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Smart Temperature and Mask detection System using Raspberry Pi and Temperature Sensor with Camera and Barrier Enabled

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Abstract

The COVID-19 pandemic, which is caused by a new corona virus, is still spreading. More than sixteen million individuals have been infected across India so far, and the figure is continually rising. The health-care system is in critical condition. Wearing a mask is one of the many preventive steps adopted to decrease the spread of the disease. It's tough to physically check if someone is wearing their facial mask appropriately and to assess their temperature. Early symptom detection and good hygiene standards are therefore critical, particularly in situations where individuals come into random touch.

In this research, we propose a Raspberry Pi-based system for limiting COVID-19 development by detecting and monitoring persons who are not wearing a face mask. Unlike handheld thermometers, which require a person to take a person's body temperature, our system uses the IR Thermal temperature sensor to provide a contactless and efficient temperature check, and an OpenCV subsystem based on a Raspberry Pi single board computer equipped with a camera module to allow or deny a person's entry into buildings and event venues for facial mask detection.

Keywords: OpenCV, Python, Tensor Flow, Raspberry pi, Keras, Deep learning, COVID-19.

1. Introduction

It has been difficult to identify persons who are infected with COVID-19 since the epidemic many patients with COVID-19 displayed no symptoms. Bad outcomes from COVID-19 ICMR antibody kits were common, indicating that a person was not sick. High body temperature is one sign of COVID-19. As a result, the WHO recommends body temperature screening to detect COVID-19. In addition, wearing a face mask in public areas is required, since multiple studies have shown that wearing a face mask minimises the transmission of disease. Many temperature guns are available, but they are not intelligent enough to monitor temperature and facemask at the same time, or to inform the appropriate authorities to take action if the protocol is broken.

Many personnel have been engaged in many areas of the world to assure people wearing facemasks and to monitor body temperature at public places of interest such as stores, movies, shopping centres, schools, colleges, and train stations. This might be one of the most dangerous and dangerous occupations imaginable, requiring employees to wear facemasks and monitor their body temperature. It might potentially result in COVID-19 being transmitted from the general public to the individual in responsible of monitoring the facemask and body temperature.

An automated facemask and body temperature sensor system driven by a Raspberry Pi microcontroller is the solution to this challenge. This configuration includes its own camera module that monitors the facemask and a non-contact temperature sensor that reads the body temperature and either permits the user to pass the COVID-19 protocols or alerts the appropriate authorities.

2. Software And Libraries

2.1 OpenCV

Machine vision and instruction operations library with open access (Open Source Computer Vision Library). OpenCV was created as a popular computer vision structure and for rapid application in machine perception consumer products. OpenCV, as a BSD-certified software, promotes businesses to use and revise the law. More than integrated algorithms are available in the library, including traditional and advanced computer vision and machine literacy algorithms. These algorithms can be used to detect and recognise images, relate objects, classify mortal exertion in photos, track camera motions, track moving objects, root 3D models of objects, construct stereo camera-ground 3D point shadows, and induce film land in high resolution of the entire scene.

OpenCV has over 18 million downloads and over a million members in the stoner community. The library is widely used in enterprises, consulting firms, and government institutions. In addition to enterprises that use OpenCV, such as Google, Yahoo, Microsoft, Intel, IBM, Sony, Honda, and Toyota, various startups, such as Applied Minds, Video Surf, and Zester, are now using it. Gathering road views, detecting intrusions into Israel's camera surveillance, covering China's mining machines, allowing robots to manoeuvre and gather information at Willow Garage, detecting pool drownings in Europe, running in Spain and New York interactive art, covering debris runways in Turkey, and checking pro markers in the field of business are just a few of the applications for OpenCV. It supports Linux, Windows, Mac OS and Android, and has Java, Python, C and MATLAB interfaces. There are further than 500 algorithms and about ten times the number of algorithm functions. OpenCV is native to C and contains an interface template with STL holders which work seamlessly.

2.2 TensorFlow

TensorFlow is a free and open-source dataflow and differentiable programming library that may be used for a variety of purposes. It's a symbolic math library that's also utilised in machine learning programmes like neural networks. TensorFlow is Google Brain's second-generation technology, which is utilised for both research and production. On February 11th, version 1.0.0 was released. TensorFlow may run on several CPUs and GPUs, unlike the reference implementation, which runs on a single device (with optional CUDA and SYCL extensions for general-purpose computing on graphics processing units).

