IJAREEIE

e-ISSN: 2278-8875
p-ISSN: 2320-3765

International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering

Volume 10, Issue 7, July 2021

ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.282

| e-ISSN: 2278 – 8875, p-ISSN: 2320 – 3765| www.ijareeie.com | Impact Factor: 7.282|

|| Volume 10, Issue 7, July 2021 ||

| DOI:10.15662/IJAREEIE.2021.1007058 |

Visage Radar: Detection system

Uma Parvathi M M[1], Arshida P[1], Athira P[1], Srejin K[1], Suhana Husna P[1] Sebin Sunny P[2]

UG Student, Department of EEE, Sreepathy Institute of Management and Technology, Pattambi, Kerala, India [1]

Assistant Professor, Department of EEE, Sreepathy Institute of Management and Technology, Pattambi, Kerala, India [2]

ABSTRACT: Presently the whole world is battling through the COVID-19 pandemic. In this crisis, wearing a mask and social distancing are the only two measures to prevent the spread of this pandemic. Wearing a mask is necessary and compulsory for public health care and controlling the spread. The world can't be at a standstill for too long, institutions have started functioning, offices, schools, colleges, shopping malls, etc. are now opened. In such a situation a dedicated accurate detection system has become the need of the hour to monitor the presence of face masks as well as to measure the temperature and provide a correct record of the number of people entering and leaving the place. So to monitor this strictly, we need a monitoring system that reduces human effort. For achieving this we propose a system that monitors whether the person is wearing a mask or not, measure the temperature and record the count of people automatically. This reduces human effort and increases accuracy. This system will act as a shield that reduces the spread in the organization by restricting the entry of people with no mask and high temperature.

KEYWORDS: CNN, Raspberry Pi, IR sensors, python

I. INTRODUCTION

Considering the present epidemic, where the spread of the virus is continuing and taking up new forms, following the protocols is the only measure to stay safe and reduce the spread. By prioritizing the safety of people technologies like CNN, Machine learning, etc. can be used effectively to develop an accurate detection/monitoring system that detects the presence of face masks and monitors the temperature of people at the entrance of a building and restricts the entry if these conditions are not met. With the help of deep learning, this system can detect whether a person is wearing a mask or not. The project details how computer vision/deep learning can be implemented in a face mask, detecting temperature, and counting the number of people in a crowd.

The face mask detector is more relevant in this present scenario. The majority of the people have no awareness of this epidemic and are not ready to wear the mask in public. So it will be the cause for the spreading of the virus. Hence if there is an efficient mask detector, it will help to detect people with masks and without masks. Also, we are using IR sensors for detecting temperature. With these data, organizations can prevent the spread to an extent. Most importantly the system provides accurate detection. All these are the most important in this scenario.

This is a developmental project. We are developing a face mask detection system that can detect those people with masks and without the mask. Also, we are including some sensors that will count the number of people in a crowd and also measures the temperature. We are using CNN and Tensorflow for the demonstration of this project.

II. PROBLEM STATEMENT

With the increase in spread, monitoring and detection at all places can be difficult. We know that at present the duty of checking for face masks and measuring of temperature is done manually. This can be tiresome work at large organizations and in places with a large crowd. Also, there are chances that the person who is bestowed with this duty misses out to check on every single person coming to the place. This reduces the accuracy in detection. At present we have a contactless thermometer to measure the temperature, regardless of this being contactless, people come in contact when they are large in numbers. So an automated system that detects the presence of a face mask as well as monitors the temperature without any human interaction or effort is the need of the hour.

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III. PROPOSED ALGORITHM

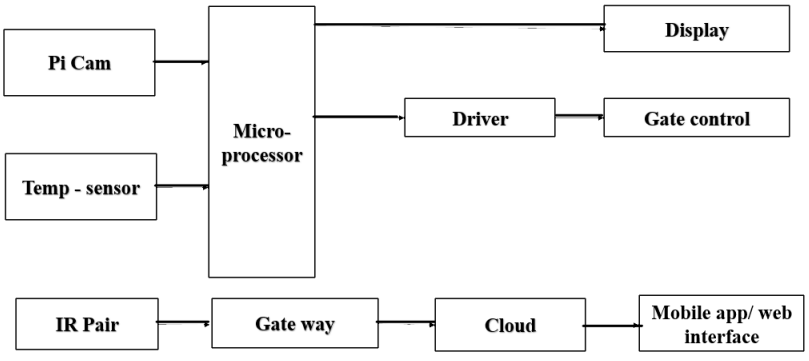
With the need for an automated and accurate detection system to monitor the presence of face masks and measure the temperature, we propose our product" Visage radar". Visage radar is an automated monitoring system the detects face masks, measures temperature, records the count of people, and also automates the entry exist mechanism. Our system will act as a public shield to reduce the spread. Visage radar is developed based on the latest technologies making it more reliable and accurate. The rampant epidemic increases the relevance of this system, as it completely restricts people with symptoms or those without masks making the area much safer. This system also keeps the record of people entering a place which helps in curbing unnecessary crowds. Our system detects images in real-time and detects the presence of a face mask and measures the temperature. If both the conditions are satisfied, then only the entry is permitted. The authorities can conveniently have a watch on the people entering remotely as our system provides an E-mail alert stating the mask status - whether it is there or not, temperature, and even the photos of the person. The E-mail alerts and monitoring of count through web/app interface help in smooth and efficient surveillance.

