FACE MASK DETECTION USING IMAGE PROCESSING AND IOT

A PROJECT REPORT

Submitted By

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in partial fulfillment for the award of the laboratory of

PROJECT BASED LEARNING

GOAL

Our project involves the identification of persons wearing face masks and not wearing face masks in public places by means of using image processing and IOT for sending alert messages to authority persons. The object detection algorithms are used for identification of persons with and without wearing face masks which also gives the count of persons wearing mask and not wearing face mask and Internet Of Things (IOT) is utilized for sending alert messages.

ABSTRACT

The novel Coronavirus had brought a new normal life in which the social distance and wearing of face masks plays a vital role in controlling the spread of virus. But most of the people are not wearing face masks in public places which increases the spread of viruses. This may result in a serious problem of increased spreading. Hence to avoid such situations we have to scrutinize and make people aware of wearing face masks. Humans cannot be involved for this process, due to the chance of getting affected by corona. Hence here comes the need for artificial intelligence(AI), which is the main theme of our project. Our project involves the identification of persons wearing face masks and not wearing face masks in public places by means of using image processing and AI techniques and sending alert messages to authority persons. The object detection algorithms are used for identification of persons with and without wearing face masks which also gives the count of persons wearing mask and not wearing face mask and Internet Of Things (IOT) is utilized for sending alert messages. The alert messages are sent to the authority persons through mobile notification and Email. Based on the count of persons wearing and not wearing face masks the status is obtained. Depending upon the status warning is done by means of using buzzer and LED's.

INTRODUCTION

The novel coronavirus covid-19 had brought a new normal life. India is struggling to get out of this virus attack and the government implemented lockdown for the long way. Lockdown placed a pressure on the global economy. So the government gave relaxations in lockdown . Declared by the WHO that a potential speech by maintaining distance and wearing a mask is necessary. The biggest support that the government needs after relaxation is social distancing and wearing of masks by the people.But many people are getting out without a face mask this may increase the spread of covid-19. Economic Times India has stated that " Survey Shows that 90 percent Indians are aware, but only 44 percent wearing a mask ". This survey clearly points that people are aware but they are not wearing the mask due to some discomfort in wearing and carelessness. This may result in the easy spreading of covid-19 in public places. The world health organisation has clearly stated that until vaccines are found the wearing of masks and social distancing are key tools to reduce spread of virus. So it is important to make people wear masks in public places. In densely populated regions it is difficult to find the persons not wearing the face mask and warn them. Hence we are using image processing techniques for identification of persons wearing and not wearing face masks. In real time images are collected from the camera and it is processed in Raspberry Pi embedded development kit. The real time images from the camera are compared with the trained dataset and detection of wearing or not wearing a mask is done. The trained dataset is made by using machine learning technique which is the deciding factor of the result. The algorithm created by means of using a trained dataset will find the persons with and without wearing face masks. The Internet of Things (IOTs) can be used for connecting objects like smartphones, Internet TVs, laptops, computers, sensors and actuators to the Internet where the devices are linked together to enable new forms of communication between things and people, and between things themselves. Intimation messages are sent to authority persons by means of using IOT .

LITERATURE REVIEW

Introduction

The literature review is split into three main categories. In the first category, the literature related to image classification using deep learning techniques is discussed. In the second category, the Internet of Things (IOT) concepts are discussed. In the third category, the literature related to combined IOT devices and deep learning techniques are discussed briefly here.

Machine learning for image classification

In the content based image classification using deep learning , Joseph Redmon et.al proposed You Only Look Once (YOLO) algorithm for real time object detection. Sanzidul Islam et.al 2020, gave a deep learning based assistive System to classify COVID-19 Face Mask which is implemented in rasbperrypi-3. Velantina et.al 2020, made an COVID-19 facemask detection by means of using Caffe model. Senthilkumar et.al 2017, compared the two most frequently used machine learning algorithms K-Nearest Neighbour and Support Vector Machine in his work for face recognition. Senthilkumar et.al 2018, proposed a new and fast approach for face recognition.

