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Detecting Possible Covid Suspects using Raspberry Pi and Creating a Masked FacialRecognition System

[1]G Guruparthavan [2]G Ashwin [3]V Harishram [4]R Divakar
*[*1]Department of ECE, Panimalar Engineering College, Chennai, India.*
*[*2] Department of ECE, Panimalar Engineering College, Chennai, India.*
*[*3] Department of ECE, Panimalar Engineering College, Chennai, India.*
*[*4] Department of ECE, Panimalar Engineering College, Chennai, India.*

Abstract
The aim of this paper is to create an embedded system to be implemented in Schools and Colleges which should able to detect the faces of the students even if they are wearing a mask, so that it enables Face Recognition based attendance system and we are automating the process of temperature checking along with early detection of fever to reduce the spread of Covid and finally with automatic hand sanitizer sprayer. All the attendance and temperature values are maintained in the database and those values are sent to the respective parents via GSM module. The main idea is to eliminate the human intervention in all those activities, to sort out the issues of the existing systems and to improveits efficiency.

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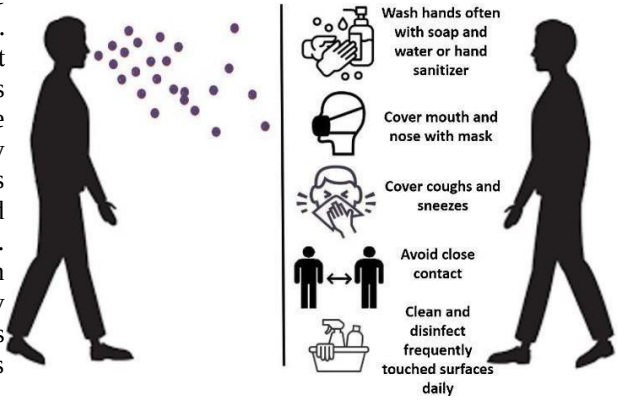
I. INTRODUCTION

The first human cases of COVID-19, the disease caused by the novel coronavirus causing COVID-19, subsequently named SARS-CoV-2 were first reported by officials in Wuhan City, China, in December 2019. Retrospective investigations by Chinese authorities have identified human cases with onset of symptoms in early December 2019. While some of the earliest known cases had a link to a wholesale food market in Wuhan, some did not. SARS-CoV-2 can be transmitted human to human by respiratory droplets, close contact with diseased patients, and possibly by fecal-oral and aerosol contact. It was recently shown that airborne transmission is highly virulent and represents the dominant route to spread the disease. The adopted mitigation measures such as social distancing and wearing of masks, the difference with and without mandated face covering represents the determinant in shaping the trends of the pandemic and spread of the disease. Majority of SARS- CoV-2 infected individuals (80 %) are asymptomatic or present mild symptomsmost likely due to a good immune response able to control the advance of the disease. There is evidence that these asymptomatic people can infect others with SARS-CoV-2. In the other hand, symptomatic individuals may evolve to more severe symptoms and eventual death. The best way to prevent transmission and illness is to avoid being exposed to the virus.

Therefore, some recommendations include wash hands often, avoid close contact, cover mouth and nose with a mask, avoid touching common things which may be touched by many others, cover coughs and sneezes, and clean and disinfect frequently touched surfaces daily. Always prevention is better than cure. In this regard, wearing of face masks in public corresponds to the most effective means to prevent interhuman transmission. Even though various vaccines have been discovered, we can't able to control the spread of corona virus. Many countries facing consecutive waves of corona.Almost 30 lakhs people lost their lives. More than 13 crore people has been already infected. India also facing the second wave of corona which is far worse than the previous wave. Daily infections crossed more than 1,50,000 per day.No one knows when it will end. Governments are trying to produce and distribute as much vaccines as possible. Even though, the virus spreads day by day. Even the most developed nations also suffered a lot in this pandemic. The death rate is very low for Covid, still it causes many other problems to those who recovered from it.



