. INTRODUCTION

Pandemics have a history of being cruel to mankind. The pathogens do not spare the rich or the poor the virus does not discriminate. They cause harm to anyone who is careless and do not prevent themselves from getting infected. The world had faced many brutal pandemics in the past and is facing one right now. Sadly, the historyrepeats itself and it might repeat again in the future. As we evolve as human race we must develop some stringent rules and preventive measure to diminish the impact caused by the pandemic.

We, humans, are social beings we love to interact and communicate with each other however the pandemic forced us to stay inside our house without physically interacting with each other. Even though we were disconnected physically, with the use of smartphones and the

Internet, we stayed connected with others, the omnipresent usage of smart mobile phones made humans embrace technology more and depend on it extensively in our lives.

Smartphones are used everywhere figure 1. shows the usage of smartphones is increasing rapidly. Phones are used to make payments, book tickets, buy groceries and even in hotels as a menu cards etc. They are now our part of life but still, there are few areas where we do not use mobile phones at our advantage to make our lives better and safer.

We still use a register(notebook) to enter our details in the security register to enter a premise this may be the traditional way but this indeed fails to avoid physical contact thus might further spread the virus from person to person who uses the register or pen even the security personnel has to come in close proximity. This can certainly be avoided if we use smartphones and the 'Contactless Entry System for Covid-19 Prevention' to our advantage.
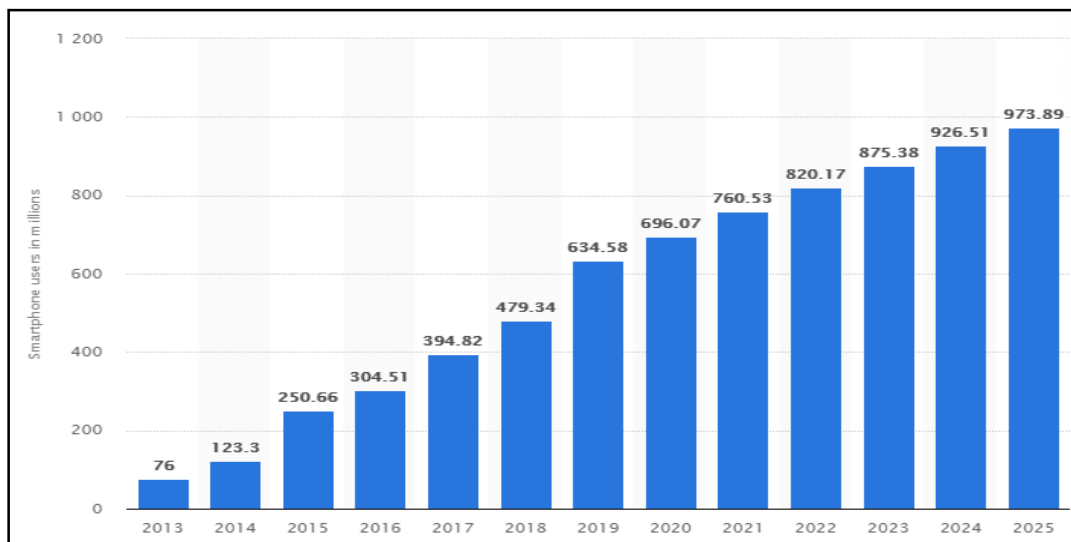

**Figure 1. Show the Estimated Growth of the Number of Smartphone Users in India
(Source: statista.com)**

The Contactless Entry System for Covid-19 Prevention System will have a standalone system with QR which will redirect the user to google form which will be connected to google sheets and with the help of google sheets API we can confirm if the user enters the detail successfully. Furthermore, the system will check the temperature and monitor the presence of a mask.

Ifa person has highbody temperature or face mask is absentthen the motor controller which controls the barricade will deny entry to the user. If the user has temperature less than 100°F, the mask is used and user had entered the personal details required to enter the premises then only the system will allow access into the institute.

Social distancing and use of maskare the new normal at least until we defeat Covid-19 together. The world has to get running soon it cannot be in a standstill for a long time. In the meanwhile, we can take all the preventive measures to control the spread and implementation of technology to do so will be beneficial to tackle Covid-19 and contain the spread. We must aim to break the chain by taking any possible measures which will curb the spread.

