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Face Mask Detection System

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Abstract: ***Since the infectious coronavirus disease (COVID-19) was first reported, it has become a public health problem in and even around the world. This pandemic is having devastating effects on societies and economies around the world. Healthcare officials from the World Health Organization and local authorities are propelling people to wear face masks as it is one of the comprehensive strategies to overcome the transmission. However, wearing a face mask that prevents the transmission of droplets in the air and maintaining an appropriate physical distance between people, and reducing close contact with each other can still be beneficial in combating this pandemic. Therefore, we focus on implementing a face mask detection model as a vision system. People violating social distancing or not wearing masks were detected using this model. It has been trained with the dataset that contains around 4000 images and compiled for differentiating accuracy to choose the best for this type of model. This solution tracks the people with or without masks in a scenario and this can be used with the existing embedded infrastructure to enable these analytics which can be applied to various verticals, as well as in an office building or at airport terminals/gates Mask has been a comprehensive strategy to overcome the transmission. So, the face mask detection model detects the face of individuals and concludes whether they are wearing masks or not at that particular moment when they are captured in the image. Existing system uses manpower. It indicates whether a person is wearing a face mask or not manually by means of manpower. Due to COVID pandemic masks are essential in public places such as airports, railways, schools, offices, shopping malls etc... So, manual checking is a hectic process. Face Mask Detection model is an application to detect people if they are wearing a mask or not. This system is capable of training the dataset of both persons wearing masks and without wearing masks. It uses python and machine learning. After training the model the system can predict whether the person is wearing the mask or not.***

I. INTRODUCTION

Face mask detection is a challenging task. It has been receiving more and more attention in this era due to the spreading of corona virus disease. Hence many countries following the rule like “No entry without mask”. Face mask detection is very important issue in security purpose and Covid-19 prevention. In the case of medical field, mask reduces potential exposure risk from an infected person whether they have symptoms or not. Face mask detection is used in Airports, Hospitals, Offices and Educational Departments etc. So face mask detection has become a very critical and challenging issue. The face recognition without mask is easier but face recognition with mask is critical one because feature extraction of masked face is very complicated than normal face. That is so many face features such as nose, mouth and chin are absent in the masked face. In medical field, mask reduces potential exposures risk from an infected person whether they have symptoms or not. So many face mask detection can be concentrated in two steps. 1) Face Recognition 2) Feature Extraction Face recognition is the first step; here we need to detect the face from an image. Mainly there is a problem such as detecting the multiple mask and unmasked faces in an image. It can be solved by using a traditional object detection method. The 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.

II. TOOLS AND TECHNOLOGY USED

Langauage: Python is a high-level, general-purpose programming language. Its design philosophy emphasizes code readability with the use of significant indentation. Python is dynamically-typed and garbage-collected. It supports multiple programming paradigms, including structured, object-oriented and functional programming.

Tensorflow We are going to use a model from the Tensorflow Hub library, which has multiple ready to deploy models trained in all kinds of datasets and to solve all kinds of problems. For our use, I filtered models trained for object detection tasks and models in the TFLite format. This format is usually used for IoT applications, for its small size and faster performance than bigger models. I choose this format because I intend to use this model on a Rasberry Pi on future projects. The chosen model was the EfficientDet-Lite2 Object detection model. It was trained on the COCO17 dataset with 91 different labels and optimized for the TFLite application.

This model returns:

- The box boundaries of the detection;
- The detection scores (probabilities of a given class);
- The detection classes; The number of detections.