Countries like USA, India, Brazil, France and Russia are mostly affected by Covid. The entire world is trying so hard to fight against Covid. As a human being, it is our responsibility to help world and try to solve the problems posed by Covid with the help of technologies. In this Covid era, the most common safety practices followed to reduce the risk of getting infected by Covid is wearing a mask, maintain Social Distancing and avoid touching common utilities which are touched by many people. At any cost, one must follow all these practices. After many months Schools and Colleges are opening again. Companies also asking their employees to come to office. The main problem is attendance. Some Schools follow traditional attendance method, in which the teacher calls out the name and marks the attendance in a paper or notebook. It takes lots of time and human effort and the possibility of error is also high because it requires a lot of human effort.

So, nowadays some Schools follow finger-print based authentication, which is good and saves a lot of time and improves efficiency. But in the times of Covid, it is not safe to use finger-print scanners because it has a high chance of spreading Covid virus from one student to many others. Sanitizing the scanner after every student is also not possible.Some Companies use Face Recognition.

Software to authenticate their employees. The main problem here is that software won't work if you are wearing a mask. So, you have to remove your mask in order to scan your face which is again not safe. So, a new authentication system is needed which should be absolutely safe and it has to be highly efficient.Next, in most of the Schools and Colleges, a Security will check the temperature of every one before entering the premises in order to ensure that you doesn't have fever. If one has fever, he has high possibility of infected by Covid. So they are checking for body temperature. There arise two problems.

1. What if one doesn't have fever while entering the College and got fever in the mid of the day?
2. It is observed that, some people faked the temperature check by intaking paracetamol tablets, an hour before the checking. It will control the temperature of the body for an hour or two.

In order to overcome these two issues, the temperature checking has to be done multiple times a day. But if we do the checks multiple times a day, the person checking the temperature has high chances of being exposed to the virus and he may spread it to many others. So, there has to be a system which checks the body temperature of students multiple times a day without human intervention and it should be able to store and process those data to predict possible Covid Suspects before they gets the fever.

All those issues you saw above are sorted out in our proposed system "DETECTING POSSIBLE COVID SUSPECTS USING RASPBERRY PI AND CREATING A MASKED FACIAL RECOGNITION SYSTEM" which uses a masked facial recognition system to detect the faces both with mask and without mask. You don't need to remove your mask while scanning. The temperature checking is automated by a contactless thermal sensor and it uses a differential algorithm analysis on all the temperature values of a person for few days and find if there are any rise in temperature in the past few days to determine the fever before he/she actually get it. So that, we can isolate them before they spread the virus to many others. By this we are enabling early detection.

II. RELATED WORK

[1]. **"Attendance System based on Face Recognition"** by Venkata Kalyan Polamarasetty, Muralidhar Reddy Reddem, Dheeraj Ravi, Mahith Sai Madala at International Research Journal of Engineering and Technology (IRJET), Volume: 05 Issue: 04, Apr-2018. Venkata Kalyan Polamarasetty et al. (2018) presented Daily attendance marking is a common and important activity in schools and colleges for checking the performance of students. Manual Attendance maintaining is difficult process, especially for large group of students. Some automated systems developed to overcome these difficulties, have drawbacks like cost, fake attendance, accuracy, intrusiveness. To overcome these drawbacks, there is need of smart and automated attendance system. The system described in this we aim to deviate from such traditional systems, introduce a new approach to identify a student using face recognition and the generation of a facial Model.

[2**]. "Smart Attendance Management System Based On Face Recognition Algorithm"** by M. Kasiselvanathan, Dr. A. Kalaiselvi, Dr. S. P. Vimal, V. Sangeetha at International Journal of Pure and Applied Mathematics Volume 120 Number 5, 2018. M. Kasiselvanathan et al. (2018) presented Facial Recognition is a technology of biometrics has been used in many areas like security systems,human machine interaction and image processing techniques. The main objective of this paper is to calculate the attendance of students in a easier way. We proposed a system called automated attendance management system that uses face recognition method gives solution to the faculty thereby reducing the burden in taking attendance. The system used to calculate attendance automatically by recognizing the facial dimensions. An efficient face recognition-based attendance system has been developed by improving the efficiency of the system and also for the secured attendance. The algorithm used in this system is Eigen Faces. The system is not only detecting the faces but also the distance of the facial characters under varying conditions

