Automatic COVID-19 face masks and body temperature detection with data logging facility using deep learning technology

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Abstract: The data attend from various sources like World Health Organization, the Wikipedia, Government Health Ministries, and other sources indicates that COVID-19 has sick more than 127 million people worldwide and has killed more than 2 million people. The two basic guidelines that required to be follow in public places to prevent the spread of the corona virus is by wearing face masks and following safe social distancing. To create a safe environment, we created a dynamic Computer Vision based automated system focused on the real-time face monitoring of people to determine both face masks and body temperature in public places by using Raspberry Pi 4 Model B to determine protocol following or not, through an integrated Pi camera module and to monitor body temperature with the help of MLX90614 sensor. For security purpose, system is deployed that will allow that person to enter if they are wearing a face mask and their body temperature is in check as per WHO guidelines. This system will help the society by saving time and also helps to reduce the spread of COVID-19.

Keywords: Deep Learning, Open CV, Keras, Python, Tensor Flow, Computer Vision, Raspberry Pi, COVID-19.

INTRODUCTION

As from the COVID-19 outbreak, it has been a biggest challenge to identify person who are affected by COVID-19, even most of the people don't have symptoms. COVID-19 ICMR antibody kits produced high rate of wrong negatives that incorrectly show a person not infected. One major symptom of COVID-19 is high temperature of body. So, WHO has given guideline for temperature screening of person's body to identify COVID-19. It is also important to wear face mask in public places, as many researches show the benefit of wearing facemask that diminish the spread of COVID-19. There are different temperature guns are available but they are not enough accurate to confirm body temperature and facemask at the same time and alert the respected alarm to take necessary actions if the protocol isn't followed.

In different places of the world many persons have been employed at public places of interest such as market, cinemas, malls, schools, bus stations, colleges, railway stations etc. to confirm person wearing facemask and to know body temperature. This could be one of the bad and riskiest jobs that anyone can land into, asking person to wear facemask and to confirm their body temperature. It could also lead to the speeding of COVID-19 from the normal people to the concerned person who is in charge of screening facemask and body temperature.

The solution to this problem is to post an automated facemask and body temperature knows system powered by Raspberry Pi microcontroller. This setup has its own camera module through which it screen facemask and it has a non-contact temperature sensor to check the body temperature of person and allows the person if they clear the COVID-19 rules or it will generate the signal to respected authorities.

DESIGN OF PROJECT

2.1 Camera Module

A 5MP Raspberry Pi Camera Module Rev 1.3 is **a custom designed add-on for Raspberry Pi**. Any USB webcam can be used with the Raspberry Pi . The 5MP camera module is accurate for small Raspberry Pi projects which have very small space allowance. The high-definition 5MP camera delivers outstanding image but can also shoot video, ideal for a CCTV project. The Raspberry Pi 4 continuously accepts signal from the 5MP Camera module for necessary calculations.
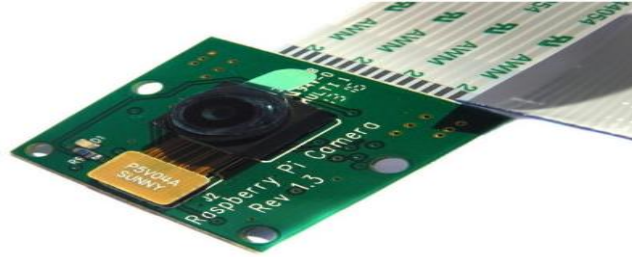
Fig.1

2.2 TFT LCD Display for Raspberry Pi

This TFT LCD Display for Raspberry Pi has 5″ dimension which features 800×480-pixel resolution. It is used to display camera nourish from the Raspberry Pi and to show person's body temperature recorded readings. It is also used to navigate through the Raspberry Pi

2.3 MLX90614 Non-Contact Infrared Temperature Sensor

The MLX90614 ESF is an Infra-Red thermometer for non-contact temperature measurements system. We are using it here to check person's body temperature. It has a range of -20 to 120 °C. It determines the body temperature of the human and feed the reading to the Raspberry Pi.

Fig.2

2.4 Servo Motor

A servo motor is a rotary actuator or a linear actuator that follows for accurate control of angular or linear position, velocity and acceleration. It includes a required motor coupled to a sensor for position feedback. We have used the servo motor for controlling the barrier arm that will allow the person to allow through or not.

2.5 LEDs

Here we have used two LEDs that emit green and red light. If the person wear a facemask and body temperature is lower than the protocol reading then the Green LED will blink, if not the Red LED will blink.

2.6 Buzzer

If the person has wear facemask and the body temperature is lower the protocol value then the buzzer will ring for a one time, if not then it will ring continuously for 5 times which will be beneficial in alerting the respected authorities.

