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HEALTHGUARD: RASPBERRY PI-BASED SMART SCREENING SYSTEM FOR PANDEMIC SAFETY

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ABSTRACT

The COVID-19 pandemic has highlighted the critical need for contactless health screening systems in public spaces to prevent virus transmission. This study presents HealthGuard, a Raspberry Pi-based intelligent screening system designed for real-time temperature monitoring and mask detection. The system integrates infrared temperature sensors and computer vision algorithms to detect elevated body temperatures and verify mask compliance, providing instant alerts for non-compliance. The Raspberry Pi serves as a low-cost, versatile platform for processing sensor data, enabling automated and scalable deployment in schools, offices, airports, and other high-traffic areas. Experimental implementation demonstrates accurate temperature detection, reliable mask identification, and efficient real-time processing, highlighting its effectiveness as a preventive tool for pandemic safety.

I. INTRODUCTION

Building a Raspberry Pi-based safety device for Covid-19 safety regulations to stop the disease's transmission is the project's primary goal. To enable individuals, we concentrate on the most widely used interior measuring method. This project uses an MLX90614 contactless temperature sensor to measure body temperature and a pi camera. Tensorflow is used in deep learning to determine whether or not a person is wearing a mask. We provide a reasonably priced indoor COVID-19 safety system. The Raspberry Pi3 CPU is interfaced with every module and sensor.

The temperature sensor uses a contactless infrared sensor to determine a person's body temperature. One by one, the people go by. When a person's body temperature rises over normal, the Raspberry Pi3 CPU sends a signal to lock the door and sounds a siren to inform others. If not, the door is opened to allow entry.

For the purpose of implementing deep learning and mask detection utilising a Raspberry Pi camera interface. When the user turns on the kit, a pi camera takes pictures. If the picture doesn't show the user's mouth or nose, it indicates that they are wearing their mask correctly, and the appropriate door will open. But if the individual isn't wearing a mask, the Raspberry Pi3 CPU sends a signal to lock the door, deliver the mail to the appropriate person, and sound a buzzer to provide aural notifications.

1.2 Block Diagram of System:

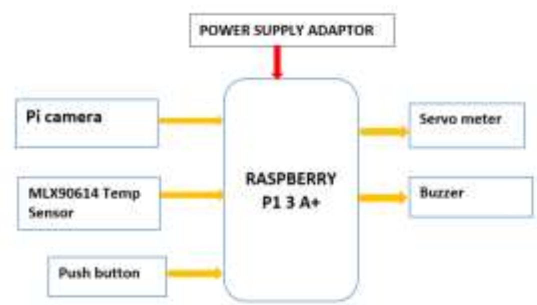

Fig 1: Block Diagram

1.3 Working Principle Of The Project:

- The main controlling device of the project is Raspberry pi3 processor, pi camera, temperature sensor, DC motor, LCD display, Ultrasonic sensor, and buzzer is interfaced to the raspberry pi processor.
- The processor continuously read the data from mlx90614 sensor. In case that person's temperature exceeds average human body then raspberry pi processor generates signal to lock the door and gives the audible alert through buzzer. Otherwise, the door is opened to let the person in.

Mask detection: The processor interfaced with pi camera and opevCV. In case that image does not contain mouth and nose, it means that person wears mask properly and corresponding door will be opened otherwise then that door is closed. However, if the person doesn't contain a mask then raspberry pi3 processor generates signal to lock the door and take the photo of the person using pi camera and send the mail along with person image to the respective person and also gives the audible alerts through buzzer.

II. Hardware Description

2.1 Raspberry Pi 3A+ :

The Raspberry Pi 3 Model A+ is the latest product in the Raspberry Pi 3 range. Like the Raspberry Pi 3 Model B+, it boasts a 64-bit quad core processor running at 1.4 GHz, dual-band 2.4 GHz and 5 GHz wireless LAN, and Bluetooth 4.2/BLE. The dual-band wireless LAN comes with modular compliance certification, allowing the board to be designed into end products with significantly reduced wireless LAN compliance testing, improving both cost and time to market. The Raspberry Pi 3 Model A+ has the same mechanical footprint as the Raspberry Pi 1 Model A+. The Raspberry Pi 3 Model A+ is the latest product in the Raspberry Pi 3 range. Like the Raspberry Pi 3 Model B+, it boasts a 64-bit quad core processor running at 1.4 GHz, dual-band 2.4 GHz and 5 GHz wireless LAN, and Bluetooth 4.2/BLE.

