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An Enhanced Surveillance Bot for Identification of Mask Defaulters

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Abstract - *The Coronavirus pandemic has changed people's lives around the world in a dramatic way. Wearing a mask is the most important method of protecting the person's health and can also curb the spread of the coronavirus. With the advancements of technology in the present world, we can use deep learning techniques to make a mask detection bot to ensure that people wear masks while entering any campuses or an organization campus to ensure safety among the people. We proposed the mask detection bot that uses clean dataset of people wearing mask and without masks and use various techniques with computer vision by using Python, Tensor Flow, Keras, OpenCV and MobileNetV2 to learn from the dataset and detect masks. With this, the proposed project should be able to classify through a video stream to see if a person wearing a mask or not and should give an alert if the person doesn't have his mask on.*

Key Words*: *Deep Learning, Tensor Flow, MobileNetV2, OpenCV, Raspberry Pi, Arduino, Detection, Surveillance.

1.INTRODUCTION

The coronavirus disease outbreak was believed to have been originated from the bats in the city of Wuhan, China in 2019. This has caused the spread of the virus from one country to another leading to infecting millions of people around the world and claiming lives leading to a pandemic. The Coronavirus (COVID-19) is a respiratory disease caused by the Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2). The symptoms can appear between a period of 2 t0 14 days after a person has been exposed to the virus. The person can experience various symptoms such as fever, fatigue, body aches, sore throat, shortness of breath, chills and pain or pressure on the chest. Coronavirus can have a critical impact on the people who are of old age.

According to the World Health Organization, wearing a face mask can help curb the spread of the virus. This can help people avoid being infected when they come in contact with people in various public areas or while working in an organization. The main purpose of the mask is to protect the mouth and nose which are the most vulnerable places for the coronavirus to start its infection process. Face mask can play a vital role of protection during such difficult times of the pandemic. [1]

In order to ensure that people take their safety very seriously, we have proposed a project called "Mask Detection Bot" to ensure that people wear their masks.

1.1 Machine Learning

Machine Learning is the study of computer algorithms that improves automatically through experience. It provides the ability to automatically learn and improve from experience without being explicitly programmed. The machine learning models are designed in such a way that it doesn't rely on the instructions, it relies on the patterns in the dataset.

1.2 Deep Learning

Deep Learning is a subset of machine learning, where artificial neural networks, algorithms are based on the neurons of the brain in the human being. These deep learning models learn from large amounts of data. Similar to how people learn from previous experiences, the same goes for the deep learning algorithm which will perform the tasks repeatedly with each time (iteration). This will tweak the model little by little to improve the outcome.

1.3 Tensor Flow

Tensor Flow is an open-source library that is mainly used in the field of machine learning. Tensor Flow is based upon the dataflow and differentiable programming which is used in neural networks and various machine learning applications. Tensor Flow can only be used in 64-bit Operating Systems and Python 3 64-bit versions. This is very flexible and can be easily deployed across many platforms and applications.

1.4 Keras

Keras is an open-source deep learning library which is used in Python for implementing various neural network algorithms easily. Keras provides an interface for Tensor Flow and can support backend neural network operations.

1.5 OpenCV

Open CV is a software library which is mainly used in computer vision projects and object detection applications. Open CV is open source and is commonly used in Python machine learning projects related to computer vision and detection.

1.6 MobileNetV2

MobileNetV2 is a deep learning library implemented in the models that uses convolutional neural network architecture. It uses depth-wise separable convolutions to make deep neural network and this can provide an efficient model for embedded vision and pattern recognition applications. [2]

1.7 Raspberry Pi 4

Raspberry Pi is a microcontroller which is basically a computer a size of a credit card. This is a single board computer which is widely used in the field of robotics. We will be using the Raspberry Pi 4 for mask detection process as this has the feature of a variety of I/O called General Purpose Input Output (GPIO) pins which can be connected to a variety of components to perform various desired operations. It features a quad core ARM Contex-A72 processor which clocks at 1.5 GHz which has an improved CPU core and memory subsystem.

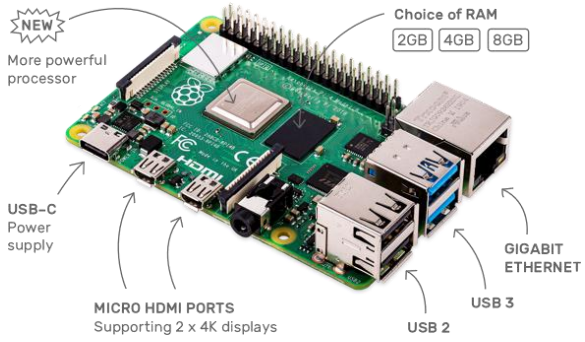

Fig -1: Raspberry Pi 4

1.8 Arduino Uno

This is a microcontroller board which is based on the architecture of the ATmega328P. This has 14 digital pins which provides input output peripheral pin slots where we can program various electronic components. This is useful in robotics and we can use this for the surveillance part for the mask detection bot.

