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Smart Door Camera with Facial Recognition Feature for Thermal Screening

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Abstract: ***In these times of COVID-19, it is essential to go through thermal screening for checking one's body temperature before entering any premises. However, it is a tiring process as it involves measuring body temperature of all people, one at atime. At the same time, those who carry out thermal screening are required to stand for more than 8 hours a day and check each and every person. This takes a lot of time and effort. So to come up with a solution that can do this job effortlessly, we have built a Facial Recognition Thermal Screening System. The device works by recognizing the face of each person and doing thermal screening to detect the body temperature. If a person is found to have a very high temperature, then the systemwill not allow entry and instead will automatically notify that person to take a COVID-19 test. If the body temperature falls between the required normal temperature range and is found to be okay, then entry is allowed after proper sanitization Keywords: Face Recognition, Covid-19, Thermal Scanning, Raspberry-pi, Thermal Sensor .The temporal variations present in thermal face images are mainly due to different environmental conditions, physiological changes of the subjects, and differences of the infrared detectors' responsivity at the time of the capture, which affect the performance of infrared face recognition systems. To perform this paper, we created two thermal face databases that include capture sessions with real and variable conditions. We also propose two criteria to quantify the temporal variations between data sets. The thermal face recognition systems have been developed using the following five methods: local binary pattern (LBP), Weber linear descriptor (WLD), Gabor jet descriptors, scale invariant feature transform, and speeded up robust features. The results indicate that the local matching-based methods (WLD and LBP) are mostly immune to temporal variations, which is noticeable when the face images have been acquired with a time lapse, while the rest of the methods are clearly affected and are not suitable for practical infrared face recognition.***

I. INTRODUCTION OF SYSTEM

(COVID-19) is an infectious disease caused by a newly discovered corona virus. This disease can show mild to moderate symptoms and like tiredness, aches and pains, sore throat, fever, difficulty in breathing or shortness of breath, loss of speech or movement, chest pain orpressure etc. This disease gets transmitted from person to person through droplets generated when an infected individual coughs, sneezes, or exhales. These droplets are tooheavy and hence they don't hang in the air, So they settle on floors and surface. When other person comes in contact with these infected surface and thereafter if he touches his mouth, nose or eyes there are high chances to get exposed to this virus. Due to these situation, many protection and safety measures were taken by governments in order to reduce the disease spread, such as obligatory indoor mask wearing, social distancing, quarantine, self-isolation, limiting citizens' movement within country boarders and abroad, often together with prohibition and cancellation of huge public event sand gathering. In these times of COVID-19, it is essential to go through thermal screening for checking one's body temperature before entering any premises. However, it is a tiring process as it involves measuring body temperature of all people, one at a time. At the same time, those who carry out thermal screening are required to stand for more than 8 hours a day and check each and every person. This takes a lot of time and effort. So to come up with a solution that can do this job effortlessly, we have built a Facial Recognition Thermal Screening System. The device works by recognising the face of each person and doing thermal screening to detect the body temperature. If a person is found to have a very high temperature, then the system will not allow entry and instead will automatically notify that person to take a COVID-19 test. If the body temperature falls between the required normal temperature range and is found to be okay, then entry is allowed after proper sanitization.

A. Problems Statement

In such exceptional times, one could argue that fever checks offer substantial population health benefits with limited long-term impacts on personal privacy. Yet, several private companies have integrated thermal imaging with facial recognition technology. Despite the aforementioned limitations of thermal detection technology and known shortfalls of facial recognition technology, firms around the world are marketing such multimodal biometric technologies as effective tools for combating the pandemic.

Collectively these companies' claims, which have yet to be systematically evaluated in the empirical literature, suggest clear benefits of combining thermal detection with facial recognition capabilities to detect and track potentially infected individuals. For example, police in China are currently using devices from Hanwang Technology that claim to identify an individual's name within a second upon detecting a temperature over 99.5°F/37.5°C. The company claims that the technology is 95 per cent accurate, even in a group of 30 individuals or among people wearing masks. China-based firms SenseTime and Sunell are also selling similar technology.Sunell recently unveiled a body temperature detection network camera that they assert is able to identify individuals, collect real-time biometric data, and trigger a warning system upon detecting an unusual temperature.Additionally, Chinese startup Rokid has developed multimodal biotechnology that includes thermal-imaging wearable glasses, a technology they are currently marketing to US hospitals and local municipalities.These smart glasses, which Rokid suggests can be paired with facial recognition software, use an infrared sensor that Rokid claims can detect temperatures of up to 200 people as far away as 3 m, and they are already being used in China in national parks, schools, and by national authorities.