A. Hardware Requirements

1) RAM: 4 GB
2) Storage: 500 GB
3) CPU: 2 GHz or faster
4) Architecture: 32-bit or 64-bit

B. Software Requirements

1) Python 3.5 in Google Colab is used for data pre-processing, model training and prediction
2) Operating System: windows 7 and above or Linux based OS or MAC OS
3) Coding Language : Python

III. LITERATURE SURVEY

Literature survey: In a Smart City Network, an Automated System to Limit COVID-19 Using Facial Mask Detection: COVID-19, a pandemic caused by a novel coronavirus, has been spreading over the world for a long time. COVID-19 has had an impact on practically every aspect of development. The healthcare system is in a state of emergency. Wearing a mask is one of the many preventative steps adopted to minimize the spread of this disease. In this paper, we will look upon

In a smart city network where all public places are monitored by Closed-Circuit Television (CCTV) cameras, we propose a technique to limit COVID-19 growth by identifying people who are not wearing any facial mask. When a person without a mask is spotted, the city network notifies the appropriate authority. A dataset of photos of people with and without masks acquired from diverse sources is used to train a deep learning architecture. For previously unreported test data, the trained architecture distinguished people with and without a facial mask with 98.7% accuracy.

Our research is intended to be effective in reducing the spread of this infectious disease in many areas throughout the world.

Face Recognition using a Masked Convolutional Neural Network: In recent years, face recognition has become a popular and important technique. Face changes and the use of several masks make it far too difficult. Masking is another prevalent case in the real world when a person is uncooperative with equipment, such as in video surveillance. For these masks, current face recognition The quality of the work suffers. A large number of studies have been conducted on recognizing faces in a variety of situations, such as shifting stance or light, degraded photos, and so on. Nonetheless, the challenges posed by masks are sometimes overlooked. The main focus of this research is on facial masks, specifically how to improve the recognition accuracy of various masked faces. A workable strategy has been developed, which involves detecting the facial regions first. A Multi-Task Cascaded Convolutional Neural Network was used to solve the obstructed face identification problem (MTCNN). The Google FaceNet embedding model is then used to extract facial traits

A. Deep Learning

1) Deep learning is an AI function that mimics the workings of the human brain in processing data for use in detecting objects, recognizing speech, translating languages, and making decisions.
2) Deep learning AI is able to learn without human supervision, drawing from data that is both unstructured and unlabeled.
3) In this, face mask detection is built using Deep Learning technique called as Convolution Neural Networks (CNN).

Deep learning methods aim at learning feature hierarchies with features from higher levels of the hierarchy formed by the composition of lower-level features.

Automatically learning features at multiple levels of abstraction allow a system to learn complex functions mapping the input to the output directly from data, without depending completely on human-crafted features. Deep learning algorithms seek to exploit the unknown structure in the input distribution in order to discover good representations, often at multiple levels, with higher-level learned features defined in terms of lower-level features.

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IV. PROBLEMS IDENTIFIED

The ability to utilize all the knowledge of deep learning and machine learning to ensure the society is safe from the spread of corona virus along with few image processing algorithms and others few related methods and ensure it meets the requirement by both the government and the people in the society.

Is this device really needed by the society at this time and will it be accessed by every single one easily.

Will the device meet the requirements and produce proper output in all possible situations.

Is the device really feasible to ensure safety among the people in the crowd from the spread of corona virus.

V. PROPOSED SYSTEM

1) This system is capable to train the dataset of both persons wearing masks and without wearing masks.
2) After training the model the system can predicting whether the person is wearing the mask or not .
3) It also can access the webcam and predict the result.

VI. WORKFLOW AND SYSTEM ARCHITECTURE

A. Tensorflow Framework

Tensor flow is an open-source software library. Tensor flow was originally developed by researchers and engineers. It is working on the Google Brain Team within Google's Machine Intelligence research organization the purposes of conducting machine learning and deep neural networks research. It is an opensource framework to run deep learning and other statistical and predictive analytics workloads. It is a python library that supports many classification and regression algorithms and more generally deep learning. TensorFlow is a free and open-source software library for dataflow and differentiable programming across a range of tasks.

B. OpenCV

1) It is a cross-platform library using which we can develop real-time computer vision applications.
2) It mainly focuses on image processing, video capture and analysis including feature like face detection and object detection.
3) Currently Open CV supports a wide variety of programming languages like C++, Python, Java etc. and is available on different platforms including Windows, Linux, OS X, Android, iOS etc

C. NumPy

NumPy is a library for the Python programming language, adding support for large, multi-dimensional arrays and matrices, along with a large collection of highlevel mathematical functions to operate on these arrays.