2.3 Keras

Keras is a human-friendly API, not a machine-friendly API. Keras adheres to best practises for lowering cognitive load by providing consistent and straightforward APIs, limiting the amount of user steps necessary for typical use cases, and providing clear and actionable error signals. There's also a lot of documentation and developer instructions. Keras includes a number of implementations of standard neural-network building elements including layers, goals, activation functions, optimizers, and a number of other tools to make dealing with picture and text data easier and to reduce the amount of coding required to write deep neural network code.

2.4 Computer vision

The study of how computers view and comprehend digital pictures and movies is known as computer vision. Computer vision encompasses all functions carried out by biological vision systems, including "seeing" or perceiving a visual stimuli, comprehending what is seen, and extracting complicated data into a form that can be utilised in other processes. Using sensors, computers, and machine learning algorithms, this multidisciplinary area replicates and automates various parts of human visual systems. The idea behind artificial intelligence systems' capacity to observe and interpret their surroundings is known as computer vision.

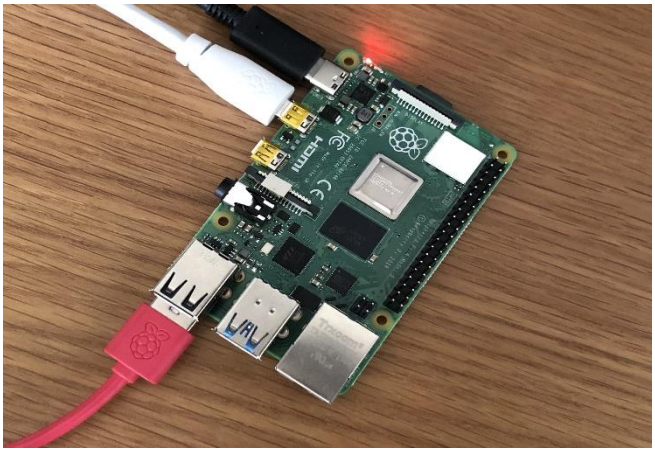
2.5 Python

Python is a high-level, general-purpose programming language with an interpreter. Python's design philosophy prioritises code readability through extensive usage of whitespace. Its language elements and object-oriented approach are aimed at assisting programmers in writing clear, logical code for both small and large-scale projects. We utilised this software to create our facial detection programme, and it includes all of the above-mentioned libraries. Python is a high-level, general-purpose programming language with an interpreter. Python's design philosophy prioritises code readability through extensive usage of whitespace. Its language elements and object-oriented approach are aimed at assisting programmers in writing clear, logical code for both small and large-scale projects. We utilised this software to create our facial detection programme, and it includes all of the above-mentioned libraries.

3. Hardware Components

3.1 Raspberry Pi

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. It's capable of doing everything you'd expect a desktop computer to do, from browsing the internet and playing high-definition video, to making spreadsheets, word-processing, and playing games.



3.2 Camera Module

A 5MP Raspberry Pi Camera Module Rev 1.3 is used for this setup. Any USB webcam can be used with the Raspberry Pi 4. The 5MP camera module is perfect for small Raspberry Pi projects which have very little space allowance. The high-definition 5MP camera delivers outstanding photos but can also shoot video, ideal for drones or a CCTV project.

3.3 MLX90614 Non-Contact Infrared Temperature Sensor

The MLX90614 ESF is an Infra-Red thermometer for non-contact temperature measurements. We are using it here to detect body temperature. It has a range of -20 to 120 °C. It detects the body temperature of the person and sends the reading to the Raspberry Pi.

3.4 LEDs

Here we have used two different LEDs that emit green and red light. If the person has a facemask and his body temperature is lower than the protocol value then the Green LED will turn on, if not the Red LED will turn on.

3.5 Buzzer

If the person has a facemask and the body temperature is below the protocol value then the buzzer will buzz for a single time, if not then it will buzz continuously for 5 times which will be helpful in alerting the respected authorities.

