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Contactless Temperature Monitoring and Face Mask Detection with Alert System

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Abstract - *In December 2019, a virus called COVID-19 has plagued the world beginning from Wuhan, China. According to the World Health Organization a total of more than 120+ counties has been affected by it. so in order to create a precaution against COVID-19 our goal is to design a live system consisting of contactless monitoring of temperature and face mask detection system with the help of programming languages like Python and C++ and python libraries like opencv, keras, tensorflow, etc with the help of Machine Learning*

Key Words: **Covid-19, Deep learning, Machine Learning, OpenCV, TensorFlow, Keras, MobilnetV2, Arduino Uno, MLX90614 module, Convolution Neural Network**

1. INTRODUCTION

In December 2019, a virus called COVID-19 has plagued the world beginning from Wuhan, China. According to the World Health Organization a total of more than 120+ counties has been affected by it. There have been more than 500 Million infected by the virus and more than 6 Million deaths caused by it. India itself has more than 20 Million patients and 300K deaths. Some people even after being vaccinated get infected by it and in early stages of pandemic there was a short supply of vaccines which resulted in skyrocketing of infected patients.

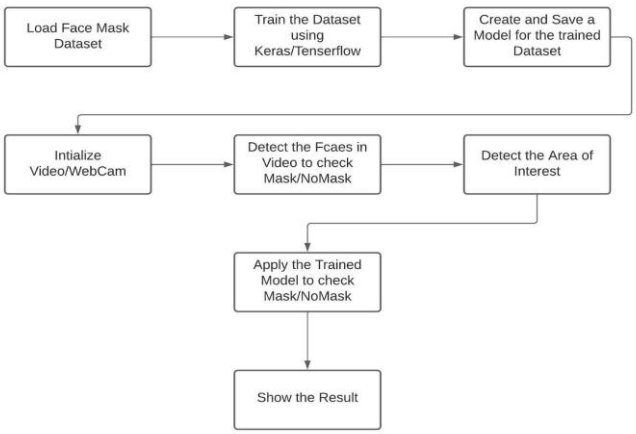
Since the virus is transmitted through the medium of air, wearing a face mask is one of the most effective ways to prevent getting infected by the virus since social distancing is not possible because of economic instability and other reasons. Thus, for this reason a face mask monitoring system was introduced. The face mask recognition system can be used in various public transportation service centers, Restaurants, Education Centers, etc. This system helps us whether a given person is wearing a mask or not. The face mask monitoring system to work properly requires to capture a human face, capture facial motions.

According to the survey conducted by various parties it is detected that more than 60% of infected people have pyrexia. This is also a method which helps the authority to check whether the given person is infected or not. But use conventional temperature people as it requires to check the person's body temperature by touching as it may cause a surge in infected people it cannot be used. So several alternate ways can be one of those are use of the MLX90614 IR sensor to measure a person's temperature without any contact with that corresponding person which is what we have used in our study. Long distance measurement of a person's body temperature may be used to reduce cross-contamination risk and minimize the risk of spreading Coronavirus disease. Studies conducted have shown that 97.7°F – 99.5°F can be considered as normal body temperature.

When people all over the world just rejoiced that pandemic has come to an end al, of a sudden there has been a surge of covid patients after nearly one year of near end cases. So in order to face such situations in future we have decided to create a system that helps us to detect body temperature and whether a person is wearing a mask or not.

2. PROPOSED MODEL

2.1 Face Mask Detection



The face mask detection module has a total of 6 steps they are

Step1: Dataset creation.
Step2: Data Processing
Step3: Splitting and training the data
Step4: Model creation
Step5: Model testing
Step6: Implementation

2.1.1 Step 1

The first step of every machine learning algorithm is to collect necessary data for pre-training the model. The face mask detection models start with collecting the data to create a model that will differentiate between people with masks and people without a mask. For this, we are required to train the data on people with masks and those without a mask.

For building this model we have used a dataset containing 1915 images with masks and 1918 images without a mask. For better processing of data, we only use the part that is necessary for model building. After all, this is done, we label the data into two respective groups: Mask and Without_Mask.