D. MATPLOT

Mat plot is a plotting library for the Python programming language and its numerical mathematics extension NumPy. It provides an object-oriented API for embedding plots into applications using general-purpose GUI toolkits like Tkinter, WX Python, Qt, or GTK+.

E. Python

What exactly is Python? You may be wondering about that. You may be referring to this book because you wish to learn editing but are not familiar with editing languages. Alternatively, you may be familiar with programming languages such as C, C ++, C #, or Java and wish to learn more about Python language and how it compares to these "big word" languages.

F. Convolution Neural Network

A convolution neural network is a special architecture of artificial neural network proposed by yann lecun in 1988. One of the most popular uses of the architecture is image classification. CNNs have wide applications in image and video recognition, recommender systems and natural language processing. In this article, the example that this project will take is related to Computer Vision. However, the basic concept remains the same and can be applied to any other use-case!

CNNs, like neural networks, are made up of neurons with learnable weights and biases. Each neuron receives several inputs, takes a weighted sum over them, pass it through an activation function and responds with an output. The whole network has a loss function and all the tips and tricks that we developed for neural networks still apply on CNNs.

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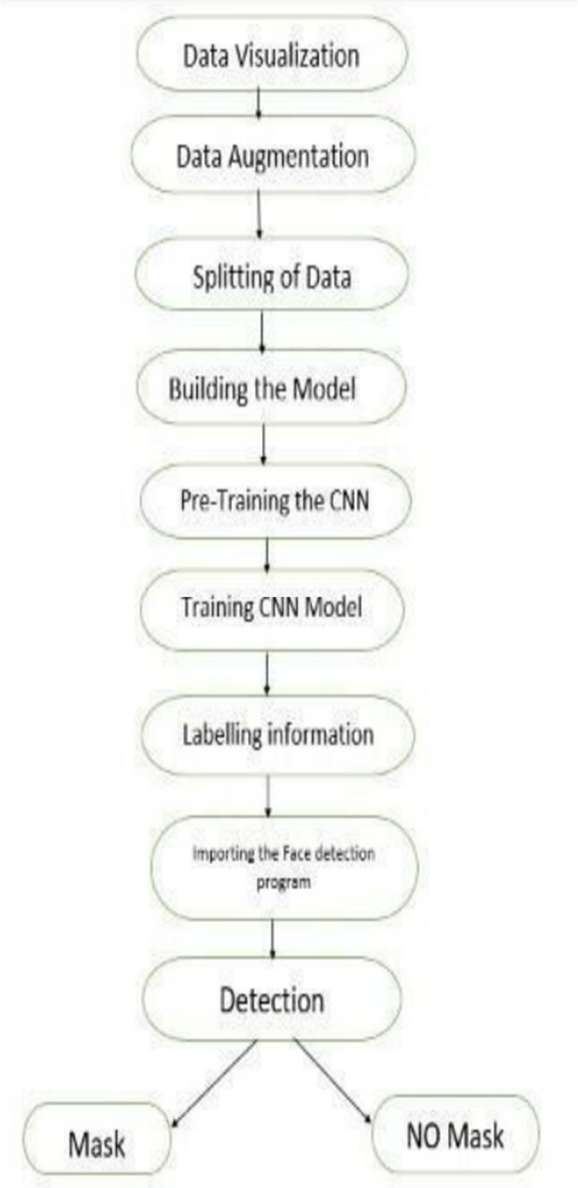
In more detail the image is passed through a series of convolution, nonlinear, pooling layers and fully connected layers, then generates the output.



Data Visualization.
Data Augmentation.
Splitting the data.
Labeling the Information.
Importing the Face detection.
Detecting the Faces with and without Masks.

Data Visualization In the first step, let us visualize the total number of images in our dataset in both categories. We can see that there are 690 images in the 'yes' class and 686 images in the 'no' class.

Data Augmentation In the next step, we augment our dataset to include more number of images for our training. In this step of data augmentation, we rotate and flip each of the images in our dataset.

Splitting the data In this step, we split our data into the training set which will contain the images on which the CNN model will be trained and the test set with the images on which our model will be tested.