This system on its own is capable to monitor theseparameters and it is cost effective as well. It certainly will prevent the spread due to the usage of pen and paper for user entries will be eliminated. It can also help to maintain the database of users entering the premises. The database will be saved in google sheet which will be in spreadsheet format thus having the capabilities to analyse the data as per our requirement.

2. LITERATURE SURVEY

Non-contact temperature identification has become important in safely inspecting temperatures at the shops, Institutes, offices, airport, and railway. Pathogens are the main cause of pandemic as in the past Pandemic had cost many innocent lives.

The work of[1]showed the interfacing of MLX90614 with the Microprocessor STM32F107. Their work was widely used in IR thermometer guns. Following their work, we want to implement a system which not only detects temperature, but logs it into the record for future references as well as to use a condition which will be based on the detected person temperature.

Wearing a mask did play a crucial role in controlling and to reduce community transmission[2]. Thus, wearing a face mask has become compulsory in public. The information age is quickly revolutionizing the way technology is advancing. There is a need for a faster and accurate user identification and authentication method. Face recognition has become one of the most important user identification methods.

Based on the work of [3] face detection using Raspberry Pi was done and previous work did by [4] did show us the method to detect unsafe ways to use a mask, our project's second condition is based on these two which will detect if the person is wearing the mask properly or not.

Object Detection using Haar feature-based cascade classifiers is an effective method which was proposed [5].It is an adaptive machine learning based approach in which a cascade function is trained from several positive and negative images. This is then used to detect objects in other images. Initially, this algorithm requires plenty of positive images (images of faces) and negative images (images without faces) to train the model. The detailed model operation can be found in [3].

The detection of face alone is a difficult task to achieve due to various skin complexity and different ethnicity around the globe hence the need of big datasets is crucial[6].Due to vast improvement of machine learning algorithms and rapid advancement in the face detection technology various algorithms and datasets are easily available.

Face mask detection based Open Computer vision has been explained in simpler terms in [7]. The usage of some vastly popular machine learning python packages such as Tensor Flow, Keras, OpenCV and Scikit-Learn had made this amazing technology available for common usage.

Today, QR codes are widely accepted in every aspect of life. QR codes are used for payments, to display menu in hotel, mark attendance in offices. As mobile technologies are booming, QR codes are being used for various purposes [8]. Detailed research work is done by [16] concludes the generation of QR is easy and simple.

The main focus of the project which has not been done in the past is to acquire the data such as temperature (using MLX 90614), photo of the user using Raspberry Pi camera module and to use QR to redirect the user to a Google form which will allow the user to enter their detail such as name and purpose of visit.Incorporating all the three factors to control the output will thus be beneficial to mankind as a single standalone system would be ableto monitor without human intervention which will definitely help to stop transmission now in the days to come.

3. HARDWARE ARCHITECTURE

Hardware architecture is shown in Figure 2. There are three conditions to be satisfied before the barricade opens, allowing the user to enter the premises and are discussed as below:

Condition 1: Temperature Check using IR Temperature Sensor

Use of Infrared thermometer to detect the user temperature and the condition is only satisfied if the temperature is below 100°F.The MLX90614 is an Infra-Red thermometer for non-contact temperature measurements which is manufactured by Melexis[9][14].

