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IoT-Enabled System for Face-Mask Detection and Body Temperature Monitoring

Aakash K[1], Dhanush Devadiga[2], Jnanesh Aradhya R[3], Kshitija V Shetty[4], Guruprasad[5]
Mangalore Institute of Technology & Engineering, Moodabidri, INDIA

Abstract: ***The world is entering the third year of the most acute health crisis and remains in its grip. Instead of meeting in the aftermath of the pandemic, a fresh wave of cases and deaths are met. The COVID-19 impact is everywhere, resulting in the closure of Schools and other educational institutions. The COVID-19 epidemic has an impact on both off-screen and on-screen entertainment, as well as work activities, interpersonal interactions, all sports activities, and other recreational pursuits. Because there is a greater danger of infection, people with high body temperatures should not be allowed in public areas. Also required at all city, business, school, and college entrances are mask inspections and temperature checks. The suggested work is being developed as a prototype to identify masks and keep an eye on people's body temperatures, particularly kids riding in buses.***
Keywords: COVID-19, Body temperature, MLX90614, Mask detection, Display, Buzzer, Convolution Neural Network, Raspberry pi.

I. INTRODUCTION

The COVID-19 pandemic has given sleepless nights to the world and has impacted our ability to gather with others. India, which is the second most populated country globally, is also suffering severely from COVID-19 disease. Researchers and World Health Organization (WHO) are putting enormous efforts into developing solutions that can deal with the pandemic. There is no such thing as zero risk in any type of gathering, especially that involves a large group of people. Fever, exhaustion, and a loss of taste and smell are a few signs of coronavirus sickness. Due to this, the government implemented numerous safety and protection measures to stop the disease's spread, including the use of masks, social seclusion, self-isolation, and quarantine. Temperature screening has been a focal point in the virus detection process. The problem with manual temperature scanning is when the supervisor is not present, an individual may skip the screening process. This problem can be resolved if temperature detection takes place without human intervention. In this paper, the face mask and body temperature detection system is described that is implemented using Raspberry Pi. In order to determine whether someone is wearing a face mask and whether their body temperature is within a certain range, this project intends to design a face mask detection and temperature reading system. To detect the temperature of an individual, an MLX90614 infrared sensor is interfaced with a raspberry pi. For mask detection, a raspberry pi camera and computer vision techniques are used. This IoT-enabled system can help to reduce the disease spread.

II. BACKGROUND

Mohamed Loey et al. [1] offered a strategy to stop the spread of COVID-19 by spotting people without face masks. The model is based on both traditional machine learning classifiers and deep transfer learning. Deep transfer learning and conventional machine learning techniques were used to create the model.

Bosheng Qin et al. [2] suggested a different method to find the face mask. This method addresses a three-category classification problem based on unrestricted two-dimensional facial photos by combining image super-resolution and classification networks (SRCNet). The method consists of four steps: face mask wearer identification, image pre-processing, facial detection, and cropping. The accuracy of the suggested SRCNet was 98.70%.

In a different paper, Arjay Das et al. [3] described a method that accurately recognizes the face in the image before determining whether or not the image has a mask. A face and a mask can both be detected while they are in motion. 2 datasets were used in this strategy. Images of people wearing face masks are in dataset 1, whereas pictures of people without face masks are in dataset 2.

In their approach, Giovanni Battista Dell'lsola et al. [4] considered both conventional causes of measurand subjectivity and clinical-medical instrumental ambiguity. In this method, the author talked about the noncontact body temperature procedures in relation to the variables that affect a person's personal and environmental influences. The proposed approach permits the reduction of negatives resulting from measurement uncertainty by combining the hygiene and ease of use of noncontact thermometers with the accuracy of contact thermometers.

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Carlo Alberto Boano et al. [5] designed a body sensor network architecture and nodes using high-precision NTC thermistors and precision amplifiers, that can measure the body temperature in a non-invasive way and also send real-time feedback to the medic. This approach guarantees a long battery lifetime, hence uninterrupted operations for weeks.

A body temperature monitor and alert system that is utilised in hospitals was created by Chen Yu et al. [6]. The suggested system makes use of USB communication interface technology, 1-wire bus temperature sensor DS18B20, and humidity sensor HS1101. This effectively keeps track of the patients' body temperatures on each ward.

Juhi Singh et al. [7] proposed an approach to detect face masks that have been created with computer vision utilizing OpenCV, Keras, Python, and TensorFlow. The main goals are to regularly verify whether people are wearing masks and to create weekly and monthly reports. The history records view option is offered by this system.

M.N Mohammed et al. [8] proposed the development of a system that uses a mounted thermal imaging system mounted on a smart helmet to automatically identify the coronavirus from the thermal image with minimal human interaction. In order to monitor the screening procedure and obtain real-time data, the thermal camera technology is integrated into the smart helmet and linked with IoT technology. The suggested system also has facial recognition technology, can show the pedestrian's personal information, and can take their temperature automatically.