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Building the Model In the next step, we build our Sequential CNN model with various layers such as Conv2D, MaxPooling2D, Flatten, Dropout and Dense. 26 Pre-Training the CNN model After building our model, let us create the 'train_generator' and 'validation_generator' to fit them to our model in the next step.

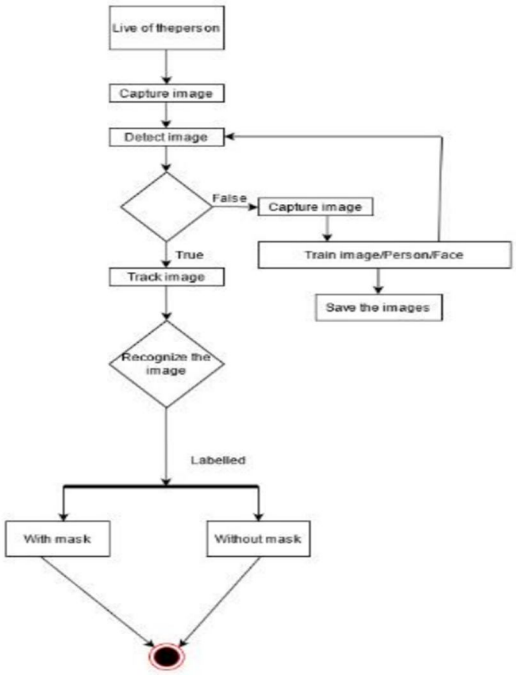
Training the CNN model This step is the main step where we fit our images in the training set and the test set to our Sequential model we built using keras library. I have trained the model for 30 epochs (iterations). However, we can train for more number of epochs to attain higher accuracy lest there occurs over-fitting.

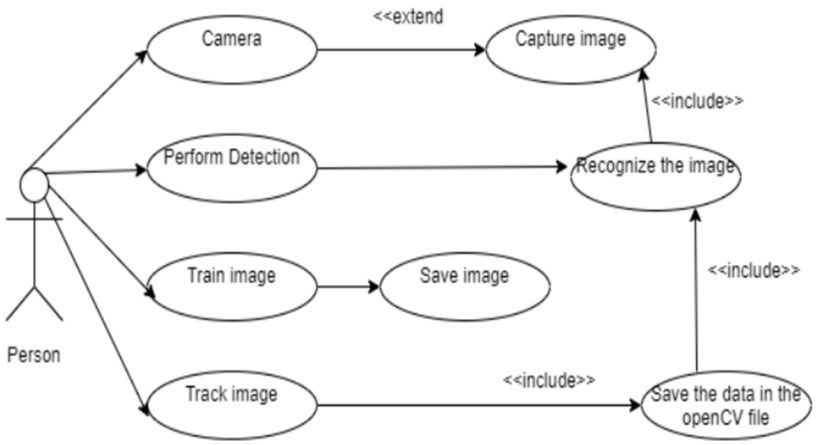
Labeling the Information After building the model, we label two probabilities for our results. ['0' as 'without_ ask' and '1' as 'with_ mask']. I am also setting the boundary rectangle color using the RGB values.

Importing the Face detection Program After this, we intend to use it to detect if we are wearing a face mask using our PC's webcam. For this, first, we need to implement face detection. In this, I am using the Haar Feature-based Cascade Classifiers for detecting the features of the face.

Detecting the Faces with and without Masks In the last step, we use the OpenCV library to run an infinite loop to use our web camera in which we detect the face using the Cascade Classifier.

Activity Diagram An activity diagram is a behavioral diagram i.e., it depicts the behavior of a system. An activity diagram portrays the control flow from a start point to a finish point showing the various decision paths that exist while the activity is being executed.





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VII. CONCLUSIONS

The artificial intelligent (AI) and machine learning (ML) are developed various models for face mask detection. In this article, discussed about various methods are used for facial mask detection. As we know nowadays mask detection is a very challenging task. The applications of Facial Mask Detection are used especially for the prevention of spreading Corona Virus, tracking & identifying criminals and anti-spoofing etc. By using a Deep Convolutional Neural Network Algorithm, we can easily detect the facial mask. But the facial mask detection and non-masked face detection accuracy provided high variations.

