Face Mask Detection for Covid-19

Prof S.S. More

Assistant Professor, Dept of E&TC Engineering, SIT Lonavala, Pune, India

E mail: - smore.sit@sinhgad.edu

Ekansh Bharadwaj, Krishna Nidvanche

UG Students, Dept of Electronics and Telecommunication, SIT Lonavala, Pune, India

E mail :- ebharadwaj29@gmail.com

krishnanidvanche.sitentc@gmail.com

Abstract

Our lives have been drastically changed over the last few years because of a global pandemic situation that closed the whole world for literally over a year and half. This pandemic definitely showed us one of the most important aspects of life - Health. Since the pandemic hit, millions have started to become aware of health as an overall necessity. In this paper, we have highlighted the manual security and biometric security finding a new non-contact solution to security to ensure safety of people indoors in closed spaces. The idea is a face mask detection safety door to ensure everyone who enters the indoor space must be in with basic protection against the virus. We have used the Haar Cascade Classifiers, a machine learning object detection program that is used for facial recognition. The NodeMCU is used to power the program which works with the camera module.

Introduction

The Covid-19 pandemic has led to a dramatic loss of human life worldwide and had given us an obstacle related to public health, world hunger and the world of work. The social, emotional and economical unsettlement and destruction caused by the pandemic was pure disastrous. The Covid 19 virus is a respiratory flu like disease that took over 6 million lives causing a global pandemic. It was first discovered in Wuhan, China and was very quick to spread all around the world. Within a few months of its discovery the global aspects of life were already disrupted and countries had to go into a total lockdown arrangement to lower the transmission rate of Covid 19, since the majority of the transmission was due to person-to-person contact.

The common symptoms included fever, loss of taste and smell, nausea, tiredness and cough which was one of the major sources of transmission as well. To protect the globe from the mass destruction happening, wearing of masks everywhere especially in public settings became a compulsion. Wearing masks and regularly sanitizing were our key tools to battle the Covid 19 back then since no medications and vaccinations were available back then. Times have changed now; the world is recovering from the rupturing pandemic and the loss of human life. Vaccinations have played an important role in fighting the disease. The concern that arises is that can there be any other virus that could possibly be more or as equally destructive as the Covid 19. Just like how Covid 19 came out of the blue can some other disease rise as well?

In this paper we have come out with a solution which works as a security system that detects face mask on a person. As humans we always believe in prevention is better than cure, and after seeing all that has happened in the last few years we surely need to work on a healthy and safe lifestyle to prevent the world from another global pandemic. The face mask detection works on the Node MCU and has a machine learning model and classifier that works and trains for facial mask detection.

Literature Review

Covid 19 was declared to be the sixth health emergency of an international scale and was declared as a global pandemic by the World Health Organization (WHO) on the 30th of January 2020. This pandemic also had a difficulty apart from the fact of the transmission, some people who caught the Covid 19 virus were asymptomatic which means they could be carrying the virus without knowing. To fight against its mass testing was performed and ad to be reinforced. OpenCV, an Intel computer vision library helps in multiple domains like face detection and face recognition. This is achieved by simplifying the computer vision. The accuracy to about 90% - 95% is normally achieved in facial detection. Face recognition is when you compare a face to the database. This process includes the involvement of the Haar features where the facial features are compared and computed by taking the difference of the added pixel intensities in adjacent rectangular window at a particular location in a window. This process can be fastened by using Integral Images.

With the completion of the facial mask recognition the table is updated with data of the analysis performed. This would be very curial and helpful to places such as workspaces and universities where the time of manual attendance can be completely written off. Apart from various and helpful uses this can be used for security as well in many different ways. The Wi-Fi module can be used to send details of the reports generated by the analysis. The ESP8266 has been dominating the globe for quite some time in IoT projects. This global module can be programmed using the Node MCU

Proposed Idea

The setup is to give entry to people in indoor spaces and compact crowded spaces with masks only. Covid 19 surely has been suppressed with all the vaccinations and testing conducted on a mass level. But as humans we always believe in prevention is better than cure. This idea is based on prevention hoping that if Covid 19 or some other virus has to rise we will already be having a good infrastructure and mindset to battle it. The face mask detection will allow humans to enter the indoor places like malls, schools, hospitals, workspaces etc. only with masks on. The door will open only for the people who have their masks on. The people who won't have a mask will be requested to wear a mask before entering the designated perimeter. The person can continue to go in the spaces only if mask is on which means a person without mask won't be able to walk in. We eventually would have people wearing masks because the masks will basically work as an ID or a pass to enter restricted areas.