[3]. **"An Overview of Thermal Face Recognition Methods"** by M. Krišto, M. Ivašić-Kos at Proceedings of Asian Biometrics Workshop. Singapore, May 2018.M. Krišto et al. (2018) proposed the popularity of surveillance systems grows as well as a need for better security systems particularly in a bad lighting conditions or at night. The aim of a security system is to collect as many details as possible to enable a better recognition of persons. In this paper, a comparison of representative thermal face recognition methods will be given, emphasizing their strengths and weaknesses. Then, trends in the development of surveillance and security systems will be outlined such as fusion of visible and thermal images and use of convolutional neural networks

[4**]. "Face Liveness and Disguise Detection Using Raspberry Pi and OpenCV"** by Piyush Devikar at International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE), Volume 5, Issue 1, January 2017.Piyush Devikar (2017) proposed face liveness and disguise detection system eliminates the chances of a person to fake his/her identity. The face recognition systems available in the market fail to detect the fake faces shaped using high-end silicone masks and prosthetics. Also, these systems misinterpret face from a physical photograph as a real face. These are the vulnerabilities present in the available systems. This paper presents a simple approach to tackle the glaring vulnerabilities that are present in almost all face recognition systems. This system works on the principle that the surface temperatures of masks are close to ambient temperatures, unlike real faces whose temperatures are higher than ambient ones. This system captures image from the webcam connected to Raspberry Pi and then it is processed by OpenCV to detect the face in the image. The temperature of the face captured by the camera is obtained by IR temperature sensor. If the face is detected in the image and its temperature is more than the threshold value (skin temperature) then face is real otherwise, it is fake.

[5]. **"Design of Non-Contact Infra-Red Thermometer Based on the Sensor of MLX90614"** by Gang Jin, Xiangyu Zhang, Wenqiang Fan, Yunxue Liu and Pengfei He at The Open Automation and Control Systems Journal, 2015, 7, 8-20.Gang Jin et al. (2015) presented liquid identification becomes more and more important in the safety inspection at the subway, airport, and railway. Non-contact liquid security identification is the best way, because it can avoid the contamination of the liquids and the injuries caused by some corrosive and toxic liquids. The paper designed the noncontact Infra-Red thermometer based on the sensor of MLX90614 and the most favored microprocessor STM32F107 for thenon-contact liquid security identification system. Completed the hardware circuit, made the PCB plate, programmed the software with Keil C and debugged by Keil uVision4 MDK V4.22.

[6]. **"Multi-angle Head Pose Classification when Wearing the Mask for Face Recognition under the COVID 19 Coronavirus Epidemic"** by Shuang Li, Xin Ning, Lina Yu, Liping Zhang, Xiaoli Dong, Yuan Shi, Wei He at 2020 International Conference on High Performance Big Data and Intelligent Systems (HPBD&IS). Head pose classification is widely used for the preprocessing before face recognition and multi-angle problems, because algorithms such as face recognition often require the input image to be a front face. But affected by the COVID-19 pandemic, people wear face masks to protect themselves safe, which makes cover most areas of the face. This makes some common algorithms cannot be applied to head pose classification in the new situation. Therefore, this paper established a method HGL to deal with the head pose classification by adopting color texture analysis of images and line portrait. The proposed HGL method combines the H channel of the HSV color space with the face portrait and grayscale image, and train the CNN to extract features for classification.

[7]. **"Towards Facial Recognition Problem in COVID-19 Pandemic"** by Imran Qayyum Mundial, M. Sohaib Ul Hassan, M Islam Tiwana, Waqar Shahid Qureshi at 2020 4th International Conference on Electrical, Telecommunication and Computer Engineering (ELTICOM). A methodology that can enhance existing facial recognition technology capabilities with masked faces. We used a supervised learning approach to recognize masked faces together with in-depth neural network-based facial features. A dataset of masked faces was collected to train the Support Vector Machine classifier on state-of-the-art Facial Recognition Feature vector.

III. PROPOSED WORK

In our proposed system, we are altering the existing concept of Face Recognition to enable the CNN network to detect faces for both with mask and without masks. It is perfectly safe to use and it has high efficiency. We are using raspberry pi with usb camera is to capture the face of each student while wearing a mask also the face will be identified, temperature of student using infrared sensor then it will spray the sanitizer and to store it in the database for their attendance. There is no need for the teacher to manually take attendance

in the class because the system records a video and through further processing steps the face is being recognized and the attendance database is updated. This system is developed using python opencv.For temperature checking, our system stores all the temperature values for a particular student for days and it will process them. For Eg: if we are doing temperature checks 5 times a day means, for 4 days- 4x5=20 values. It will process those 20 values and find if there is any constant rise in temperature.