Condition 2: Mask Detection using Raspberry Pi Camera Module

The person image would be monitored using the camera, this condition will be satisfied if the user wears a mask properly.We have used the Raspberry Pi Camera module of 5 megapixels.This Rpi has inbuilt connection to connect to camera module. This part will be based on open CV and Tensor flow and a model based on An Automated System to Limit COVID-19 Using Facial Mask Detection in Smart City[10][11][13][15].
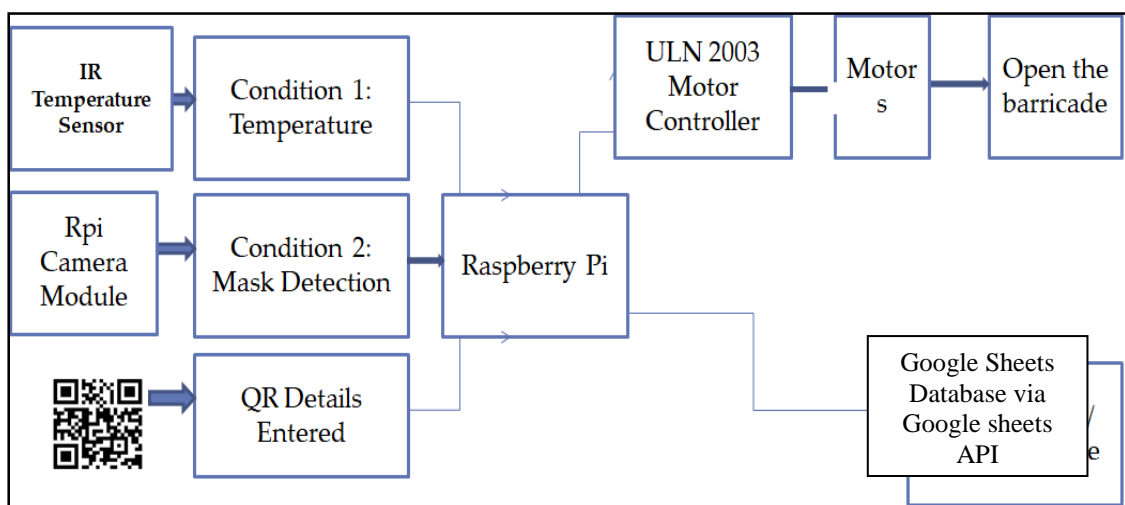

Figure 2. Hardware Architecture

Condition 3: QR details

Use of QR code to redirect it to Google Form where the user enters the details such as Name, purpose of visit and the time is automatically updated at the time of entrance. This google form is linked to Google sheets where all the functions of sheets can be used. This Google sheet is connected to Raspberry Pi using an API which is capable of sending the user entered data to and from the Raspberry Pi. Once the user enters the details raspberry confirms it from the Google sheets and if the entry is found the third condition gets satisfied.

If all conditions are satisfied, then the motors will function to open the barricade.

4. IMPLEMENTATION AND METHODOLOGY

The IR temperature sensor (MLX 90614) detects two temperatures, ambient temperature (room temperature) and object temperature (user in front of the IR sensor) from those two-values object temperature will be referred and a conditional will be created will be False if the object temperature exceeds 37.77.

The camera Module will capture the image and will use two datasets one with mask and one without. The captured image will be then compared to the datasets and if the captured user image is not detected in the dataset with mask the conditional will be False. We will use open CV and tensor flow to reach this approach[7].

For the third conditional the user will have to scan the barcode. Once the barcode is scanned the user will be directed to a Google Form where he must enter the required fields once the required fields are entered the third conditional will return true, thus satisfying the final condition.Figure 3 show model of the Concept of Temperature and Mask Check Entry-Exit System for Covid-19 Prevention
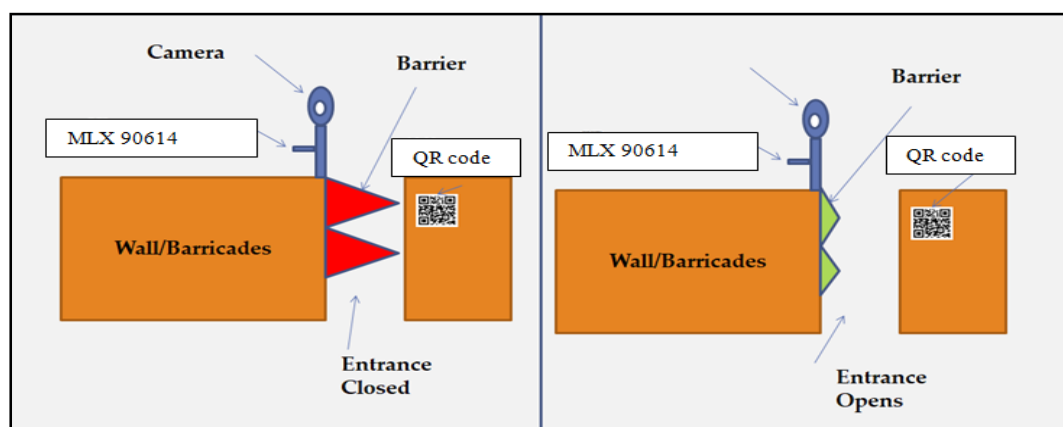

Figure 3. Model of the Concept

5. SOFTWARE ARCHITECTURE

The programming language used for this project is python 3.7as it supports many libraries such as Open CV for image processing, Tensor Flow for deep learning and also the Raspberry Pi supports it. We used Raspbian OS for the Rpi board.