2.1.2 Step 2

The preprocessing is done so as to improve the quality of the dataset and remove unwanted information which is not necessary during the implementation. In face mask detection model the pre-processing mainly consists of four steps

1. Changing the size of all images into one fixed size.
2. Storing the images into an array.
3. Pre-processing input using MobileNetV2.
4. Converting the array into a numerical array for further processes.

In order to increase the effectiveness of the model, it is necessary to resize all the images into a fixed size. So, we will be resizing the imaging by changing its dimensions to 244*244 pixels as it is the optimum size. Then, we will process all the images in the dataset into an array. The image is converted into the array for calling them in the loop function. After that, the image will be used to pre-process input using MobileNetV2. And the final step in this phase is performing numeric encoding on labels. It is necessary to label as Machine learning models require all input and output variables to be numeric. This means that if your data contains categorical data, you must encode it to numbers before you can fit and evaluate a model.

2.1.3 Step 3

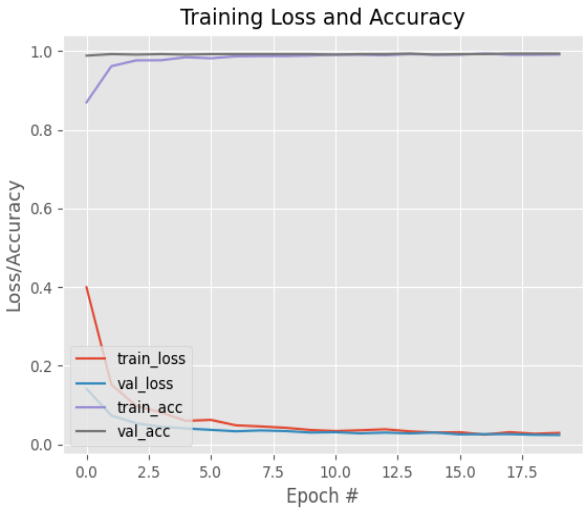
Training the data is one of the important and compulsory steps for any machine learning algorithm. In our study we have divided our data into two parts which are training and testing data. Training data consists of 75% of the total data while testing consists of the rest 25% of the data. Each part contains both Mask And Without_Mask data.

2.1.4 Step 4

This is the most important step as we are gonna create a model for our study and this model is what we are gonna use for the implementation of our project. There are six steps in building the model which are constructing the training image generator for augmentation, the base model with MobileNetV2, adding model parameters, compiling the model, training the model, and the last is saving the model for the future prediction process.

2.1.5 Step 5

After creating a model it is necessary to test a model so that we can evaluate its performance to verify that the model is working properly or there is any need to make any changes to improve the model. Model training is necessary to evaluate whether the prediction made by the model is highly accurate or not and less training loss.For this we make predictions on the testing set. We have trained the model for a total of 20 epochs, checking the loss and accuracy of the model. After the model is tested we have the result of checking the model for 20 epochs in loss and accuracy in the form of graphical representation. It is shown in the following chart.

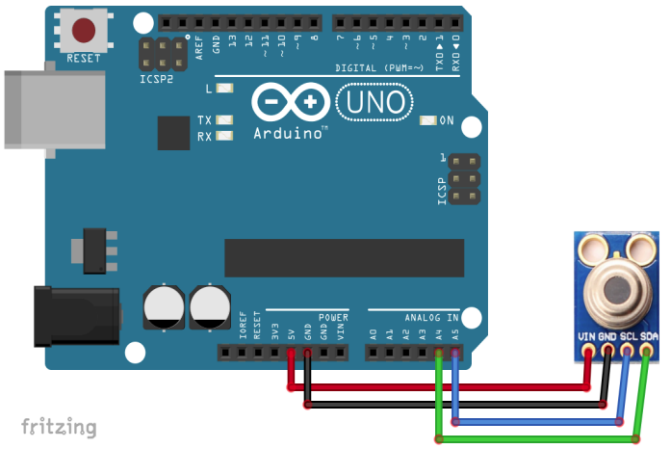


2.1.6 Step 6

The model is implemented in the form of video. When the video starts, it reads from frame to frame, to detect the face area it starts to implement the face detection algorithm. If a face is detected, the model will proceed to further processes. From the detected frames that contain the faces, reprocessing will be carried out including resizing the image size to 244*244, converting to the array, and pre-processing input using Convolutional Neural Network. The CNN architecture we used in this model is MobileNetV2.