Fig -2 Arduino Uno

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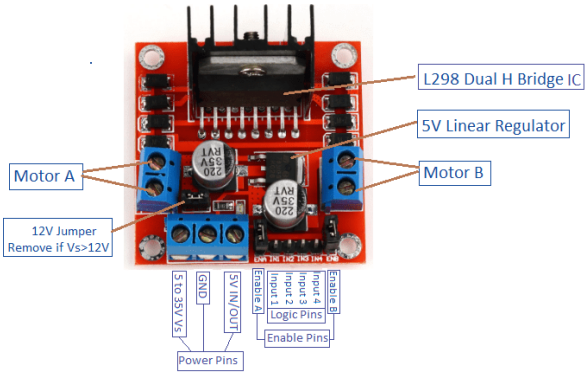
1.9 L298N Motor Driver

This is a module which controls the spin of the motors of the bot. We can link this to the Arduino uno to control the motor and the direction according to the instructions given. It has a dual H-Bridge motor drives that allows it to control the speed.



Fig–3 L298N Motor Driver

1.10 HC-SR04 Ultrasonic Sensor

This is an Ultrasonic sensor that can measure the distance between the object and the sensor using ultrasound sonar. This is used to measure the distance so that the bot can turn away as it approaches closer to the object. It has two ultrasonic transmitters, a control circuit and a receive which can help Arduino navigate in the field. This is an Ultrasonic sensor that can measure the distance between the object and the sensor using ultrasound sonar. This is used to measure the distance so that the bot can turn away as it approaches closer to the object. It has two ultrasonic transmitters, a control circuit and a receive which can help Arduino navigate in the field.

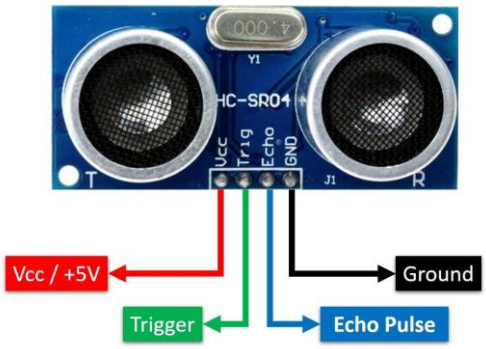


Fig-4 HC-SR04 Ultrasonic Sensor

2. Proposed System

Our proposed system is to ensure that the people wear mask while entering and also during their stay in their campus while working. The proposed system must also perform surveillance around the campus with the help of Raspberry Pi and Arduino uno. We will be using deep learning algorithms by using OpenCV, MobileNetV2, Tensor Flow and Keras.

3. Methodology

The model is made using various deep learning techniques, library requirements and hardware to perform this operation. The model loads the dataset that contains the pictures of people who are wearing masks and who aren't wearing the mask. The model is then trained on the dataset for the neural networks to understand the data for any given input to be recognized. The model is then tested for the accuracy and then loaded onto the hardware. The hardware model will initialize the face detector model and will start detecting the people faces to see if they are wearing the mask or not. The green rectangular frame will tell if the person has the mask on and the red rectangular frame will tell if he hasn't worn a mask which will give an alert. We can use Raspberry Pi 4 for this to make a mask detection bot and integrate it with the model due to its compact feature.

In order to make this work and check every part of the campus, we need to make sure it can perform surveillance around the campus. We can use Arduino to make a surveillance bot to ensure that there is surveillance going on around the campus or in the place of an organization to ensure that people wear mask and shouldn't put other people's lives at risk.