2.7 Raspberry Pi

We have gone with the latest release from the Raspberry Pi Foundation, the Raspberry Pi 4B. It serves highest speed, multimedia performance, storage and connectivity compared to the old generation. It is a credit card sized microcontroller which hosts our software and gain data from the attached peripherals and it performs action based on the set condition given to the Raspberry Pi. It has a quad-core CPU that run at speeds up to 1.5GHz and the new Video Core VI 3D unit and now it runs at up to 500 MHz The on-board memory range from 1 GB to 8 GB RAM.

Fig.3

III. SOFTWARE & LIBRARIES

3.1. MACHINE LEARNING

Machine learning is a application of artificial intelligence (AI) that gives systems the strength to automatically learn and improvement from experience without being programmed. Machine learning focuses on the development of computer programs that can run data and use it to learn.

The process of learning begins with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future based on the examples that we provide. The primary aim is to allow the computers learn automatically without human intervention or assistance and adjust actions accordingly. But, using the classic algorithms of machine learning, text is considered as a sequence of keywords; instead, an approach based on semantic analysis mimics the human ability to understand the meaning of a text.

3.2 DEEP LEARNING

Deep Learning Deep learning is a artificial intelligence environment that starts the workings of the human brains in processing data and designing patterns for use in decisions making. Deep learning is part of machine learning in artificial intelligence that has networks capable of learning unsupervised from data that is non-structured or non labeled, Also known as deep neural network.

3.3 COMPUTER VISION

Computer vision is a field of artificial intelligence (AI) that enables computers and systems to derive meaningful information from digital images, videos and other visual inputs and take actions or make recommendations based on that information. Computer vision is the field of study surrounding how computers see and understand digital photos and videos. Computer vision spans all tasks performed by biological vision systems, including "seeing" or sensing a visual stimulus, understanding what is being seen, and extracting complex information into a form that can be used in other processes. This interdisciplinary field simulates and automates these elements of human vision systems using sensors, computers, and machine learning algorithms. Computer vision is the theory underlying artificial intelligence systems' ability to see and understand their surrounding environment.

3.4 PYTHON

Python is an interpreter, high-level, general-purpose programming language. Python's design philosophy emphasizes code readable with its notable use of significant whitespace. Its language constructs and object-oriented approach to help programmers write clear, logical code for small and big-scale projects and programs. We have used this software to write our facial detection program and all the necessary above said libraries are installed here. It is often described as a "batteries included" language due to its comprehensive standard library.

3.5 TENSORFLOW

Tensor Flow is a open-source software library for data flow and differentiable programming across a range of tasks. It is a math library, and is also used for machine learning applications such as neural networks. It is used for research and production at Google, Tensor Flow is Google Brain's second-generation system. Version 1.0.0 was released on February 11, While the reference implementation runs on single devices, Tensor Flow can run on multiple CPUs and GPUs (with optional CUDA and SYCL extensions for general-purpose computing on graphics processing units). Tensor Flow can be used in a wide variety of programming languages, most notably Python, as well as JavaScript, C++, and Java.[11] This flexibility lends itself to a range of applications in many different sectors.

3.5 OPENCV

OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to gives a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. Being a BSD-licensed product, OpenCV makes it simplefor businesses to use and recreate the code. The library has more than 2500 optimized algorithms, which includes a

comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms. These algorithms can be used to determine and recognize faces, identify objects, classify person actions in videos, track camera movements, track moving objects, extract 3D models of objects, produce 3D point clouds from stereo cameras, stitch photos together to produce a high resolution photos of complete scene, find similar or related images from an photo database, remove red eyes from photos taken using flash, follow eye moves, recognize scenery and establish markers to overlay it with augmented reality, etc. We have used functions available in this library to implement our facial recognition part.

3.6 KERAS

Keras is an API designed for human beings, not for machines. Keras follows best practices for reducing cognitive load: it offers consistent & simple APIs, it reduces the number of user actions neede for common cases, and it provides clearly shows & easily removable error messages. It also has extensive documentation and developer guides. Keras contains numbers of implementations of commonly usable neural-network building blocks such as layers, objectives, activation functions, optimizers, and a host of tools to make working with image and text data easier to simplify the coding necessary for writing deep neural network code.