2.2 Temperature Detection

2.2.1 Arduino Connections



In this step we are going to establish a connection between Arduino, MLX90614 and our device. Firstly, we have to use a breadboard to connect our IR sensor (MLX90614) with arduino, for that we are going to use four wires to connect the 4 ports of our IR sensor to the arduino. The connections consist of

1. VIN to 5V

2. GND to GND

3. SCL to A5

4. SDA to A4

The above connections are from sensor to arduino. After the above connections all we have to do is to connect our device to Arduino using USB (Universal Serial Bus) 2.0 Male to Male cable. We can check whether the connection is established by blinking of pin 13 led, which indicates an established connection.

2.2.2 Python Connectivity

In this step all we have to do is to connect our arduino program to our python program and run it using the python language. For that all we do is establish a connection using the code.

ser= serial.Serial('COM3',9600)

In this we have used the serial command from the serial to create a serial port connection with the device COM3. Hee, the device COM3 is an Arduino.

2.2.3 Implementations

In implementation we will detect the body temperature of a person using MLX90614 and send it to the arduino as output values. After a link between the arduino program and the python program is established, we will take the output data of the arduino as input in python and convert it into string values for further operations. We will take up to 20 readings from Arduino and establish conditions for whether the temperature of a given person is safe or not.

```
The temperature readings are :
30.25
30.29
30.19
30.25
31.21
32.81
33.77
37.21
38.89
37.27
35.43
37.17
37.41
35.15
34.85
34.07
34.25
34.63
35.09
34.99
The Average Temperature is: 34.26
This Person is "Safe to go"
```

2.3 ALERT SYSTEM

2.3.1 Sound Alert

Sound alert is a system in which a user can upload his sound or popular sound from online to provide an alert system based on sound. In this study, when a person not wearing a mask is detected in the camera the system sends a sound notification to the main computer alerting the person monitoring the camera that a person is detected not wearing a mask.

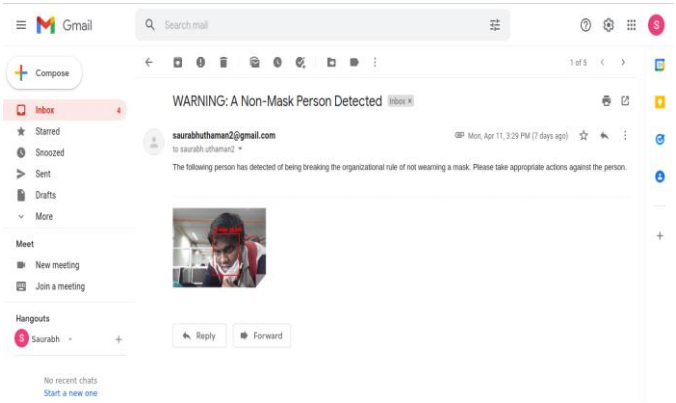
2.3.2 Message Alert

In this study, when a person not wearing a mask is detected in the camera the system pauses the camera containing the non-masked person for 10 seconds and sends the pop-up warning message to the main system alerting the person monitoring the camera that a person is detected not wearing a mask. The message alert system was made to work together with the sound alert system.

2.3.3 Mail Alert

The above alert systems were made on the assumption that someone was monitoring the screen continuously.

But, in case sometimes when there is no one monitoring the screen then the current system comes to use. In this study, when a person not wearing a mask is detected in the camera the system takes the screenshot of the camera that detected the non-mask person, then this screenshot is attached to a mail informing the admin of the non-mask person.



3. CONCLUSIONS

In this study, we have presented a model that uses Convolutional Neural Network(MobileNetV2) for face mask detection and Arduino and MLX90614 for temperature detection. The Face Mask Detection architecture consists of MobilenetV2 as its backbone. We have used tensorflow, keras OpenCV and CNN to detect whether a person is with or without a mask. The model was tested using images and real time videos. By the development of face mask detection we can detect if the person is wearing a face mask and temperature detection model helps us identify whether the temperature of a given person is optimum or not. Our study would be of great help to our current pandemic ridden society ensuring safety to our fellow citizens.

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