B. Objective of the System

The device works by recognising the face of each person and doing thermal screening to detect the body temperature.
Individual is found to have a very high temperature, then theses model will not allow entry and instead will automatically notify that person to take a COVID-19 test.
If the body temperature falls between the required normal temperature range and is found to be okay, then entry is allowed after proper sanitization.
To control and monitor easily without human effort.

II. PROPOSED SYSTEM AND IT'S IMPLEMENTATION

This system come up with Precautionary measures for limiting the spread of virus we have made this Device. This venture intends to identify faces from pictures in Raspberry Pi. In face discovery, the calculation ought to be powerful and quick. In this model, the calculation utilized is proposed by Viola and Jones which has a very high identification rate, low false positive and negative rates and short computational time. Utilizing the proposed calculation, a face indicator is based on a Raspberry Pi Model B.
After detection, we recognize the faces from the recognition algorithm. IN the recognition part we recognize the different faces which are captured from web cam. Once face is detected our secondary system will measure temperature using mlx90614 thermalscanner. This system will avoid the entry of person having high temperature hence to reduce spread of covid-19 virus. Block diagram of the system is given below.

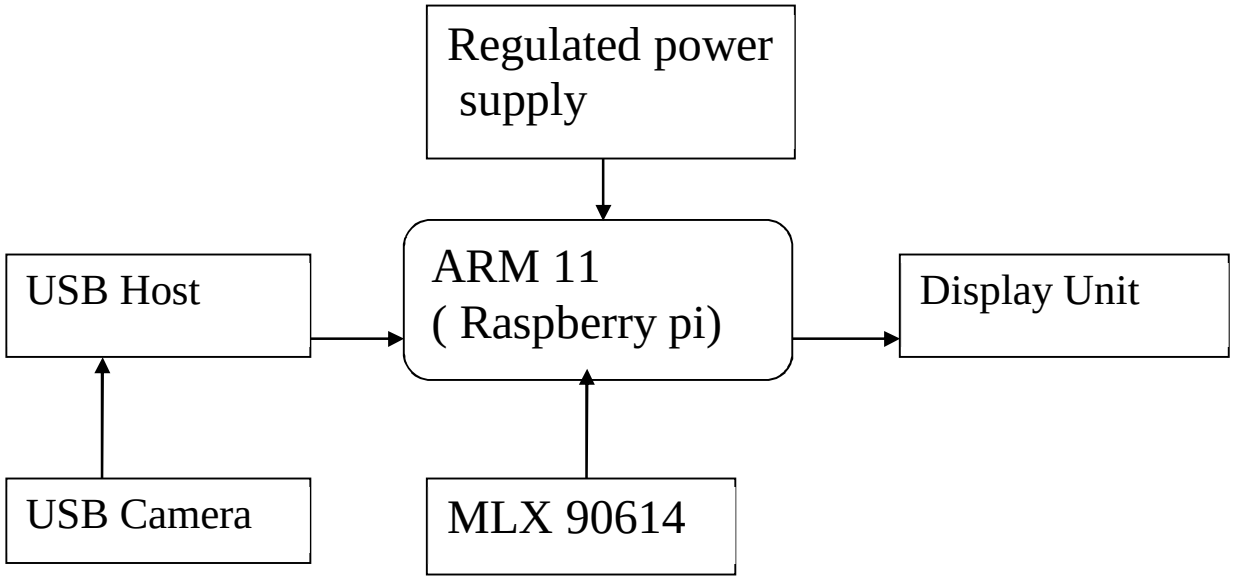

Fig . Block diagram of Smart thermal scanning using facial recognition using IR sensor..