IV. PROPOSED SYSTEM

4.1 FACEMASK DETECTION

This system will useful determine people on photo/ video stream wearing a facemask with the help of Deep Learning and Computer Vision algorithms by using different libraries of python such as OpenCV, Keras, TensorFlow etc. The photos are downloaded from various open source websites and are differentiated as "mask" and "no mask". The images that we downloaded were of different sizes and different resolutions.
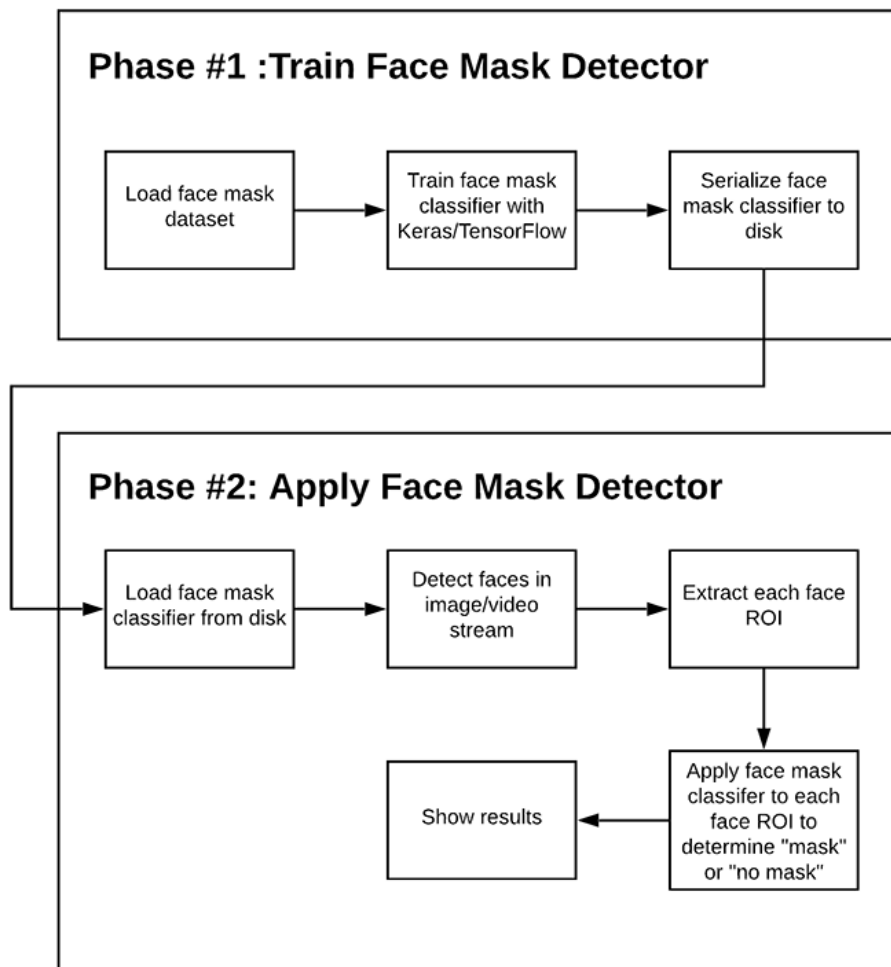

Fig.4

4.2 CONTACTLESS TEMPERATURE DETECTION

The MLX90614 sensor is a non-contact infrared temperature sensor which determines temperature changing from -20 to 120 °C. It can communicate or contact with the microcontroller through I2C interface. Being an I2C device you need to connect to the SDA, SCL and select a suitable or desired GND and Vin, either 3.3V or 5V.

4.3 SYSTEM FLOW

Facemask detection and Temperature detection

To identification of the faces done in the OpenCV framework was used. The model shows output using web images. This facemask wear or not data detected by the Raspberry Pi camera module is sent to the Raspberry Pi 4 for processing.

The temperature will be checked with the help of MLX90614 sensor. Now the temperature related data will be processed on the Raspberry Pi and, if the concerned person has worn the mask and the body temperature is below the threshold then the green light will blink along with the buzzer rings for a single time and the door will be open On the other hand, if the concerned person has not wear facemask or the temperature is more than range then, the red light will be blink. Now the buzzer will ring for 5 times to alert the respected authorities.
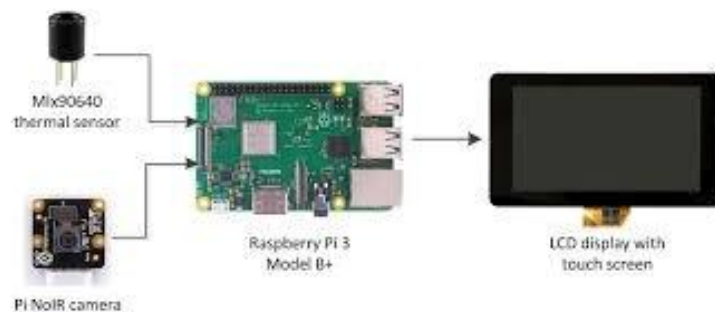

Fig.5

V. CONCLUSION

In this project we have successfully implemented a working project of Automatic COVID-19 face mask and body temperature detection with data logging facility using deep learning technology. This project more useable in public places with large people comes such as colleges, schools, railway stations, offices, shopping malls etc. The system first determines whether the person is wear a facemask and sends the data to the microcontroller for processing. The non-contact temperature sensor read and collects the person's body temperature and upon checking it opens the barrier arm and allows the person to go inside. With the help of this project an automatic allow or denied person according protocol of COVID-19 hence there's no need for any human to monitor COVID-19 protocols. The accuracy of facemask detection can be achieved camera module with a larger image processing dataset. In conclusion, Face Mask and body temperature detection can help us to reduce the large gathering of people in one place without masks, lowers the risk of getting infected from COVID-19.

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