System Requitements

I) Hardware Components

A. Node MCU ESP8266:

NodeMCU is an open-source Lua based firmware and development board specially targeted for IoT based Applications. It includes firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module.

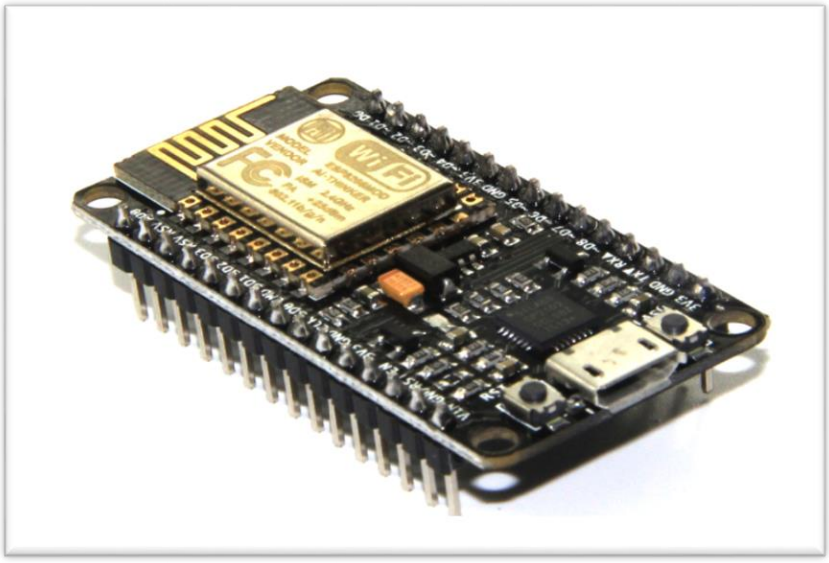

Fig 1. Node MCU

B. Ultrasonic Sensor HC-SR04 (generic):

Ultrasonic Sensor HC-SR04 is a sensor that can measure distance. It emits an ultrasound at 40 000 Hz (40kHz) which travels through the air and if there is an object or obstacle on its path It will bounce back to the module. Considering the travel time and the speed of the sound you can calculate the distance.

Fig 2. Ultrasonic Senor

C. SG90 Servomotor:

Servomotor are high torque motors which are commonly used in robotics and several other applications due to the fact that it is easy to control their rotation. Servo motors have geared output shaft which makes it easy even to rotate them 1 degree at a time.

Fig 3. Servomotor

D. Web Camera:

A web camera is a video camera that feeds on live stream of an image or video in real time or through a computer network, such as the internet. They are usually small cameras that sit on the computer desk or attach to monitor or are built into the hardware.

Fig 4. Inbuilt Web Camera

II) Software Components

A. Arduino IDE:

Arduino IDE is an open-source software, designed by Arduino.cc and mainly used for writing, compiling and uploading code to almost all Arduino modules. The main code also known as sketch created in the IDE will ultimately generate Hex file which is transferred and uploaded to the controller.

Fig 5. Arduino

B. OpenCV:

OpenCV is a Python opensource library which is used for computer vision in artificial intelligence, machine learning and facial recognition. CV in the name abbreviates to Computer Vision, which is the study that helps computers understand digital images.

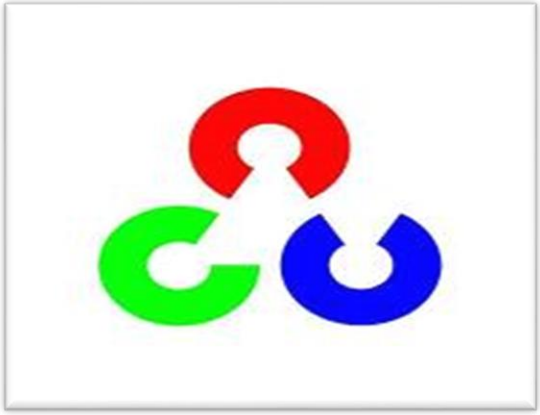

Fig 6. OpenCV

C. Tenser flow:

Tenser flow is a free and open-source software library for machine learning and artificial intelligence. It can be used across range of tasks but particularly works on deep learning and training of neural networks.