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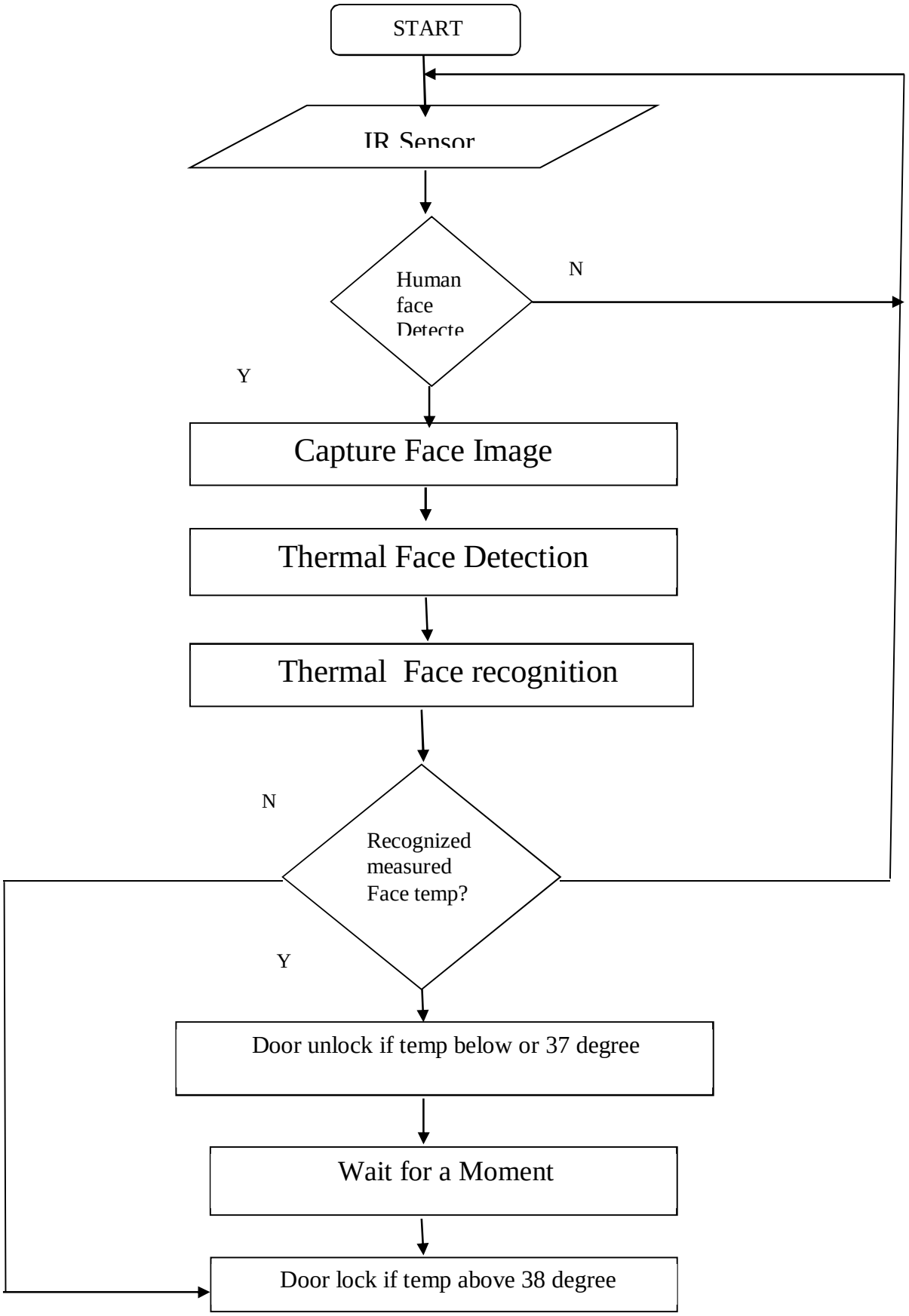

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III. BLOCK DESCRIPTION

The main blocks of this project are

1) Raspberry pi
2) IR Temperature sensor MLX90614
3) Camera Module V2
4) HDMI Signal TFT LCD Display Panel

The above block diagram gives an overview of the project in the pictorial form. With the help of the block diagram and flow chart we will create pre model of the project and analyze the function of the project .The explanation of the project with block diagram over view is given as follows:

A. Raspberry Pi

In the 1970s, the information age began. From the largest supercomputers to the smallest home desktops, this period brought with it the ability to access information at the touch of a button or click of a mouse. Advances in technology have reduced computers from behemoths stored in large warehouses to devices you can carry in your pocket or wear on your wrist. Today you would be hard-pressed to find a business or industry that does not use computer technology in one form or another.

