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Real-time temperature detection and Mask entry system

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Abstract: Corona virus disease (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus that causes illness in the Respiratory system in humans. Covid-19 affected our day-to- day life and still, it is continuing to mutate. Though we have discovered vaccines for the treatments, we can't stop them from spreading. To prevent us from Covid-19, we have to wear a mask and maintain Social distance in public places. Here, we are making an Embedded system device that automatically detects the temperature of a person and checks whether the person wears a mask or not in public places such as Hospitals, Shopping Malls, Stations, etc. The Government of India has made wearing face masks compulsory but the people don't wear masks in public places. To create awareness among the public, these types of devices would help. Many Face detection models have been developed using different approaches and algorithms. The proposed approach in this paper was developed to avoid mask-less people from entering a desired places by detecting face masks using Deep Learning, Keras library, Tensor Flow and Computer Vision. MLX90614 ESF Non-Contact Human Body Infrared Temperature Measurement Module is used to detect the temperature of a person without contact. Adriano is used as a Microprocessor. If either a person doesn't wear a mask or the temperature of that person is above normal, then it detects it and starts making a sound (alarm) using Buzzer. If a person wears a mask and the temperature of that person is normal, then it detects it and allows that person to Enter.
Keywords: Face Mask Detection, Contactless temperature Detection, Arduino, Computer Vision, Deep Learning, Tensor Flow, Keras.

1. Introduction

According to a recent report, India is headed towards the fourth wave of corona virus, which could cause irreparable damage to its population and economy. There are so many schools and colleges in India that are reporting new covid-19 cases every day. The truth is that we do not know. We do not know why after over 500 million confirmed cases, 6 million deaths, nearly 11.56 billion vaccine doses given worldwide, including in India, the waves of destruction and deaths keep coming and threatening to drown humanity in its worst nightmare[1][2]. We do not know why vaccinated people are getting infected or re- infected. To overcome such situations, the only solution is to create awareness among the people. The Government of India is also planning to bring back the restrictions which they had imposed during the first, second, and third waves. For such things, if we create an embedded system that helps sense the temperature of a person and automatically detects whether he has a mask or not, then it will helpful for the Government. Face Mask Detection algorithm involves the detection of location of the face and then determining whether it has a mask or not. Face identification categorically deals with distinguishing a specific group of entities i.e., Face. It has numerous applications, such as autonomous driving, Education, surveillance cameras, and so on. This paper presents a simplified approach to serve the above purpose using the basic Deep Learning packages such as Keras, Tensor Flow Open CV[3].The section II deals with the Face Detection overview. The section III deals with components being used here. The section IV describes the proposed approach of this paper.

2. Face Detection Overview

Face Detection is basically an image segmentation process where an image is segmented into two parts: one representing the faces and the other representing the non-face regions. Face Detection takes images as input and it locates face areas within these images. This is done by separating face regions from non-face regions. Facial Feature Extractions includes important features such as eyes, eye-brows, nose and mouth. From these features, we can easily differentiate the face regions from the non-face regions. In General, an image or video is passed as input for pre-processing. Image may be of any format (jpg or png), size and resolution. In pre-processing stage, noise is removed from the given image or video. The Classifier decides whether the region of image belongs to face or not from the previous learning from dataset. Finally, the output differentiates between face and non-face regions.

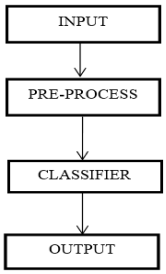

FIGURE 1. General face detection system

There are various face detection models each having its own advantages and disadvantages. Some of them are discussed here. a. Face Detection based on skin colour: Detection of skin colour in coloured images is very useful and popular technique in face detection model. Compared to facial features processing, skin colour processing is very much faster and can get up to 80% accuracy. The main disadvantage of this model is that sometimes it detects the sand, mud (which has same colour as humans) as a human face [3]. b. Viola Jones Detection System: It is an Object detection framework which provides robust and competitive object detection rates in real-time. It is proposed by Paul Viola and Michael Jones in 2001. It is capable of processing images very rapidly with higher accuracy. The main advantage of this model is that it takes longer time to train [3].
c. DNN face Detector: It is a caffe model which is based on the single-shot multi- box detector (SSD). It uses ResNet-10 architecture as its backbone. In this approach, we uses caffe model for the face and mask detection.