In normal method, if one has temperature below the threshold value, he will be allowed. But in our system, even if one has temperature below fever, but he has constant rise in temperature for 2 days means he/she can have fever in matter of hours. So we can isolate them even before they get fever by which we can reduce the spread of Covid through early detection.In normal methods, it is not easy to note all the values of temperature for all people for days. It will be in thousands and processing that is not possible.

3.1FACE RECOGNITION BASED ATTENDANCE SYSTEM

The webcam, temperature sensor, IR sensor, Monitor, GSM, Relay and Solenoid all have to be connected with the Raspberry Pi board correctly. First, we have to create a Database containing the images of each and every student in the Class. We can use either images with masks or without masks. One image per person is enough. We have to rename each image as per the name in the attendance form. Then, we have to choose a location, where attendance and temperature values are to be stored. We can use separate files or save all that info in a single file itself. The maximum temperature which should be allowed is to be set. It is upto the organization's wish. Usually, temperature below 37 degree Celsius is normal. That's all about the pre-requisites.

After finishing all those steps, the python file containing the code has to be compiled and encoded. Once encoding is finished, the system is ready to use. Camera is capturing the video continuously. The students can now give the attendance. Once the Student's face is captured by the Webcam, it will check the entire database for a match. If perfect match is found, it will show the Student's name in the Monitor and asks him/her to check for the body temperature. If the temperature is below the permittable range, then the System marks the attendance along with the Date and Time and their temperature values in the database. Then the GSM Module is triggered to send an SMS to the respective parent's mobile stating the attendance and temperature details along with time of attendance. At the end of the day, the attendance can be downloaded in the excel format.

3.2 FACE RECOGNITION WITH MASKS:

Normal Face Recognition tries to capture various features of the face and tries to match it with the database. Features of the face includes Eye, Nose, Eye-brows, Mouth, Skin tone, Hair Color..., Each feature has its own sensitivity towards the final result. Only when sufficient percentage in the final result matches with the dataset, then only will tell it's a match. The main problem with masks is it covers most of the features of the face and only few features is visible to the Camera and it won't be sufficient for the system to tell it is a match. What we going to do is identify what are the features which are covered by the face which are nose, mouth and some parts of the face curve. So, we are reducing the sensitivity of those features and increase the sensitivity of the features which are always visible to the Camera even with or without masks such as eyes, eye-brows, skin-tone, hair color So that the final result won't be much affected by mask.In this way, the system able to detect the faces of the Student even with or without masks.

3.3 EARLY DETECTION:

Our system checks the temperature of the Student multiple times a day. It stores all the values in the database for days. So, we can have more than 50 temperature values of a particular student among various days and times of a day.By analyzing that, we can able to detect even a slight increase in his/her temperature. By this we can determine fever even before he/she can actually realize it. By this early detection we can able to isolate them before they spread Covid to any other Students. This system is far better than the existing system of just checking for fever.

ADVANTAGES

- Automatically manage the attendance record with body temperature.
- It saves time and effort
- Enables early detection of fever.
- Face recognition works on both with and without masks.
- Improves efficiency.
- Parents are aware of their children's health and safety.

IV. RESULTS AND DISCUSSION

In this project, we used masked facial recognition to detect the faces of the students for attendance system and a contactless temperature sensor to measure the temperature and all those values are noted in the database along with date and time. To capture the image, we are using a web camera which will record the video and if any face detected, it tries to match it with the images in the database. The database can be viewed in the live time by connecting a monitor or TV display with the processor. With the help of GSM module all those values are sent to the respective parents. The system also has an automatic hand sanitizer sprayer. To perform all these actions, we used raspberry pi model 3 as a core processing unit. First we have to connect all the necessary devices with the pi and power it. We used Raspberry OS in it.