While the benefits of computer technology are extensive, the disparity it leaves between classes and economies is hard to ignore. Countries that cannot afford the infrastructure required to use advancing technology continue to fall behind countries that can. People without access to basic computing skills fail to keep up with advancements and find themselves falling behind their peers. Students, young and old, who lack access can find their education stunted. In short, lack of knowledge of technology, and the inability to navigate the information superhighway widens the chasm between the haves and the have-nots.

The Raspberry Pi is a credit card sized single-board computer with an open-source platform that has a thriving community of its own, similar to that of the Arduino. It can be used in various types of projects from beginners learning how to code to hobbyists designing home automation systems. There are a few versions of the Raspberry Pi, but the latest version, has improved upon its predecessor in terms of both form and functionality. The Raspberry Pi Model B features:

The Raspberry Pi is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python.

The Raspberry Pi 3 is the third time Raspberry Pi.
It has a 1.2GHz 64-bit quad-focus ARMv8 CPU
802.11n Wireless LAN, Bluetooth 4.1
Bluetooth Low Energy (BLE), 1GB RAM
USB ports, 40 GPIO pins
Full HDMI port
Ethernet port, united 3.5mm sound jack and composite video
Camera interface
Display interface
Micro SD card opening
Video Core IV 3D outlines focus.
It is endorsed for some generally valuable use and in many wander based utilization

This higher-spec variant increases the Raspberry pi GPIO pin count from 26 to 40 pins. There are now four USB 2.0 ports compared to two on the Model B. The SD card slot has been replaced with a more modern push-push type micro SD slot. It consumes slightly less power, provides better audio quality and has a cleaner form factor.

B. IR Temperature Sensor MLX90614

The MLX90614 ESF is an Infra-Red thermometer for noncontact temperature measurements. Both theIR sensitive thermopile detector chip and the signal conditioning ASIC are integrated into the same TO- 2239 can. The Integrated MLX90614 GY-906 is also a low noise amplifier, 17-bit ADC, and powerful DSP unit thus achieving high accuracy and resolution of the thermometer. The user can configure the digitaloutput to be PWM. As a standard, the 10-bit PWM is configured to continuously transmit the measuredtemperature in the range of -20 to 120 °C, with an output resolution of 0.14 °C.

MLX90614 is a non-contact infrared temperature measurement device, it uses low-noise amplifier, 17 b A/D converter and powerful DSP processing unit with high temperature resolution and measurement accuracy. The thermometer temperature range is -40~+125℃, calculate and store in RAM ambient temperature and object temperature can achieve data with 0.01˚C resolution. In addition, the sensor outputs digital signals that are accurate and linearly correlated with temperature, which simplifies the design. For the MLX90614, the accuracy is shown in Fig. 2 within the range of 10ºC-40ºC ambient temperature and 32ºC-42ºC tested object temperature [3,4]. Ta is the ambient temperature and To is the measured temperature. Since the thermometer is generally used indoors, the temperature usually ranges from 20 to 30 °C and the human body temperature ranges from 35 to 42 °C. As shown in the Fig. 2, the accuracy of the MLX90614 is 0.1℃ ~ 0.2℃, so the design uses MLX90614 infrared temperature sensor to meet the design requirements. The working principle of infrared sensor MLX90614 is to transform the infrared radiation signal collected from objects and bodies into electrical signals, send the electrical signal into converter after noise amplification processing by amplifier, then the electrical signal is converted to digital signals and store the processed signals into the internal memory, finally send the signals into the SCM control system for further processing [5]. MLX90614 infrared temperature sensor uses the SPI bus, when connected to the microcontroller, SCL termination microcontroller serial input port RXD, serial output pulse signals of sensor are provided by the microcontroller, it is used to transmit temperature information, SDA serial output port TXD is used to provide temperature information for the microcontroller, in the specific operation, the microcontroller transfer data through the serial port mode 0. Infrared temperature measurement circuit.