3. Proposed Approach

A. Software requirements: Artificial Intelligence (AI) is defined as the ability of a computer or a robot controlled by a computer to do tasks that are usually done by humans because they require human intelligence and efforts. It is a broad field of Computer Science where the intelligence is demonstrated by machines. Self-driving cars, Digital assistants, vehicle recognition identifications, robots are the real-life application of AI. Machine Learning is a subset of Artificial Intelligence. It is a type of AI that allows software applications to become more accurate at predicting outcomes without being explicitly programmed to do so. Deep Learning is a subset of machine learning in which the computer tries to imitate the human behaviour. Deep Learning is highly inspired from human neurons. Some of the deep learning modules which we are going to use here are TensorFlow, Keras and computer vision (OpenCV) [4].

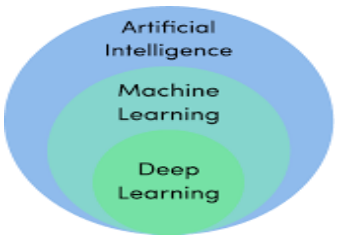

FIGURE 2. Ai, Ml, Dl Representation

a) TensorFlow: Tensorflow is an open source platform developed by Google in 2017. It has become more popular in a very short period of time because of its simplicity and flexibility. Some of the major applications of Tensor Flow are Speech Recognition Systems, image/video recognition and automatic tagging or commenting, Sentiment analysis, etc

b) Keras: Keras is also an open source software library that provides a Python interface for artificial neural network (ANN). It is a high-level API of TensorFlow. It is approachable and highly productive software for solving machine learning problems. Keras application module is used to provide pre-trained models for deep learning. OpenCV: OpenCV is an open source library of programming functions mainly aimed at real-time computer vision problems. It was originally developed by Intel and supported by Willow Garage and Itseez. It supports multiple languages such as Python, C++, Java.

c) Caffe based face detector and MobileNetV2 file:

B. Hardware requirements

FIGURE 3. Arduino Uno R3 Model

a) Arduino UNO R3: Arduino UNO R3 is a low- cost microcontroller board based on Atmega328P. It was introduced in the year 2005. It is open source programmable tool to create interactive works. It can drive motors, sensors, LEDs and other components. It is a small computing system used for low power and low memory purposes. A microcontroller consists of a microchip on a circuit board with read-write capabilities, memory, inputs, and outputs. Generally, Arduino pack is made up of hardware called the Arduino development board and a code developing software known as the Arduino integrated development environment (IDE). The hardware is built up with a 32-bit Atmel ARM or an 8-bit Atmel AVR microcontroller's that are manufactured by Atmel. These microcontrollers can easily be programmed using C or C++ programming languages in the IDE. The Arduino microcontroller enables designers to execute electronics incorporated works that were traditionally performed by specialized electrical and biomedical engineers. The Arduino UNO R3 is shown in Fig.3.1

FIGURE 3. Ov7670 Camera

b) OV7670 camera module: Cameras have always dominated the industry as it has lots of applications such as visitor monitoring system, surveillance system, attendance system etc. Here we are using this camera for recording the real-time

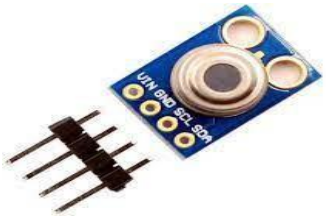

FIGURE 4. Temperature Sensor

c) Temperature Sensor: The temperature sensor (MLX90614) acts as an infrared non-contact temperature reader. It reads the temperature of a person without even contacting them. It have a digital System Management Bus output, with PWN which has been factory calibrated and prepared. A 10-bit PWN is programmed to continuously broadcast the recorded temperature of approximately -19 to 130°C with an outcome resolved up to 0.15°C [4].
d) IR Sensor: Infrared sensors are generally used to count and monitor the number of people who enter and leave the room [4]. It is based on the principle that everybody releases IR rays from their bodies. IR sensor sense the Infrared rays released from our bodies. Its operating voltage is 5VDC, and the I/O pins are 5V and 3.3V compatible.
e) Buzzer: This is used to make sound either when someone enters the room without mask or he hashigher temperature than normal. The LED will also blink in this situation.