III. PROPOSED SYSTEM

The proposed work will keep an eye on the person's body temperature and make sure that they are wearing a mask in an effort to stop the virus from spreading. A Raspberry Pi single-board computer is employed in this work. It is a cheap device that connects to a computer. In this prototype, when someone gets into the bus, their body temperature is taken. For this, a body temperature sensor called the MLX90614 is employed. The LED display will flash a red warning light if the user's body temperature is too high and a green warning light if the temperature is normal. A Raspberry Pi Camera is used to detect masks. The buzzer will be audible throughout the bus if the person is found without a mask. If the mask is detected, that individual will be allowed to travel on the bus. Figure 1 is the overall architecture of the system.

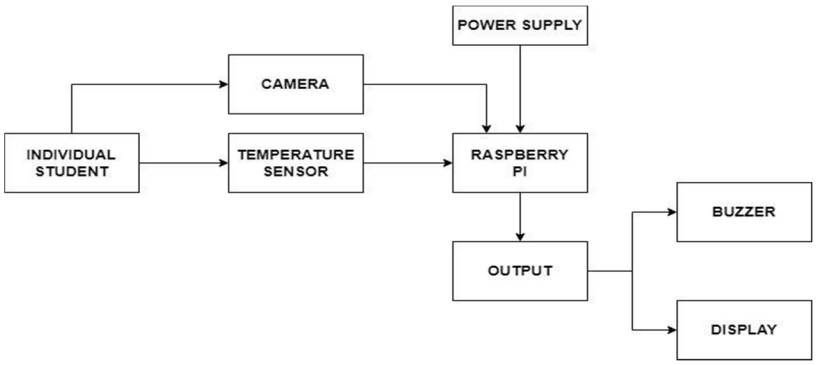


Fig1: Architecture of the proposed system

A. Temperature Monitoring

Code is created for the MLX90614 temperature sensor, which is connected to the Raspberry Pi's GPIO Pin. If the temperature exceeds the threshold value, the red light will be displayed as a warning. If the temperature is normal, the green light will be displayed. Figure 2 illustrates a flowchart of the temperature monitoring process.

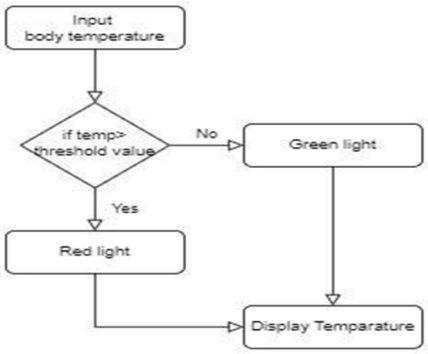


Fig 2: Temperature monitoring

B. Mask Detection

Face mask recognition uses the Convolution Neural Networks (CNN) Technique, a deep learning algorithm. It is mostly utilised for image analysis and picture recognition. A final result is produced by combining around 1000 filters, and the output is then forwarded to the neural network's next layer. Utilizing the face mask detection algorithm and the TensorFlow software library, the proposed solution is evaluated. In this approach, if an individual tries to enter the bus without wearing a mask, the buzzer will be heard on the bus.

Fig 3 shows the steps involved in the mask detection process.

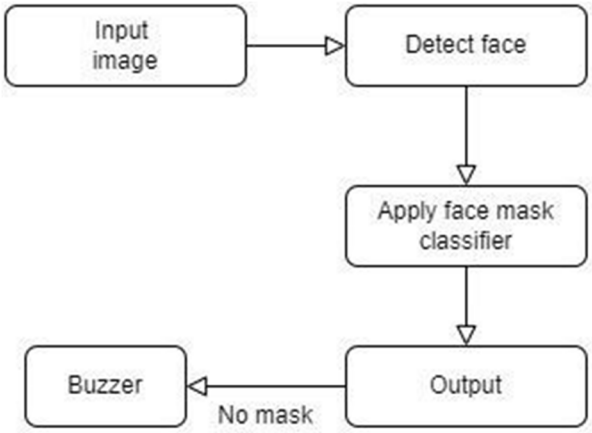


Fig 3: Facemask detection

C. MLX90614 Sensor

A non-contact infrared temperature measurement tool is the MLX90614 model. It makes use of a strong DSP processing unit with high-temperature resolution and measurement precision, a low-noise amplifier, and a 17 b A/D converter. The thermometer has a range of -40 to +125 degrees. The sensor also produces reliable digital signals that are linearly connected with temperature, simplifying the design. The sensor communicates with the microcontroller using the I2C protocol and measures the object's temperature using IR rays without making any physical contact.

D. Buzzer

A beeper or buzzer, for example, could be electromechanical, piezoelectric, or mechanical in design. The signal is converted from audio to sound as its primary function. It is often powered by DC voltage and used in timers, alarm clocks, printers, computers, and other electronic devices. A buzzer's operation is based on the idea that once a voltage is applied across a piezoelectric material, a pressure difference is created. Two conductors and piezo crystals make up a piezo type.

These crystals propel one conductor and drag the additional conductor through their intrinsic property once a potential discrepancy is established between them. Consequently, a sharp sound signal will be produced by this ongoing motion.