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III. MLX90614 Temperature Sensor :

The MLX90614 is an InfraRed thermometer for noncontact temperature measurements. Both the IR sensitive thermopile detector chip and the signal conditioning ASSP are integrated in the same TO-39 can. Thanks to its low noise amplifier, 17-bit ADC and powerful DSP unit, a high accuracy and resolution of the thermometer is achieved. The thermometer comes factory calibrated with a digital PWM and SMBus (System Management Bus) output. As a standard, the 10-bit PWM is configured to continuously transmit the measured temperature in range of -20…120˚C, with an output resolution of 0.14˚C. The factory default POR setting is SMBus.

The MLX90614 is a Contactless Infrared (IR) Digital Temperature Sensor that can be used to measure the temperature of a particular object ranging from -70° C to 382.2°C. The sensor uses IR rays to measure the temperature of the object without any physical contact and communicates to the microcontroller using the I2C protocol.

Fig.2 : Temperature sensor

3.2 Push Button:

Mechanical switches can be reliant on a variety of different potential actuation methods, depending on the purpose they serve. Push button switches, also referred to as push button switches, push switches, or simply push buttons, are prevalent in a multitude of modern applications. This short blog will give an overview of push button switches including their basic operation, common types, and key design specifications. A push button switch is a mechanical device used to control an electrical circuit in which the operator manually presses a button to actuate an internal switching mechanism. They come in a variety of shapes, sizes, and configurations, depending on the design requirements. Push button switches rely on a simple in-out actuation mechanism. They can be employed to break (off) or initiate (on) a circuit. Alternatively, they can provide an input for the user interface of a piece of equipment or start/stop a particular function.

Push button switches may be categorized as being either momentary (where the switch function only continues for as long as the operator is pushing the button) or maintained (where the switch function stays latched in that status after it has been actuated).

A Push Button switch is a type of switch which consists of a simple electric mechanism or air switch mechanism to turn something on or off.

Fig.3: Push Button

3.3 Servo Motor:

A servo motor is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision. If you want to rotate an object at some specific angles or distance, then you use a servo motor.

It is just made up of a simple motor which runs through a servo mechanism. If motor is powered by a DC power supply then it is called DC servo motor, and if it is AC-powered motor then it is called AC servo motor. For this tutorial, we will be discussing only about the DC servo motor working. Apart from these major classifications, there are many other types of servo motors based on the type of gear arrangement and operating characteristics. A servo motor usually comes with a gear arrangement that allows us to get a very high torque servo motor in small and lightweight packages. Due to these features, they are being used in many applications like toy car, RC helicopters and planes, Robotics, etc.

Servo motors are rated in kg/cm (kilogram per centimeter) most hobby servo motors are rated at 3kg/cm or 6kg/cm or 12kg/cm. This kg/cm tells you how much weight your servo motor can lift at a particular distance. For example: A 6kg/cm Servo motor should be able to lift 6kg if the load is suspended 1cm away from the motors shaft, the greater the distance the lesser the weight carrying capacity. The position of a servo motor is decided by electrical pulse and its circuitry is placed beside the motor.

Fig.4 : Servomotor

3.4 Jumper Wires:

Most, if not all, electronics suppliers stock jumper wire in various lengths and assortments. These wires are commonly used with breadboards and other prototyping tools like Arduino. Jumper wires make changing circuits as simple as possible. They come in a wide array of colors, too, but do they mean anything?

A jumper wire may appear uncomplicated, and it doesn't get much more basic than other wires or cables. But there are tiny details you need to pay attention to. Generally, jumpers are tiny metal connectors used to close or open a circuit part. They have two or more connection points, which regulate an electrical circuit board. Their function is to configure the settings for computer peripherals, like the motherboard. Suppose your motherboard supported intrusion detection. A jumper can be set to enable or disable it. Jumper wires are electrical wires with connector pins at each end. They are used to connect two points in a circuit without soldering. You can use jumper wires to modify a circuit or diagnose problems in a circuit. Further, they are best used to bypass a part of the circuit that does not contain a resistor and is suspected to be bad. This includes a stretch of wire or a switch. Suppose all the fuses are good and the component is not receiving power; find the circuit switch. Then, bypass the switch with the jumper wire. How much current (I) and voltage (V) can jumper wires handle? The I and V rating will depend on the copper or aluminium content present in the wire. For an Arduino application is no more than 2A and 250V. We also recommend using solid-core wire, ideally 22 American Wire Gauge (AWG)

Fig.5 : Jumper Wires

3.5 Pi Camera

This 5mp camera module is capable of 1080p video and still images and connects directly to your Raspberry Pi. Connect the included ribbon cable to the CSI (Camera Serial Interface) port on your Raspberry Pi, boot up the latest version of Raspbian and you are good to go!