FIGURE 5. Buzzer and Led Light

4. Methodology

The system is designed to do two works at the same time. First, it senses the temperature of a person entering the room and if it is higher, it makes sound through Buzzer and an indication of red light through LED occurs. Secondly, if a person doesn't wear a mask then also it makes sound. If any one of these cases occurs, it makes sound and red light blinks. If none of these happens (i.e. the temperature of a person is in normal range and he/she wears a mask properly), then it doesn't make sound and red light doesn't blink.

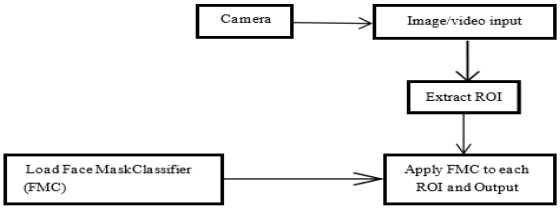

FIGURE 6. Block Diagram for Face Mask Detection

The dataset contains two folders named as 'with_mask' which contains 3,725 images of people with face mask and 'without_mask' that contains 3,828 images of people without face mask. This dataset for training and testing the images are obtained From the internet.

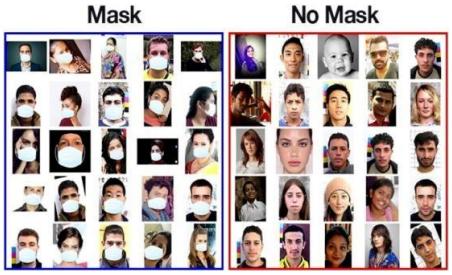

FIGURE 7. Dataset sample

For temperature detection, the camera, temperature sensor (MLX90614), IR sensor is connected to Arduino. All the specifications of these sensors were discussed above. The block diagram of temperature detection system is shown in Fig.4.2

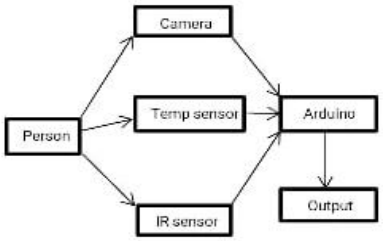

FIGURE 8. Block Diagram of Temperature Detection

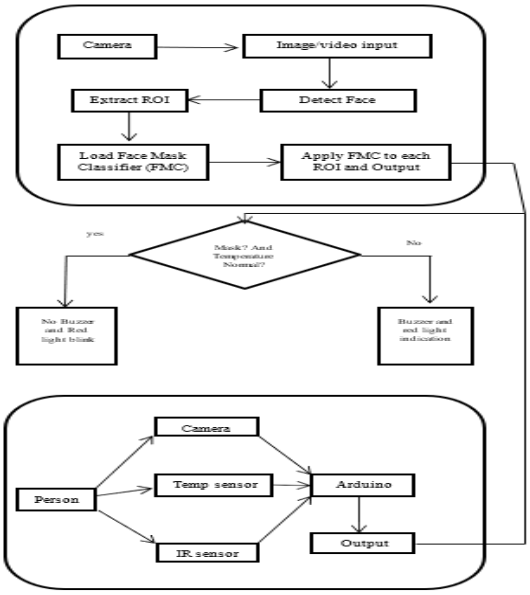

FIGURE 9. The Combination of Face Mask Detection System And temperature detection system

5. Conclusion

In this paper, Deep Learning libraries has been used to detect face and determine whether the person wear a mask or not. The real time face- detection system has a high accuracy in detecting mask, this help to control the spreading of COVID- 19 in public places by preventing the people to enter it without wearing a face mask. Also it senses the temperature of a person accurately.

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