Fig 7. TensorFlow

System Design

The ultrasonic sensorHC-SR04 senses the person in front of camera. The VCC pin of the ultrasonic sensor is connected to the VCC pin of the Node MCU. The ground is connected to the ground of the Node MCU. Now the trig pin of ultrasonic sensor is connected to EN pin of Node MCU. With the help of two series resister echo pin of the ultrasonic sensor is connected to GND of node MCU. Here we use the web camera for the face mask detection using OpenCV. The web camera is already inbuilt to the laptop/pc or you can use separate web camera that can enhance the location and resolution. Now the servo motor is implied as a door to operate as a door and will respond to the program running in back end. The servo motor will rotate to show the opening of the door when mask is detected. The servo motor is connected to 3.3V, VCC, GND respectively to the Node MCU pins. There is a webserver running in Node MCU that is connected to python program via serial. Once you have the firmware on the device that is ESP8266 you can access the REPL over UARTO which is connected to USB serial convertor depending upon board. The python libraries need to be installed here such that pyttsx, serial, OpenCV python. If the person is in front of ultrasonic sensor, then it will type H in serial and then python will read it and start the procedure of the mask detection. If it finds that the person is not wearing a mask then it will post an HTTP request to servo motor and vice versa.

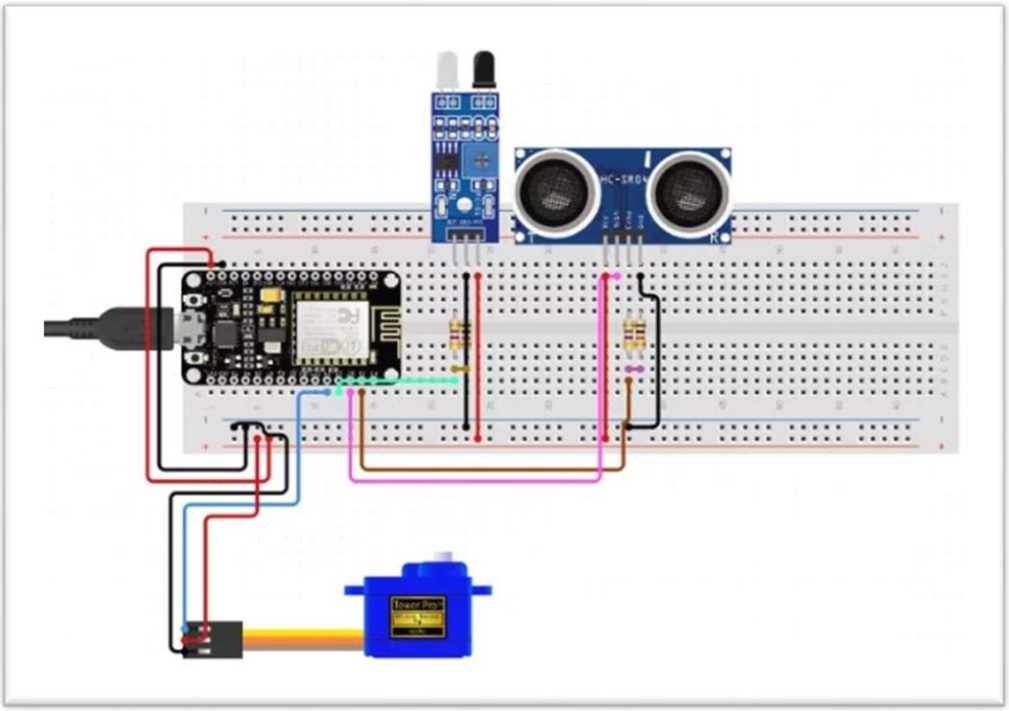

Fig 8. 3D Diagram

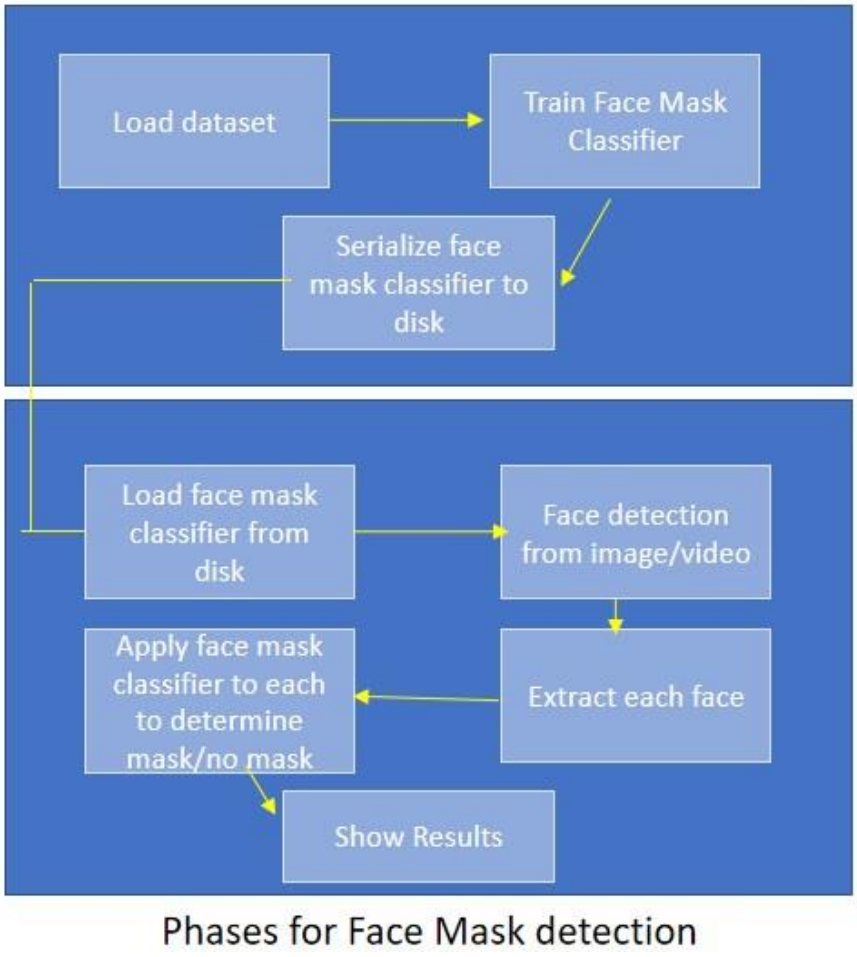

Fig 9. Phases of Mask Detection

Results and Discussion