Internet of Things

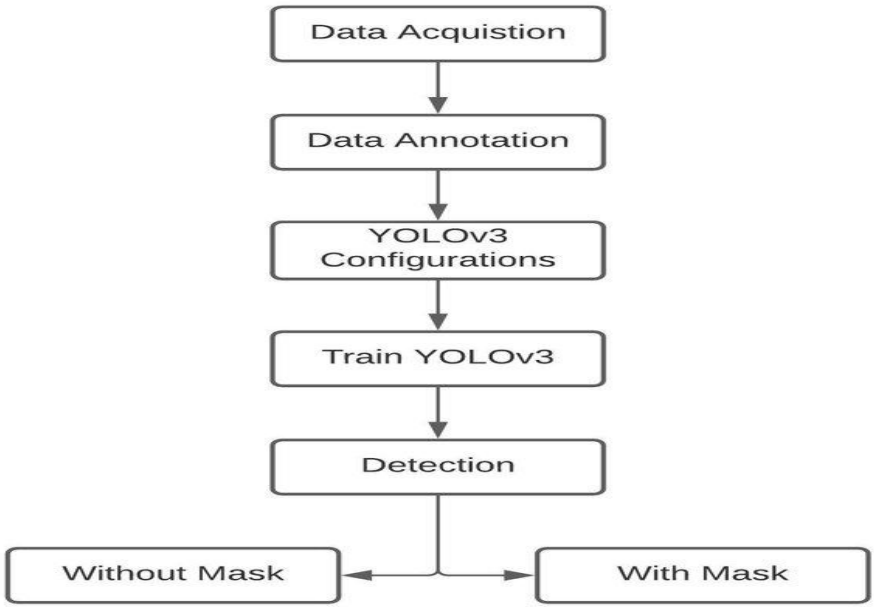
Luigi Atzori et.al reviewed different versions of the Internet of Things are reported and corresponding enabling technologies. Lu Tan et.al and Neng Wang discussed the Future internet in their work. Feng Xia et.al and others discussed briefly about the Internet of Things, 2012 in their work.

IOT device and Machine Learning

Yair Meidan et.al 2017, has implemented nine IOT devices and treated each IOT device as separate classes. For classification purposes, deep learning techniques were used. Yair Meidan et.al and Michael Bohadana et.al 2017, proposed a security system for detection of unauthorized IoT devices using machine learning techniques. Liang Xiao et.al 2018, has improved the IoT Security techniques based on machine learning using Artificial Intelligence concept. With this, based on the above literature surveys, we have made a new deep learning algorithm for face mask detection.

YOLO - object detection algorithm

Deep Learning consists of a very enormous number of neural networks that use the multiple cores of a process of a computer and video processing cards to manage the neuranetwork's neuron which is categorized as a single node. Deep learning is used in numerous applications because of its popularity especially in the field of medicine and agriculture. Here YOLO deep learning technique is used to identify persons wearing and not wearing face masks. Joseph Redmon et al. introduced You look only once also known as YOLO in 2015. YOLO is a convolutional neural network (CNN) for doing object detection in real-time. The algorithm applies a single neural net5 work to the full image, and then divides the image into regions and predicts bounding boxes and probabilities for each region. These bounding boxes are weighted by the predicted probabilities. Some improvements were done over years and YOLOv2 and YOLOv3 versions were introduced respectively in 2016 , 2018.Our model uses YOLOv3 and it provides good results regarding object classification and detection. In the previous version of Yolov2 Darknet-19 is used. Yolov3 uses darknet-53. Darknet is a framework used for training neural networks written in C language.



BENEFITS

YOLO is a popular object detection algorithm because it achieves high accuracy while it is also able to run in real-time. The algorithm “only looks once” at the image means that it requires only one forward propagation pass through the neural network to make predictions. After non-max suppression it then gives the recognized objects along with the bounding boxes. In YOLO, a single CNN simultaneously predicts multiple bounding boxes and class probabilities for those boxes. YOLO directly optimizes detection performance since it trains on full images. YOLO has a number of benefits over other object detection methods they are

• YOLO is extremely fast

• YOLO scans the entire image during training and also during testing. So, it implicitly encodes contextual information about classes as well as their appearance.

• YOLO learns generalizable representations of objects so that when it is trained on natural images and tested , the algorithm performs excellently when compared to other top detection methods.

YOLOv3 Configuration

The YOLOv3 configuration involved the creation of two files and a custom Yolov3 cfg file. YOLOv3 configuration first creates a ”obj.names” file which contains the name of the classes which the model wanted to detect. Then a obj.data file which contains a number of classes in here is 2, train data directory, validation data, ”obj.names” and weights path which is saved on the backup folder. Lastly, a cfg file contains 2 classes. figure 3.2 shows the configuration steps involved. Next is training of our YOLOv3 in which an input image is passed into the YOLOv3 model. This will go through the image and find the coordinates that are present. It divides the image into a grid and from that grid it analyzes the target objects features. Here 80 percent data is used for training , and remaining 20 percent is used for

validation. Now weights of YOLOv3 trained on the dataset are created under a file. Using these trained weights now we can classify the persons wearing and not wearing the mask.