IV. FUTURE TRENDS

The proposed system is a combination of face mask detection and temperature monitoring. It gives a warning signal when an individual is detected without a face mask or with a high body temperature. The health care system will benefit greatly from the deployed model. The model can eventually be improved to recognize whether someone is donning a virus-prone mask. To determine if a mask is surgical or not, the model might be further enhanced.

V. CONCLUSION

It is necessary to take action to slow the COVID-19 pandemic's spread. The suggested system keeps track of temperature and looks for face masks that could improve public safety. Thermometer MLX90614 is used to measure body temperature. With the help of the Convolution Neural Network technique, the facemask detector is modeled. A dataset of 3000 photos of masked and unmasked faces is utilized to train, validate, and test the model. Resources like Kaggle were used to create these photos. To slow the spread of the disease, this concept can be used in numerous locations, including shopping malls, airports, and public transportation.

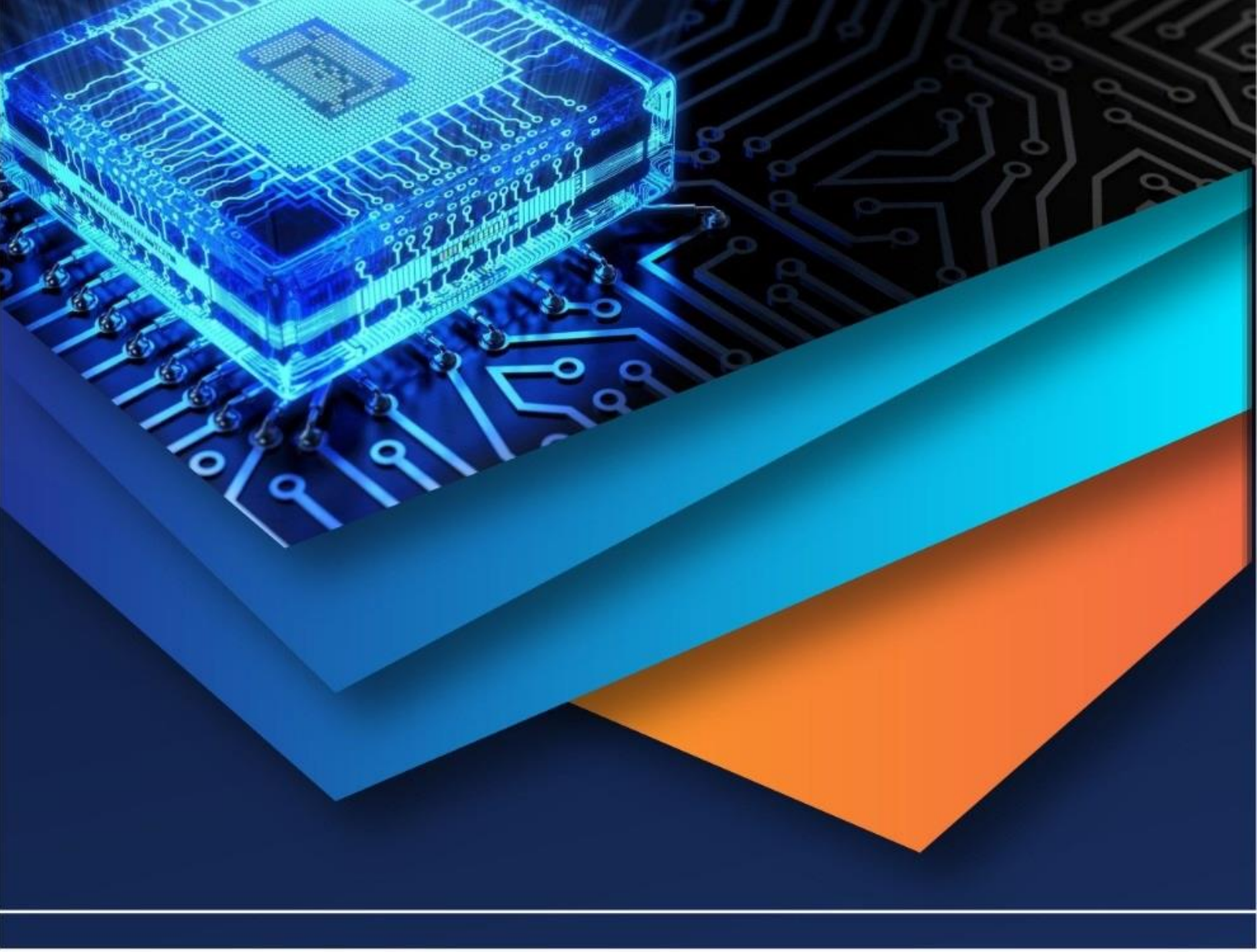
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Biodata

The authors of this paper are pursuing their B.E. in Computer Science & Engineering from Mangalore Institute of Technology & Engineering, Moodabidri. This work is a part of their contribution towards final year project work under the supervision of Mr. Guruprasad, Senior Assistant Professor, Department of Computer Science & Engineering.

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