Fig.6 : Raspberry pi Camera Module

The board itself is tiny, at around 25mm x 20mm x 9mm and weighing in at just over 3g, making it perfect for mobile or other applications where size and weight are important. The sensor has a native resolution of 5 megapixel, and has a fixed focus lens onboard. In terms of still images, the camera is capable of 2592 x 1944 pixel static images, and also supports 1080p30, 720p60 and 640x480p60/90 video.

RPI CAMERA BOARD plugs directly into the CSI connector on the Raspberry Pi. It's able to deliver a crystal clear 5MP resolution image or 1080p HD video recording at 30fps with latest v1.3. Board features a 5MP (2592 × 1944 pixels) Omni vision 5647 sensor in a fixed focus module. The module attaches to Raspberry Pi, by way of a 15 pin Ribbon Cable, to the dedicated 15 pin MIPI Camera Serial Interface (CSI), which was designed especially for interfacing to cameras. The CSI bus is capable of extremely high data rates, and it exclusively carries pixel data to the BCM2835 processor.

IV. Result

4.1 Result

4.1.1 Without Power Supply

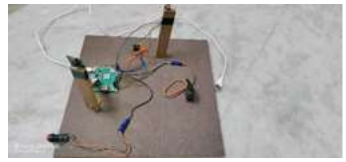

Fig .7 : without power supply

4.1.2 With Power Supply: Door opened

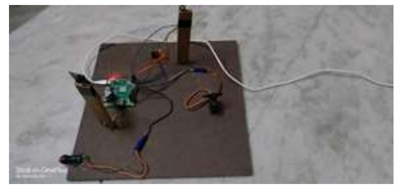

Fig.8 : With power supply with door opened

4.1.3 : Human temperature status :

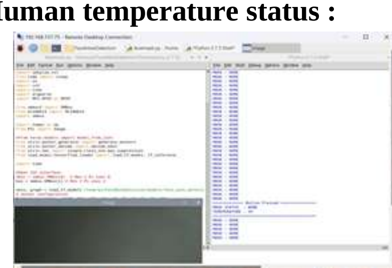

Fig.9 : Human temperature status

4.1.4 Mask Status of the person:

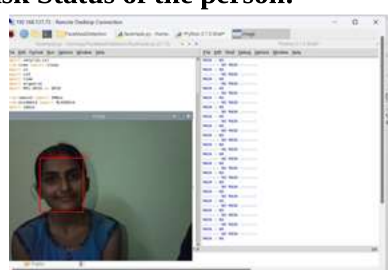

Fig.10 : Person with no mask detected

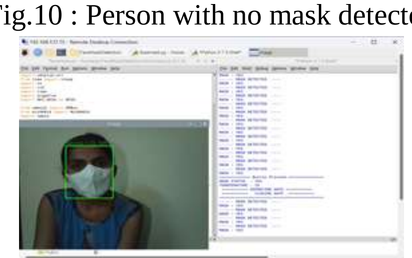

Fig.11 : Person with mask detection and door opening status

The project **"Wireless Temperature Monitoring System For Covid Prevention using IoT''** was designed an indoor measurement system to allow the people using some covid rules as body temperature and face mask detection. Raspberry pi3 based contact less body temperature measurement and face mask detector which detects whether the person is wearing a mask or not using Pi camera. If the person doesn't wear a mask then raspberry pi3 processor generates signal to lock the door and send the mail to the respective person and also active the buzzer. If the person's temperature exceeds average human body the raspberrypi3 lock the door and gives the audible alert through buzzer. Otherwise, the door is opened to let the person in.

V. CONCLUSION

The HealthGuard system successfully demonstrates that Raspberry Pi-based contactless health screening can provide an effective, scalable, and low-cost solution for COVID-19 prevention. By combining real-time temperature monitoring with automated mask detection, the system minimizes human intervention, reduces infection risk, and enhances compliance in public spaces. Experimental results confirm high accuracy and responsiveness, making it suitable for deployment in diverse environments. Future enhancements may include integration with cloud-based analytics, mobile alerts, and additional vital sign monitoring for comprehensive health screening. Overall, HealthGuard provides a practical, intelligent, and proactive approach to maintaining public health safety during pandemics and similar health crises.

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