Google has been a blessing to researchers and individual for their quest for knowledge. It has become a popular search engine which has helped millions of users to find what they seek for. It has also many other technologies and services which are available for free, but rarely explored by the individual. Google Forms and Google Sheets have gained popularity but the usage of Google Sheets API is lesser known to the general population due to the complex nature of implementation. The usage of google sheet's API is free thus reducing the overall cost of the system. The software architecture is shown in the Figure4.
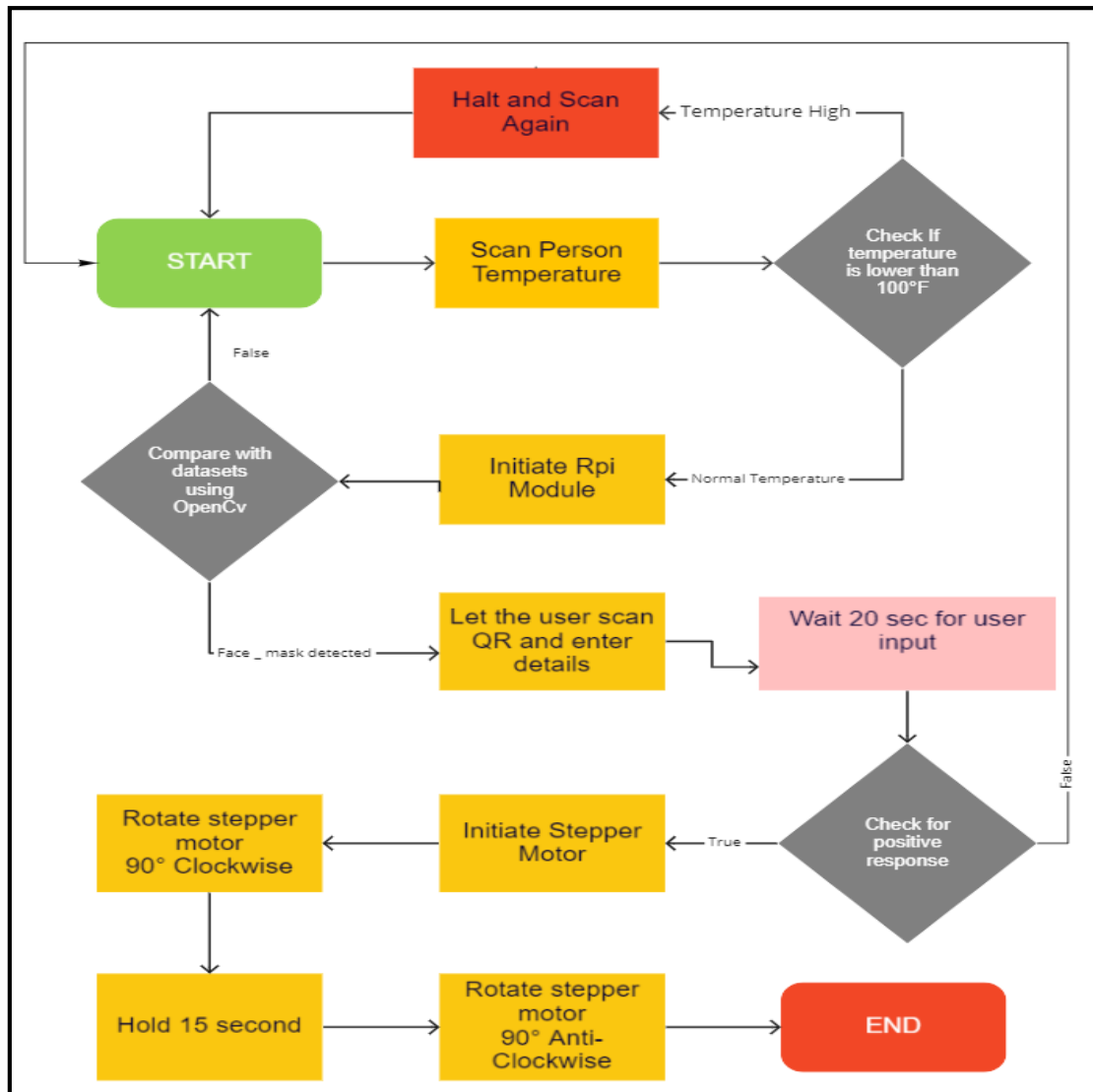