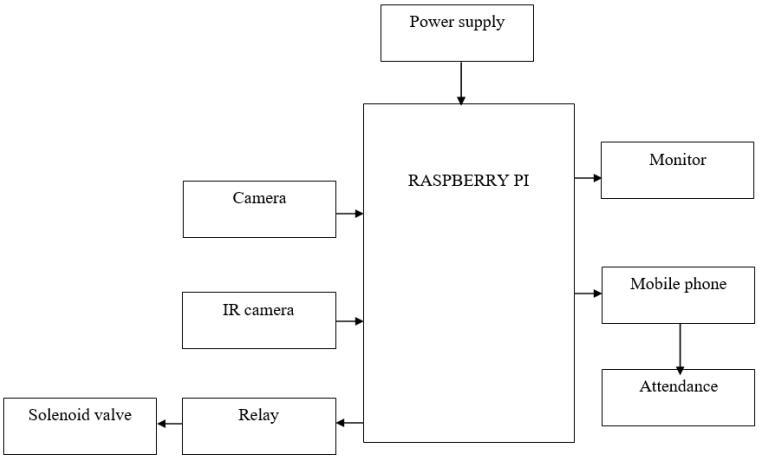


Fig: 4.1 Block Diagram

Create a database containing all the images of the students in a particular class for whom the attendance system is to be created. Place all the images in a single folder and add the path directory to the source code. All the images are to be renamed with the names of the students.Any number of students can be added to the database.

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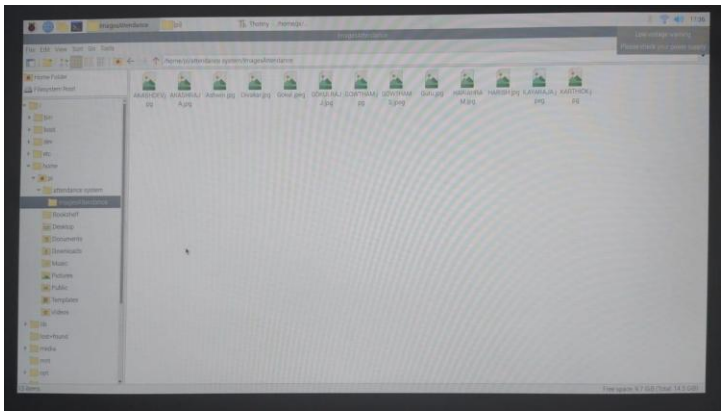
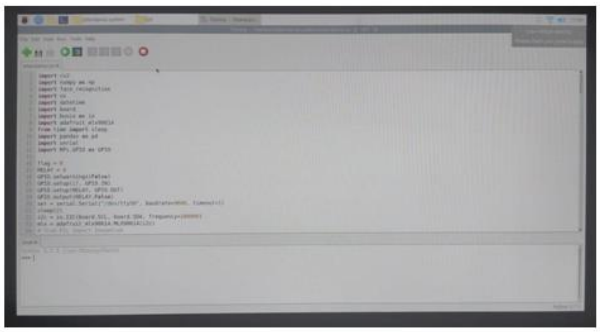


FIG 4.2 : DATBASE CONTAINING IMAGE OF STUDENTS

All the coding are done in python language which has the extension .py Open that file and add the path ofthe folder which has the images and execute the python program.After clicking the execute button, the system is trained with all the images of the students along with their names. It will take some time to load for the first time.



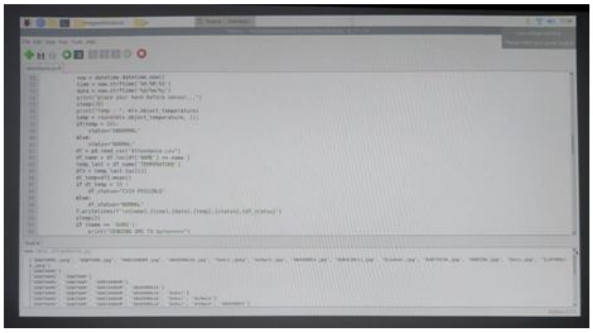
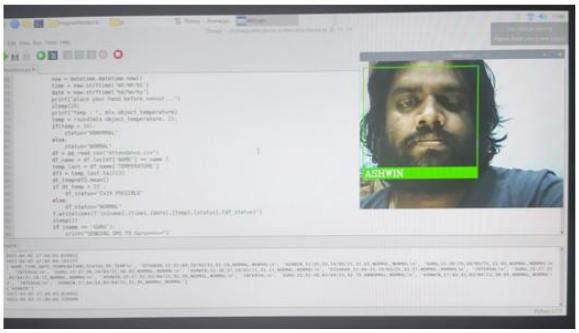


FIG 4.3 PYTHON FILE CONTAINING SORCE CODEFIG 4.4 : EXECUTING THE CODE

Once loaded, it will show "ENCODING IS COMPLETE" message. Then the system it ready for scanning the face. Once the message is displayed, it will automatically trigger the web camera to start recording and the live display of the recording will be shown in the screen.If any face recognized in the video, the system will try to match it with the images in the database. If the face matches, it will show the name of that person in the screen like shown in the above.We created a masked facial recognition system, so both face wearing a mask and without a mask will be recognized.