IV. BLOCK DIAGRAM

Raspberry pi 4 is the processing module used here. The Pi-cam and temperature sensor comprise the input module. These are connected to the terminals of the raspberry pi. The raspberry pi is configured than enables the working of the pi-cam and temperature sensor. The sensor used is MLX90614. To control the entry and exit of people a gate control is provided with the help of motor and driver IC. A display is also provided to show the corresponding message. The codes to detect the mask, temperature, and control of gates are fed to the raspberry pi. The pi takes the input and processes as per the codes fed and produces an output, which controls the modules in the output section.

The camera captures the images of people and the temperature sensor measures the temperature. These data are processed by raspberry pi and an output is generated. If the person has worn the mask and the temperature is also in the prescribed range, then the servo rotates and the entry is permitted or else the servo motor won't rotate and the person is restricted from entering the premise. An E-mail alert based on this is also sent to the authorities.

A provision for count monitoring is also provided. This is done using IR pair and nodemcu ESP8266 as the gateway to connect with the cloud. The IR pair detects the presence of a person and sends the data to the cloud. The cloud used here is Thingspeak. This is then displayed through an app. This explanation is based on a system that works using nodemcu but for the large institution, we use lorawan as the gateway as it covers a large area. A cloud platform like IBM cloud can be used.



V. HARDWARE ENVIRONMENT

A) Raspberry pi

Raspberry pi is a single board computer. The latest version is Raspberry pi 4 model B. It has 2GB, 4GB or 8GB LPDDR4-3200 SDRAM (depending on model), 2 USB 3.0 ports; 2 USB 2.0 ports. Raspberry Pi standard 40 pin GPIO header.

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B) MLX90614

The MLX90614 is an infrared thermometer for non-contact temperature measurements. The operating voltage is 3.6v to 5v. The ambient temperature range for better performance is -40c 125c and the Object temperature range, that is the range of temperatures the sensor can measure is -70c to 382.2c. The supply current is 1.5 mA Distance between object and sensor must be between 2-5 cm. It uses the I2C communication protocol to communicate with the host processor.

C) Servo motor

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity, and acceleration. It consists of a suitable motor coupled to a sensor for position feedback.

D) IR pair

The IR pair is a combination of LED and Photodiode. The operating voltage is 5V DC. LM358 is an Operational Amplifier (Op-Amp) is used as a voltage comparator in the IR sensor.

E) Pi cam

5MP color camera module for raspberry pi. It supports both model A and B. Lightweight and portable.

F) NodeMcu ESP8266

NodeMCU is an open-source firmware. Open source prototyping board designs are available. The name ”NodeMCU” combines ”node” and ”MCU” (micro-controller unit). In addition, by providing some of the most important features of microcontrollers such as GPIO, PWM, ADC, etc, it can solve many of the project’s needs alone.

VI. SOFTWARE ENVIRONMENT

A) Raspbian

Raspbian is a free operating system released in July 2012 that runs on the Raspberry Pi single-board computer. It is derived from Debian Linux. The latest version is Debian version 10 which is suitable for raspberry pi 4 also.

B) Proteus

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. We have used this software to simulate the power supply part of our project.

C) Google colab

Colab is a free Jupyter notebook environment that runs entirely in the cloud. Most importantly, it does not require a setup and the notebooks that you create can be simultaneously edited by your team members.

D) Thonny

Thonny is an integrated development environment for Python that is designed for beginners. It supports different ways of stepping through the code, step-by-step expression evaluation, detailed visualization of the call stack, and a mode for explaining the concepts of references and heap.

E) Python

Python is a high-level and general-purpose programming language that is ideal for developing firmware or portable applications. Originally intended for writing system software. Here it will be used for programming. Python 3.8 is used as our programming language.