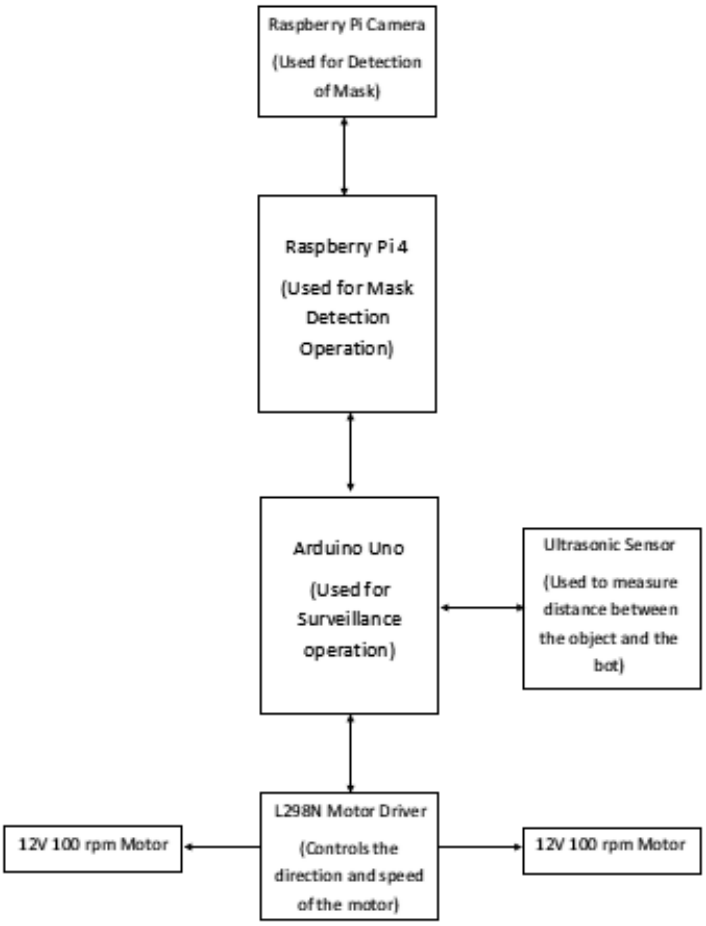


Fig-5 Block Diagram of the Architecture of the Mask Detection Bot

4. Approach

Firstly, we need to load the dataset, which has a sample image data of people wearing a mask and not wearing a mask. We then pre-process the data and then split it into training dataset which is used for training the model and the testing model that is used for checking the accuracy of the model. With that we can import this model to the Raspberry Pi, which we will build on for the mask detection software.

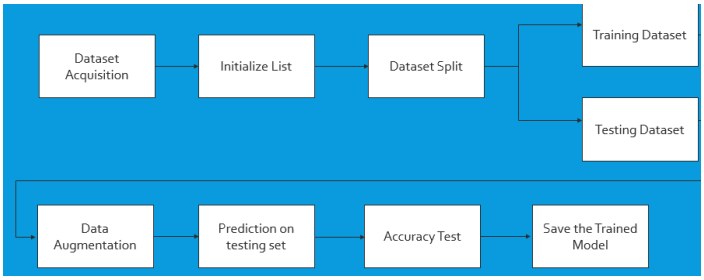


Fig-6 Training Block Diagram

Now with the algorithms developed, this should be able to augment the frame when it detects the face and should be able to check if the person is wearing the mask or not. The frame should be highlighted green if the mask is present and

should highlight red if not present. It should warn the user by giving a sound indicating to put on the mask.

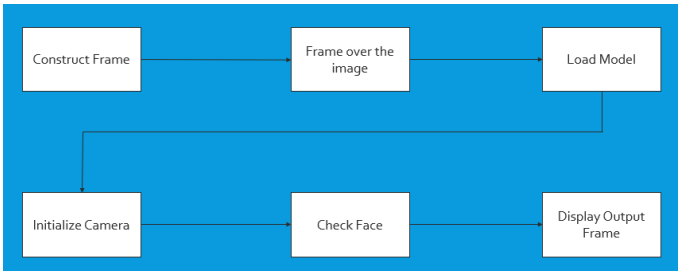


Fig-7 Detection Block Diagram

5. Results

After training the model, the following test results have proved that the model is efficient and accurate enough for providing surveillance by the following metrics.

```
[INFO] evaluating network...
              precision    recall  f1-score   support

   with_mask       1.00      0.80      0.89       383
without_mask       0.83      1.00      0.91       384

    accuracy                           0.90       767
   macro avg       0.92      0.90      0.90       767
weighted avg       0.92      0.90      0.90       767

[INFO] saving mask detector model...
```

Fig-8 Accuracy Results

This proves that the model trained is much capable of detecting mask and surveillance with high accuracy.

6. CONCLUSION

With the ongoing pandemic, the importance of wearing a face mask is increasing and plays a crucial role of protecting the people from getting infected by the coronavirus. With the availability of resources and advancement in the field of technology, we are able to implement a mask detection bot to curb the spread of the coronavirus and save many lives. We have used various deep learning libraries and hardware which can be capable of doing the detection of mask by using a real – time video stream. We have achieved a high accuracy value and the bot is useful to check for mask in public areas such as airports, malls, cooperate campuses and many more. This can be a great application to the society.

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