The person walks in and the ultrasonic sensor HC-SR04 detects the person and the camera starts in search for a face for it to recognize. The camera puts up a display screen for the person to view if they are in the camera detection range. The machine learning program in the back end runs to check if the person is wearing the mask or not. The face is detected by the Haas Classifiers used in OpenCV (Python). If the person is wearing the mask the servomotor in the project implied as a door rotates to open the pathway for the person to walk in. If the person is not wearing a mask the servomotor remains idle implying the doors are not open.

The trained program in the backend using CNN classifiers and a dataset which has two categories namely Mask on and Mask off train itself to provide optimal accuracy of 95%. Increase of the dataset can increase the accuracy of identifying masks and other things covering up the face.

The project can be definitely be enhanced by using better sensors and adding more to the existing project. The enhancement and further ideas have been stated below in the conclusion and the future scope if the project.

Conclusion and Future Scope

The current model checks for the face mask on a person and allows entry through the door for only the person who is wearing a mask and denies the entry for one who isn't. The model will check for masks as Covid 19 safety guidelines are clear about wearing masks. This will make certain, people wearing masks avoiding a global pandemic to re rise. In the future, this model can be transformed into a security system as a whole with thermal sensors, temperature sensors, metal detectors, scanning systems and many more. The future has endless possibilities towards this project and can be used everywhere around the globes where transmission risks are high or need to be controlled.

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