F) Tensorflow

TensorFlow is an end-to-end open-source platform for machine learning. It has a comprehensive, flexible ecosystem of tools, libraries, and community resources that lets researchers push the state-of-the-art in ML, and developers easily build and deploy ML-powered applications. Tensor flow 2.3.0 is used here.

G) Convolutional neural network

A Deep Learning algorithm that can take in an input image, assign importance to various aspects/objects in the image and be able to differentiate one from the other.

H) Thingspeak

It is an open-source Internet of Things application and API to store and retrieve data from things using the HTTP and MQTT protocol over the Internet or via a Local Area Network.

I) Arduino IDE

The Arduino Integrated Development Environment is a cross-platform application that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards.

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VII. SIMULATION RESULTS

A simulated circuit diagram is depicted (Fig 1). The circuit was physically implemented and tested to receive satisfactory results. The system was able to detect the presence of the face mask correctly and label it as “Masked” (Fig 2) and “Unmasked” (Fig 3) in real-time testing. The temperature was also measured and based on the process an E-mail alert was also generated. The image of the e-mail alert is shown here (Fig 4).

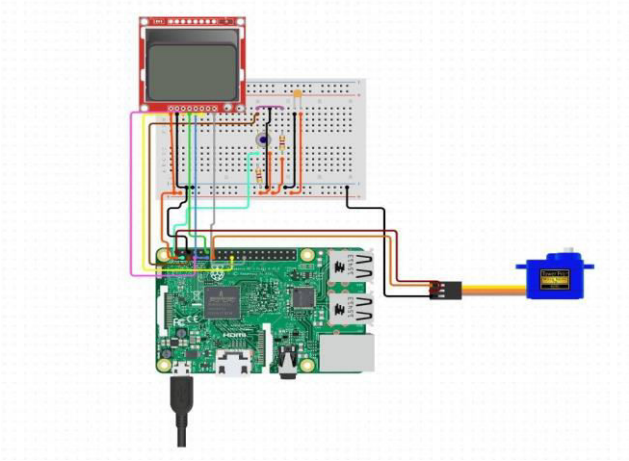

Fig.1. Circuit diagram

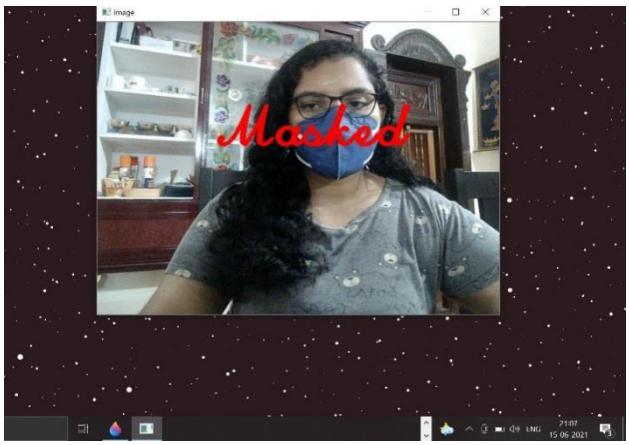

Fig.2.Detected face mask

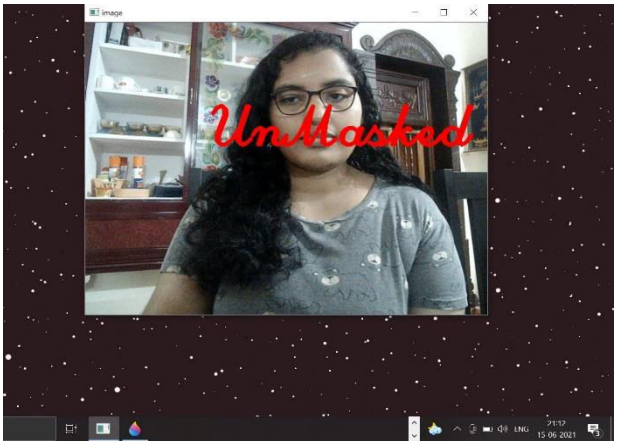

Fig. 3. Detected no mask

Fig. 4. E-mail alert

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VIII. CONCLUSION AND FUTURE WORK

It is clear that from the results that an automated system for detection is accurate. Through our real-time automated system, the covid protocols can be strictly monitored in public places like organizations and shopping malls, etc. This is a Standalone system with real-time count monitoring which is again another benefit of our system. Hence the control of the crowd can be done much faster and efficiently. The human effort can be minimized thus this will act as a protective shield for our public. With a system that restricts the maneuver people will become more aware. As a future enhancement, we will use Lorawan and IBM cloud for count monitoring. This helps us in covering a large area than what is available now. Thus improving the system function.