VIII. FUTURE SCOPE

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.

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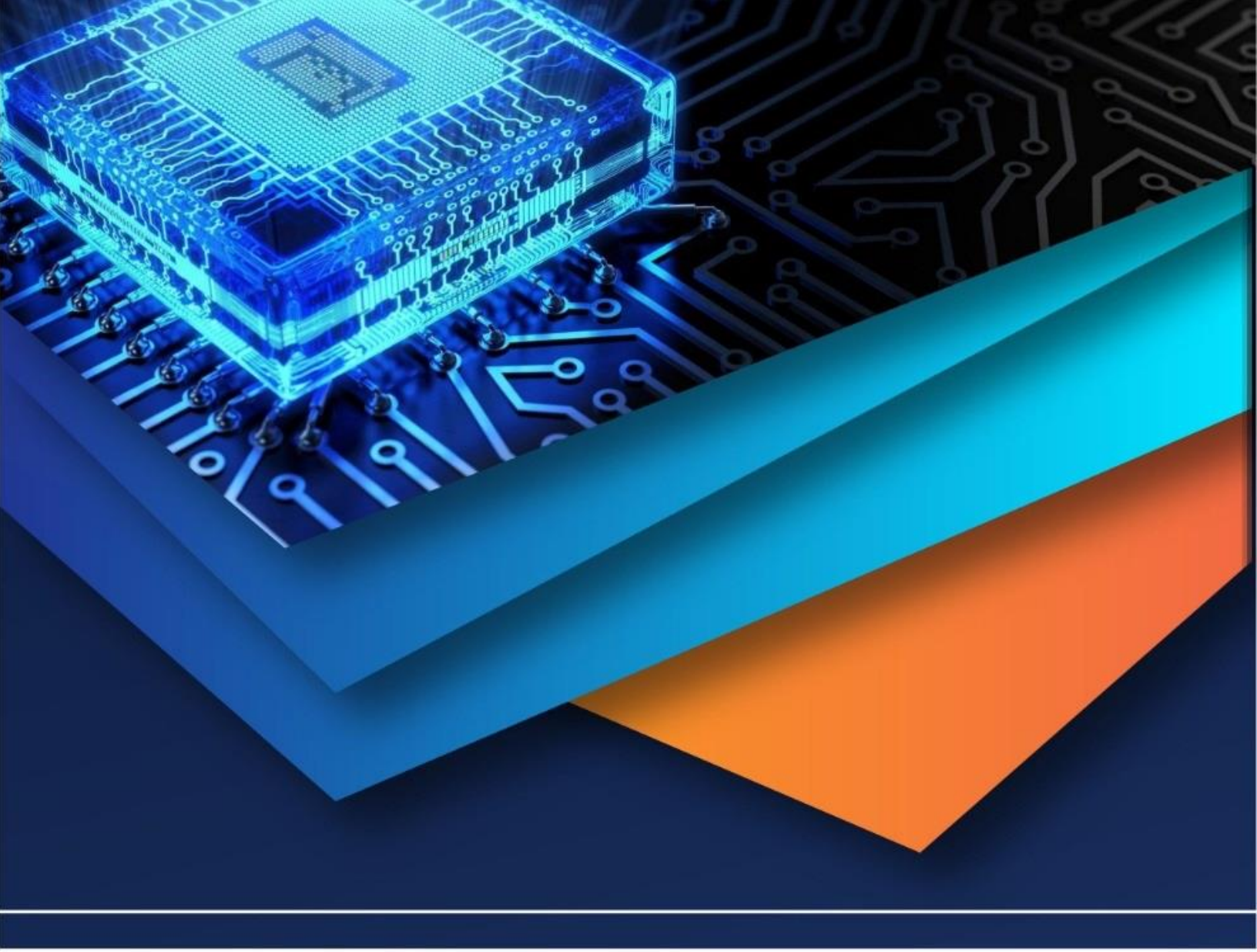

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