Figure4. Software Architecture

As soon as the code is executed the first phase i.e. the temperature detection will initialize. If the Object temperature detected is more than the threshold level mentioned then the loop terminates else the loop moves toward the second criteria which will load the face mask detector model. The model will scan the mask for multiple instances and if the percentage of instances is greater than 80% the second condition gets satisfied else the loop terminates returning the No – Mask Detected Notification. If the Instances of mask detected is more than 80% the code will move forward toward the final stage execution. The third stage will delay

the execution for 20 sec which will give user time to scan and enter his/her personal details using his/her cellphone. If within 20 sec the user did not enter the details the in system additional time can be provided. Once the system detects some input in the database the system prints out the display most recently entered and save it in the database.

When all three conditions get satisfied the code will execute the operation of stepper motor which will rotate 90° Clockwise to open the barricade, hold for 15 second and the rotate again 90° anti-clockwise to close the barricade.

6. RESULTS AND DISCUSSIONS

Testing the MLX90614 infrared sensor the result were very good the IC gave accurate readings 98% of times if distance between the IC and the test object was between 1cm to 5cm. The IC gave inaccurate reading if the distance exceeded 5 cm. There was certain ambiguity in the result if the test object was wet or the surface had some water on it.

Results from Open CV were extremely good considering the quantity of images in the datasets. The accuracy can be further improved if the model being used is trained for more faces and dataset consist vast images of masked and unmasked person. The image detection can be further improved with use of HD camera instead of a Raspberry camera module. Figure 5 and 6 shows the test image with and without mask respectively, used for experimental purpose
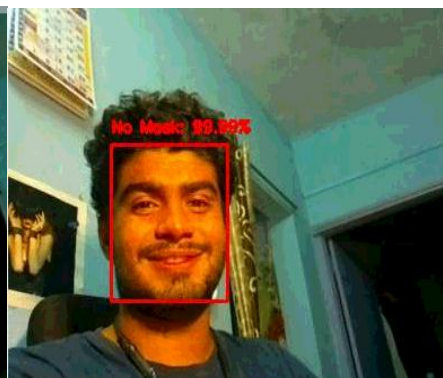

Figure 5. Test Image With Mask   Figure 6.Test image Without Mask

The result of the system varied and showed false results for some cases if the used mask and the skin complexity of the user had a resemblance in color. The Table 1 shows the system predicted mask if the mask color was contrasting to the skin complexity and the accuracy decreased if the color of the mask had a resemblance of color. This certainly can be improved by training the model and with the usage of the higher quality camera.

Figure 7shows a graphical representation of the performance of the mask detection model. From the figure the readings put light that the system is not fallible and the result start to degrade if the mask has a resemblance to the skin complexity of the user. Figure 8-10 shows terminal windows for different conditions. Figure 11 shows the Google Sheet Database Updates as Per User Entries.

Sr. No	No of times Mask detected	No Mask	Total frames captured	Accuracy in %	Remarks
1	23	0	23	100	Colour of the mask in contrast with skin complexity of user
2	24	0	24	100	
3	23	0	23	100	
4	22	0	22	100	
5	22	0	22	100	
6	21	0	21	100	
7	22	1	23	95.65	Skin complexity and mask colour has some resemblance
8	23	1	24	95.83	
9	20	4	24	83.33	
10	19	4	23	82.60	