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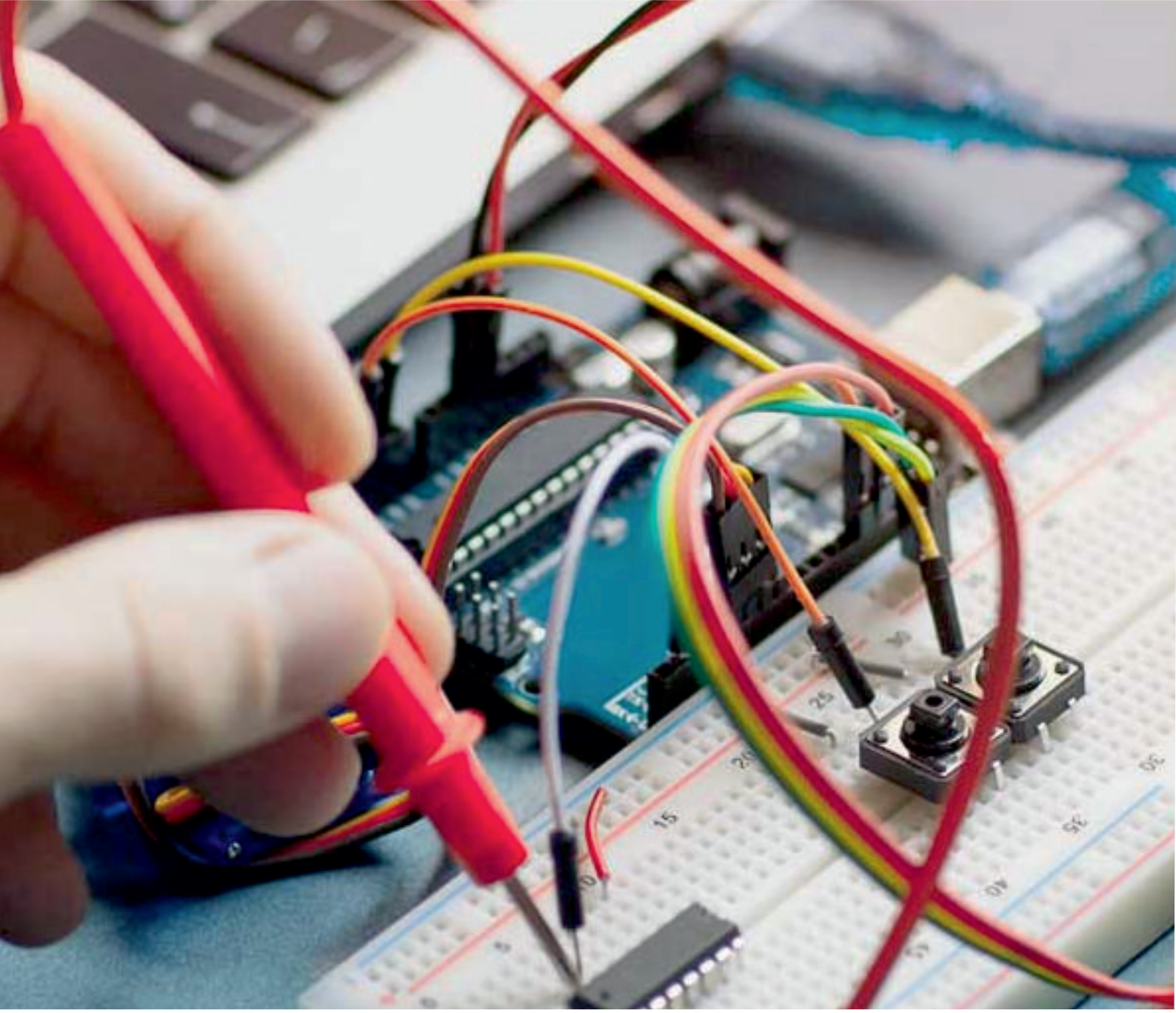
BIOGRAPHY

Uma parvathi M M, Arshida P, Athira P, Srejin K, and Suhana Husna P are final year students from the electrical and electronics engineering department who are very well aware of the present situation that we are going through and the need for technology to tackle this epidemic. The idea to develop a device that can be helpful in this time and the innovative concept brought us together as a team.

Sebin Sunny P, Assistant Professor, in Electrical and Electronics Engineering Dept. has been motivating and guiding students to nourish their skills and abilities for creating innovative products.



INNO SPACE
SJIF Scientific Journal Impact Factor

Impact Factor: 7.282

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