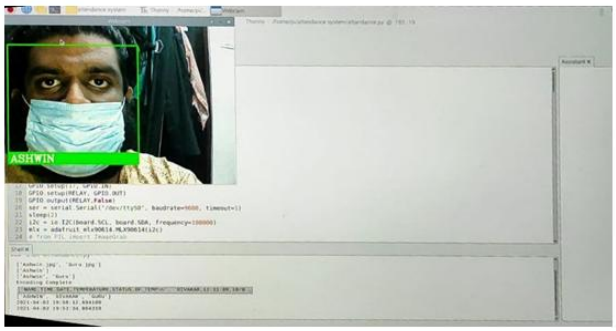


FIG 4.5 : RECOGNIZING FACE WITHOUT MASKFIG 4.6 : RECOGNIZING FACE WITH MASK

Once the face in the video matched with any image in the database, the name of the student is shown in the screen and the recording will be stopped. Then the system will ask to check for the temperature.

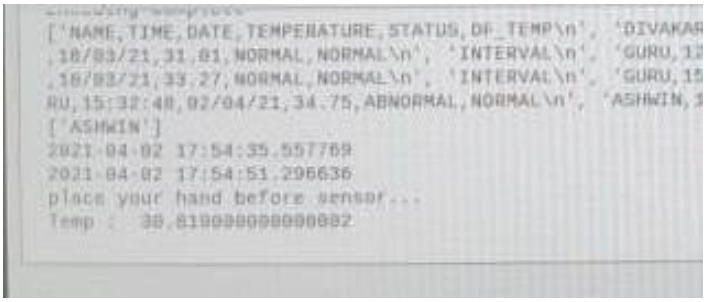


FIG 4.7 : SYSTEM CHECKING TEMPRATURE

Then, the system will update the attendance and temperature value along with the date and time in the database file.

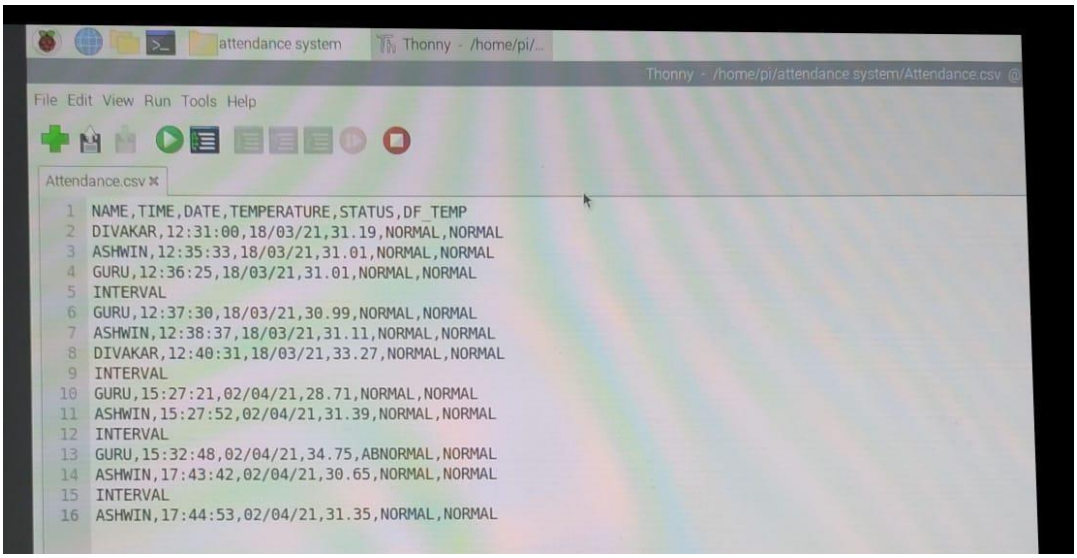
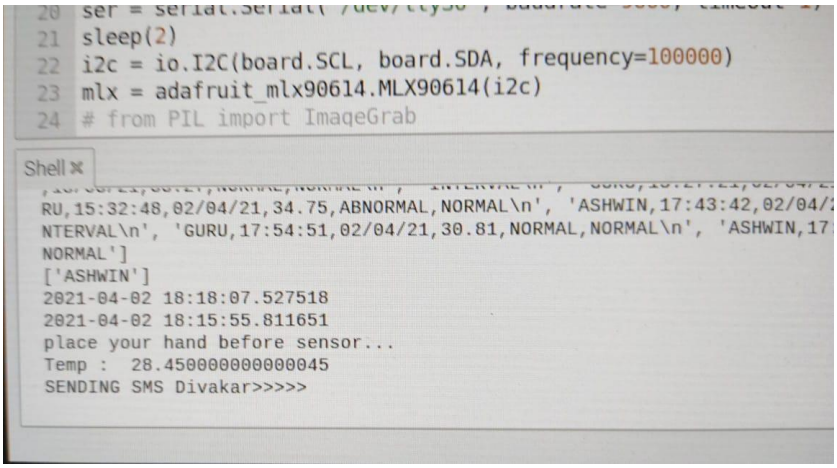