Face Mask Detection Algorithm

Step 1: Start the program.

Step 2: Input image is feeded.

Step 3: YOLOv3 trained weights are loaded from the disk.

Step 4: Persons with and without face mask are detected by means of object detection algorithm.

Step 5: After detection resultant image is displayed along with count of Persons with and without masks.

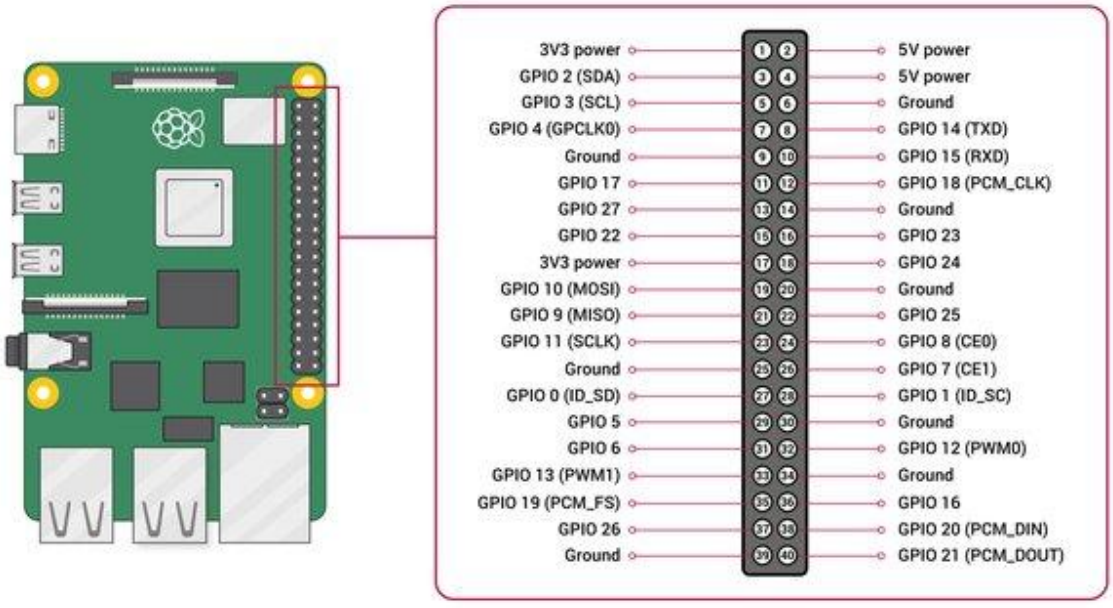
Step 6: The ratio of with and without face mask is calculated and based upon ratio status is obtained.

Step 7: Based on status output LED and buzzer connected to Raspberry pi will be activated.

Step 8: Resultant image is saved in Raspberry pi for identification.

Hardware description

Raspberry Pi4 Development kit is used in this face mask detection system. The Raspberry Pi is a very cheap computer which runs on Linux OS, but it also provides a set of GPIO pins that are used to control electronic components and also Internet of Things . It is also used for image processing projects because of its processing speed and size..Either camera or video stream is used as an input.The raspberry pi is connected with a buzzer and indication leads. For communication purposes we are using Blynk server (IOT) which is connected with the raspberry pi. figure 4.2 shows the Raspberry Pi 4 pin details. . Blynk Server is used for sending messages between Blynk mobile applications and various development kits. Blynk IOT server is installed in this system and an activation link sent to registered email id. This activation link is copied and pasted in the Raspberry Pi terminal in order to interconnect this Raspberry Pi and Blynk IOT server. The blynk server mobile app and shows connections established between raspberry pi and Blynk server.



Software description

About Python

Python is a general-purpose interpreted, interactive, object-oriented, and high-level programming language. It was created by Guido van Rossum during 1985-1990. Like Perl, Python source code is also available under the GNU General Public License (GPL). Python 3.0 was released in 2008. Although this version is supposed to be backward incompatible, later on many of its important features have been back-ported to be compatible with version 2.7.

Features

Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It uses English keywords frequently whereas other languages use punctuation, and it has fewer syntactic constructions than other languages.

Libraries

Python's standard library is very extensive, offering a wide range of facilities as indicated by the long table of contents listed below. The library contains built-in modules (written in C) that provide access to system functionality such as file I/O that would otherwise be inaccessible to Python programmers, as well as modules written in Python that provide standardized solutions for many problems that occur in everyday programming. Some of these modules are explicitly designed to encourage and enhance the portability of Python programs by abstracting away platform-specifics into platform-neutral APIs.