C. Camera Module

Through this camera module it capture image of person . Sony imx219 eight megapixel sensor. The advanced camera module might be utilized to take superior quality video, andstills pix. It's smooth to use for fledglings, however has masses to offer propelled clients in the event that you're hoping to grow your know-how. There are masses of cases online of individuals the utilization of it for time-slip by, steady development, and diverse video astuteness. You may moreover utilize the libraries we bundle manage the computerized camera to make comes about. The digital cam works with all designs of raspberry pi 1, 2, and three. It cane gotten to by means of the meal and v4l APIs, and there are different 0.33-festival libraries worked for it, alongside the pi camera python library. Camera module capture the image of human and using IR sensor detect the temp of body by image processing using that temp of body it make a thermal image as shown in fig below-

D. HDMI Signal TFT LCD Display Panel

Windstar Released for Mini / Small HDMI Signal TFT LCD Display Panel: Windstar released for HDMI signal Displays are designed to work with the Raspberry Pi or embedded system, single board computers (or desktop/laptops) which support HDMI signal output. This series display modules come with a control board with a HDMI signal interface output; it is designed to make Raspberry Passage become easily

IV. THERMAL FACE DATABASES

IR images are acquired using thermal cameras that estimate the temperature of a body and generate an image through a process called thermograph [23], [24]. The energy collected by thermal sensors is a sum of several energy components related to the different elements present in the scene captured by the camera. A scene can be divided into three elements: the object to be measured, the background and the atomsphere.

Fig. Thermal database (1)

Fig. Thermal Database (2)

Variations in one of these components may affect the temperature estimation performed by the IR camera and consequently affect facial recognition. Thereby, the main challenges of the use of thermal face images for face recognizetin include: undesirable variations produced by the changes of environment temperature and weather—known as dextrinsic factors—and intrinsic factors such as variable sensor response when the IR camera is working for long periods of time, and physiological changes in the metabolic procusses of the subjects (e.g. disease). Both extrinsic and interimsic factors generate temporal variations in the face images affecting the thermal face recognition performance—which is also known as the time-lapse problem. For both databases, all the images were acquired in a controlled environment, between 23◦C and 24◦C, allowing the minimization of the effects of the background or any atmospheric factors that may lead to thermal variations in the thermal face images.

Fig. Thermal scanning image using body temp

Thus, the images were only tentatively affected by physiologycal factors which cannot be controlled, observing temporal metabolic variations of the subjects such as changes in their appearance during the capture period (beard, haircut, mouseache, etc.). The UCHThermalTemporalFace (UCH-TTF) and the PUCVThermalTemporalFace (PUCV-TTF) databases are used to carry out face recognition experiments in the thermal domain. The UCH-TTF and PUCV-TTF databases were crewacted for this study mainly due to the lack of databases for the study of the temporal problem in thermal face recognition in the literature.

A. Advantages

Cost effective model: Cameras can measure the temperature of multiple people at once, especially beneficial in busy public areas .
Contactless measurement: effectively avoids crosscontamination
Reduced psychological impact: the non-interfering process provokes less fear and negative emotions
Data Stored can be accessed any time for future reference.
Can be used as an alternative for Biometric System of Attendance.
Will reduced Human Effect and lead to Automation

B. Disadvantages

Time consuming and labor intensive: can cause long queues when used in areas with a high volume of people, such as at high footfall areas, railway stations, airports and other public areas.
Chances of skipping this process and entering the premises.

C. Applications

The device works by recognizing the face of each person and doing thermal screening to detect the body temperature. If a person is found to have a very high temperature, then the system will not allow entry and instead will automatically notify that person to take a COVID-19 test.
This system can be used in malls, school, offices and various corporate and government places.

V. RESULT AND DECLARATION

The output for smart door camera with facial recognition feature for thermal screening is shown below. Fig shows the complete prototype implementation of the proposed system.