Table 1. Accuracy of Mask detector Model Using Different Masks
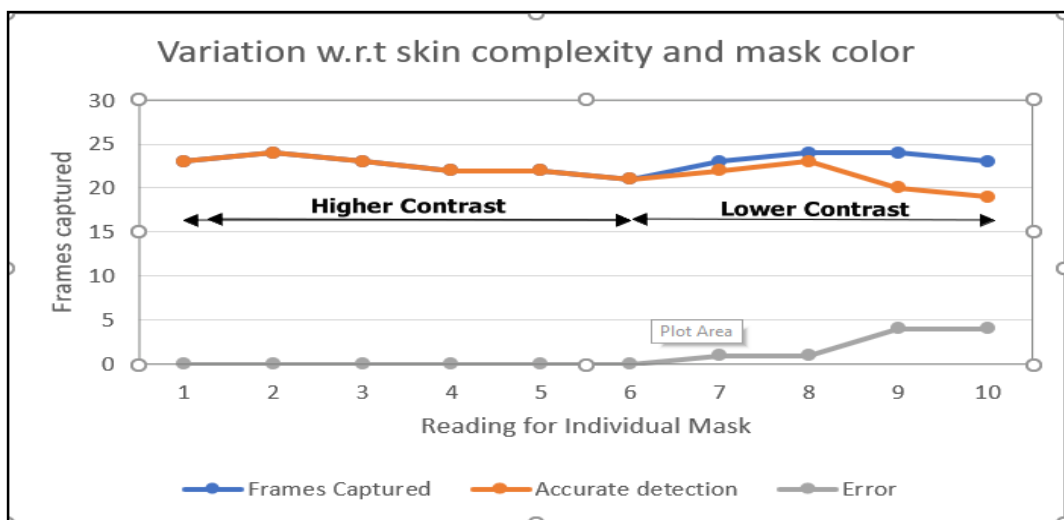
Figure7.Variation of Mask Detector Model w.r.t skin complexity and mask color

Figure 8.TerminalResult Window:Temperature Check Passed but Failed Mask Detection

Figure 9.TerminalResult Window: First TwoConditions are Satisfied

Figure 10.Third Condition User Entered Data Displayed on Terminal.

Timestamp	First Name	Last Name	Purpose of Visiting	Visiting Department	Detected Temperature
5/13/2021 14:29:27	Rahul	Tiwari	Official Work	IT Department	31.66
5/13/2021 14:42:41	Dinesh	Suryawanshi	Lectures	Mechanical Department	31.66
5/13/2021 15:23:59	Pramod	Chavan	Faculty	E& TC Department	33.6
5/13/2021 18:02:38	Sukumar	Patra	Mvoie	Mechanical Department	31.66
5/13/2021 18:03:51	Utsav	Bhowmik	Lectures	E& TC Department	31.66
5/13/2021 18:05:12	Mangesh	Agashe	Official Work	E& TC Department	31.66
5/13/2021 18:06:40	Mayur	Tambade	Official Work	Electrical Department	31.66
5/13/2021 18:14:30	Swapnil	shah	Lectures	E& TC Department	31.66
5/13/2021 18:17:10	Rohit	damle	Faculty	Computer Department	31.66
5/13/2021 18:17:58	Srinivas	Mate	Faculty	E& TC Department	31.66
5/13/2021 18:19:09	Parag	Patil	Faculty	IT Department	33
5/13/2021 21:04:47	sangram	shinde	Official Work	Computer Department	31.66
5/13/2021 21:07:11	Rohit	Garud	Faculty	E& TC Department	33
5/13/2021 21:09:42	Akshay	Suryawanshi	Faculty	Computer Department	31.66
5/13/2021 21:13:25	Sumit	Mohite	Maintainance	Mechanical Department	33
5/13/2021 21:15:36	Sangram	Kale	Lectures	Electrical Department	33.03
5/13/2021 21:18:36	Rupesh	Tiwari	Official Work	E& TC Department	32.27
5/13/2021 21:25:54	Balaji	Garud	Faculty	Computer Department	34.98
5/13/2021 21:28:51	Manoj	Wagh	Lectures	IT Department	31.41
5/13/2021 21:35:19	Manoj	Mohite	Lectures	E& TC Department	30.99
5/13/2021 21:44:01	Sameer	Adkar	Lectures	IT Department	34.98
5/13/2021 21:47:34	Vivek	Ghanekar	Faculty	E& TC Department	31.25

Figure 11. Google Sheet Database Updates as Per User Entries

7. CONCLUSIONS

A person is flagged by the system for high temperature or no Mask and has not verified the details using a QR code the system will not open the barrier. Also, details can be saved of the person who enters based such as entry time, temperature, Person visiting and purpose of visit etc.

The results obtained from testing limited test cases were highly precise. The Mask detector module and the temperature sensor IC worked accurately and had very little acceptable error margin depending on the ambient color, skin complexity and color of the mask.

This system indeed proves to be efficient to eliminate the use of security personal. As it can perform all the tasks such as temperature detection, face mask detection, register the details and open the door/barricade. Hence, social distancing can be practiced without compromising on security.

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