The Python installers for the Windows platform usually include the entire standard library and often also include many additional components. For Unix-like operating systems Python is normally provided as a collection of packages, so it may be necessary to use the packaging tools provided with the operating system to obtain some or all of the optional components.

EXPERIMENTS RESULTS AND DISCUSSION

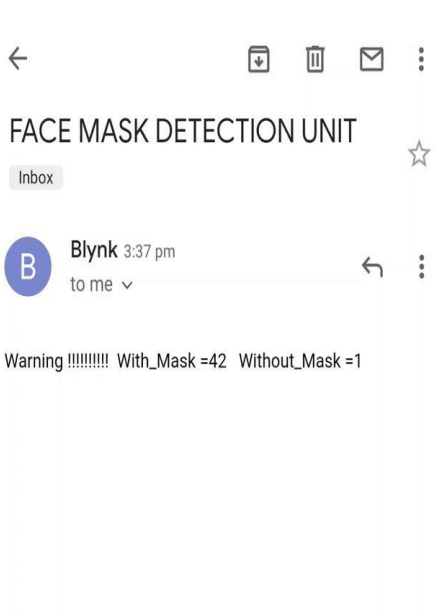
The experimental results obtained in this project work is discussed here. The results are analyzed at various levels. The face mask detection python file is runned in a Raspberry Pi 4 module along with the YOLOv3 files so the images are feeded and the identification of persons wearing and not wearing masks is processed. Input images feeded to Raspberry Pi. Incase of live stream input video is received and they are processed frame by frame.

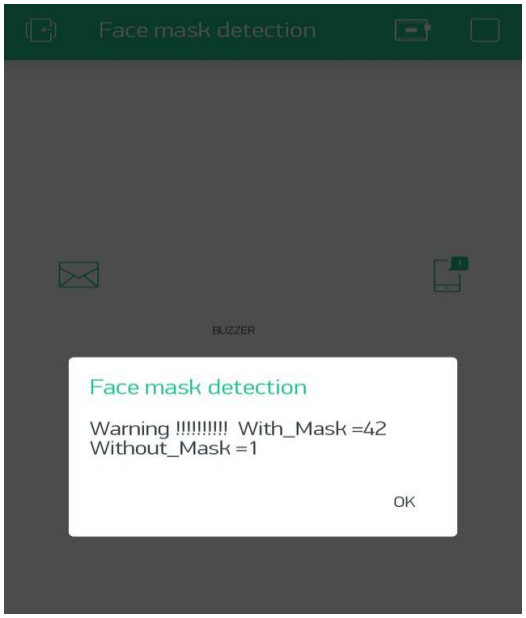
Here after detection, based on status the LED and Buzzer will glow.

Safe	ON	OFF	OFF
Warning	OFF	ON(Blink)	ON(Blink)
Danger	OFF	ON	ON

Once the detection is done then the situation or condition is displayed whether safe, warning or danger. Based upon the condition intimation is sent to the authority person through the IOT and the indication light glow and buzzer is activated.

After detection of persons with and without face masks the intimation message is sent to the authority person by means of blynk server. From the Raspberry Pi the mobile notification and the email is sent to the authority person. The mobile notification is received in Blynk mobile application. The mail and mobile notification consist of status and count of persons with mask and without mask.


FACE MASK DETECTION UNIT
Inbox
Blynk 3:37 pm
to me
Warning !!!!!!!!!! With_Mask =42 Without_Mask =1


Face mask detection
BUZZER
Face mask detection
Warning !!!!!!!!!! With_Mask =42
Without_Mask =1
OK

CONCLUSION AND FUTURE WORKS

In this work of face mask detection we have used YOLOv3 to detect the persons with face mask and without face mask with good efficiency and and sent an intimation message to authority persons by means of IOT. It's performance is really well in images and our detection results were also quite good. This detection can also be used for video stream or camera fed inputs. To get improved performance and speed, Raspberry Pi of higher variant such as 4GB or 8GB RAM can be used to implement the detection algorithm. The Future development of the project is planned to involve the identification of a person and sent the intimation message to the persons mobile who were not wearing face masks. This can be implemented in offices and institutions by means of training the database with employees images or students images and by means of face recognition the person is identified by which the mobile number and other details of the person is obtained from database and hence it will be easy to notify that particular person or useful for taking any actions regarding not wearing face mask.The proposed model can also be enhanced by means of including various parameters like peoples count, social distance and temperature measurement. This project will be very helpful and can be implemented in hospitals, airports, schools, colleges, offices, shops, malls, theaters, temples, apartments etc. and can also be implemented for Covid free event management.