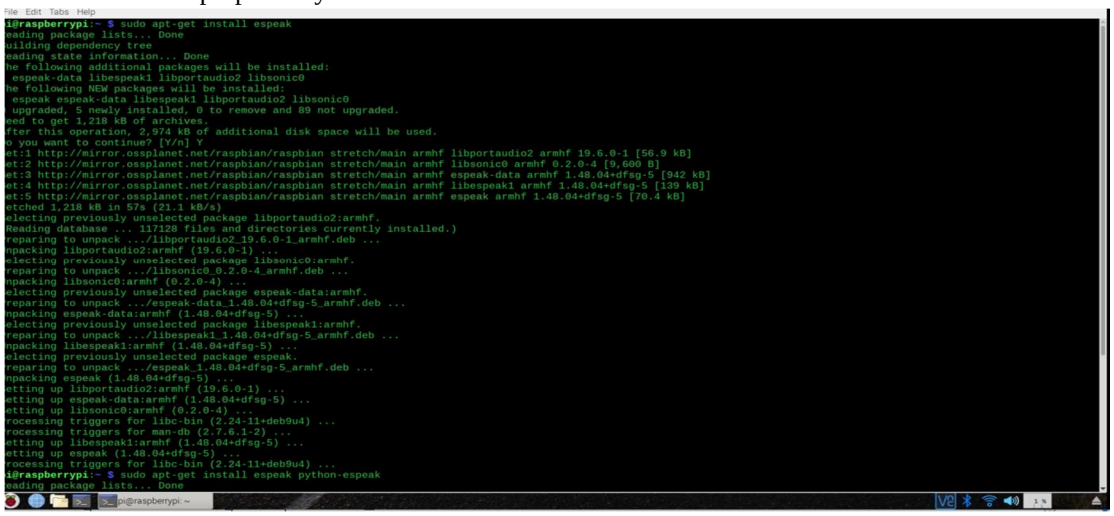

Fig. screenshot of raspberry pi code

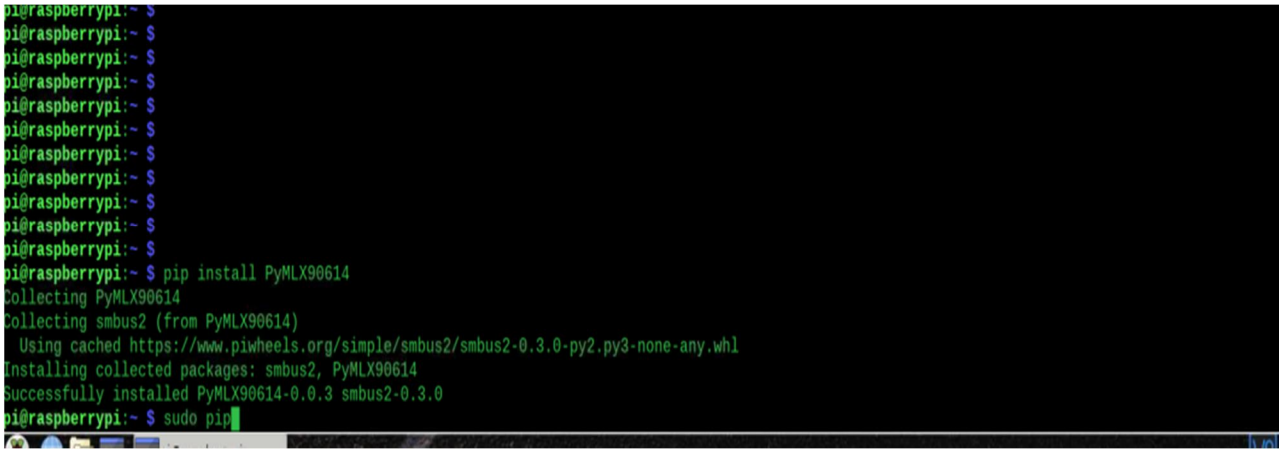

Fig. Screenshot of raspberry pi code

A. Result

Our point, which we believe we have come to, was to develop a methodology for face affirmation that is speedy, lively, and sensibly essential and correct with respectably fundamental and clear computations and procedures. This system aiming to help organizations respect the COVID-19 safety rules and guide lines in order to reduce the disease spread.

VI. CONCLUSION & FUTURE SCOPE

A. Conclusion

This review will surely help for the research in same field which can further be studied and make can be converted into large scale application based device. These research and project is done by using embedded systems like Raspberry pi, MLX 90614 (IR temperature sensor), LCD display, etc. This low cost, effective and reliable equipments used in our methodology can make a positive impact on today's covid-19 scenario.