FIG 4.8 : ATTENDANCE UPDATING IN DATABASE

Once everything is finished, it will trigger the GSM module to send SMS to the student's parent stating the student's attendance and temperature value.



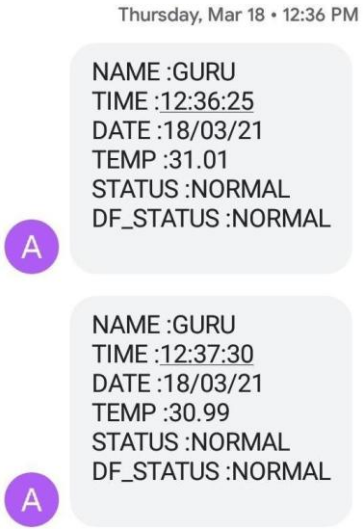


FIG 4.9 : SENDING SMS VIA GSM **FIG 4.10 : MESSAGE IN MOBILE**

To send SMS to the parent's mobile, all the student's parents mobile has to be collected and must be included in the python program against the students' image name and then the program has to be executed. As you see in the fig , there is two rows STATUS and DF_STATUS. STATUS will check if the temperature is whether below the threshold temperature for fever. If it is, then it shows like NORMAL. DF_STATUS will check for all the previous values of that same person in the database and analyze them. If there is any constant increase in temperature, even it is below the fever temperature, it shows like ABNORMAL because the person has high chances of getting fever in the near future. By this, we are enabling early detection of fever and by isolating them from others we can reduce the spread of Covid.

After finishing the scanning, the face and temperature, a container containing hand sanitizer is connected to a solenoid and a IR sensor. If you extend the hand, it will sense your hand via IR sensor and dispense the sanitizer for 1 second.By using this system, we are eliminating the human intervention in attendance, temperature checking and sanitizer dispensing and overcoming the issues faced by the existing system and also increasing its efficiency.

V. CONCLUSION

Capturing the images from camera or cc camera and applying techniques face detection and recognition can decrease the manual work from human and increase the security safety, taking the decision from this recognition result. Based on this face detection and recognition can used in implement so many

application-like automatic attendances system based on face recognition, worker attendances, security, safety, police application like finding thief in image that help to catching thief. Because our system detects the face in both with and without mask. In this system we have implemented an attendance system for students. This attendance system shows the use of facial recognition techniques for the purpose of student attendance and for the further process this record of student can be used in exam related issues. The temperature is measured using the infrared thermometer is a sensor that consists of a lens to focus the infrared (IR) energy on to a detector, which converts the energy to an electrical signal that can be displayed in units of temperature after being compensated for ambient temperature variation.We analyze the temperature variation by using differential analysis so that we can detect the fever as early as possible. So that we can isolate them before they spread the virus to many others. There is also an automatic hand sanitizer sprayer attached to this system. The main idea is to eliminate the human interaction as much as possible, to sort the issues of the existing systems and to improve its efficiency.

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