4. EXISTING SYSTEM

The existing system uses CNN (convolutional neural network) in face mask detection models, and they train the machine using clustering, classification, and max pooling. The CNN uses a dataset to train the machine; around 20% of the images in the dataset are utilised to train the machine, while the remaining 80% is used to test the results. The face mask detection model understands the challenges caused by COVID-19 for people all over the world. This technique goes a long way toward preventing the epidemic from spreading and festering farther into our lives. To determine the temperature, a temperature gun, also known as a laser or non-contact thermometer, is an infrared thermometer that monitors an object's temperature from a distance. Temperature guns are used to screen travellers at airports, by businesses to check arriving customers, in driveways, and wherever else.

The issues with the existing methods are as follows:

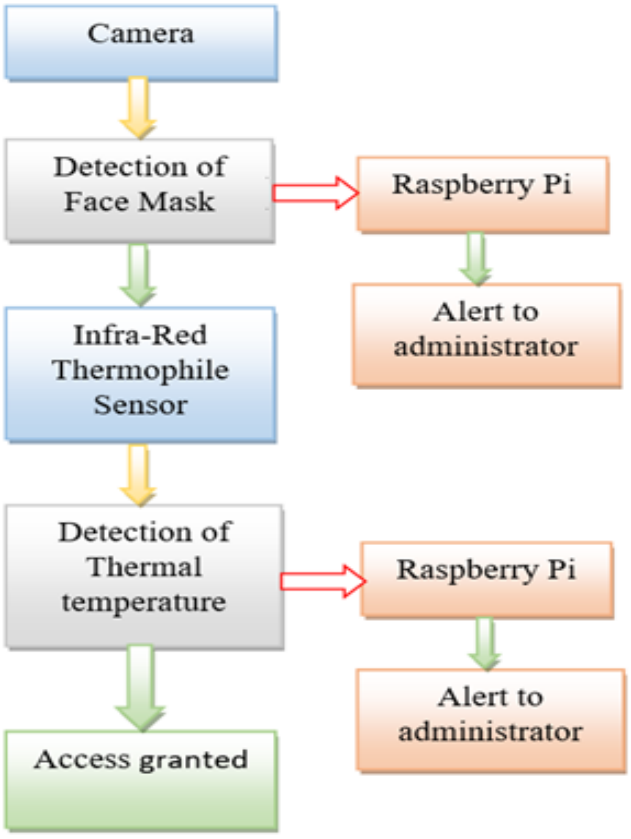
- CNN used in existing system are slow and resource hungry, which makes the training process slow.
- The existing scheme does not detect multiple faces.
- The existing system does not detect faces from all angles.

5. Proposed System

The proposed system will concentrate on improving predictive performance and detection probability. This configuration includes its own camera module that monitors the facemask and a non-contact temperature sensor that reads the body temperature and permits the user to proceed if the COVID-19 protocols are followed.

For facial mask recognition and detection, a hybrid system model combining conventional and deep learning will be constructed. The system uses a face mask detection dataset that includes images with and without masks, as well as OpenCV to recognise faces in real time from a livestream through the Webcam. The face mask detection system will be built utilising the picture dataset. Deep learning will be used to implement the system, which will be done utilising Python, OpenCV, Keras, and Tensorflow. The system's main purpose is to use computer vision and machine/deep learning to determine if the observed subject on video or picture is wearing or not wearing a mask.

To implement mask detection using an OpenCV and a Raspberry Pi camera. When the user turns on the kit, the photographs are captured by the web camera. If the picture does not include a mouth or nose, it signifies the individual is correctly wearing a mask, and the appropriate door will be unlocked. The temperature sensor uses a contactless IR sensor to determine the person's temperature. One by one, the individuals pass. The Raspberry Pi CPU creates a signal to lock the door and sends an audible alarm through the buzzer if the temperature exceeds the average value or if the mask is not detected or correctly matched.



6. Conclusion

The major goal of this project is to automate the covid- 19 methods for assessing temperature and determining whether or not individuals are wearing masks. The spread of the covid-19 virus may be controlled using this technique, and temperature testing accuracy is improved over human methods. Certain management officials do not need to be concerned about employee or student health and safety. This approach can also alleviate the lack of attention of the worker who monitors the circumstances. The mask identification accuracy can be improved in the future and our project has a lot of room for improvement. A number of features can be added to this system in future like for security systems and any other outbreak preventing systems. By reporting the information to the government sectors, they can track prevent the spreading.

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