B. Future Scope

A Reliable and Application oriented approach will make this Device Compatible for general use. This Device will be step towards automation in corporate and other Sectors .Major Device for the safe environment from Covid-19.As Pandemic may likely to remain for long time this device will have a huge demand in market. The device works by recognising the face of each person and doing thermal screening to detect the body temperature. If a person is found to have a very high temperature, then the system will not allow entry and instead will automatically notify that person to take a COVID-19 test.

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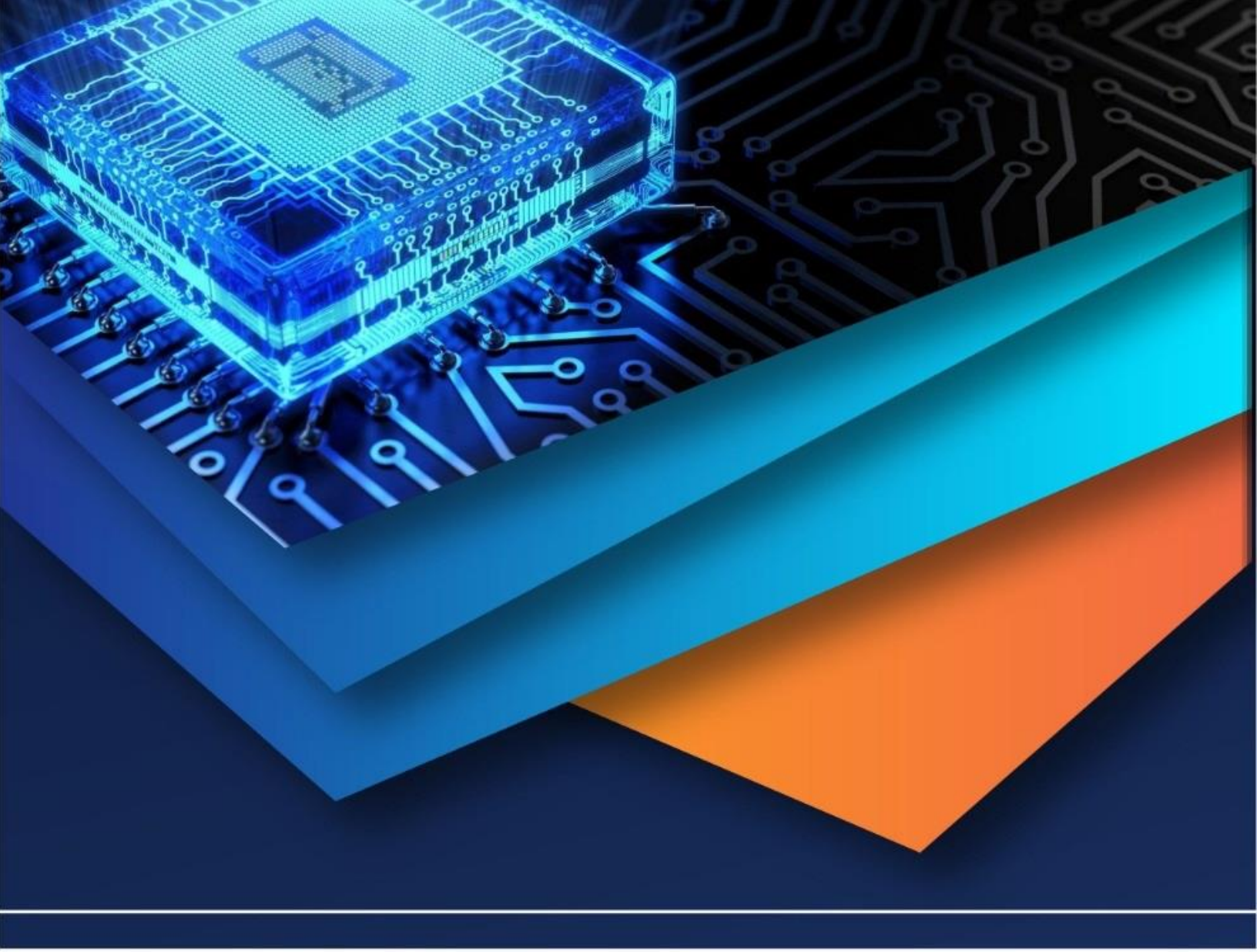

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