Design of Face-Mask Detection System using Artificial Intelligence Techniques at Traffic Signals

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***Abstract*— The COVID-19 pandemic has had a dramatic impact on our daily lives, disrupting global trade and transportation. Wearing a face mask for protection has become a new normal. In this project, we propose intelligent face-mask detection system, which will give a high accuracy. For this purpose we are using some basic machine learning packages like TensorFlow, Keras and Open CV. Our model is trained on a dataset that contains images of people with and without face masks in two categories. Three levels of work that we carried out are: images pre-processing, extracting crucial part from images and image classification.**

Furthermore, we have also applied a novel image processing algorithm which is used to identify the license plate number of vehicles. This is achieved by using several Open CV digital image processing technique developed with python to bring about image segmentation. Once the region is obtained; an optical character reorganization (OCR) is used via a trained template for several character styles to obtain the text format of the license plate.

Keywords: Face-Mask detection, TensorFlow, Keras, OpenCV, Number plate recognization, Digital image processing, Optical character recognization(OCR)

I. INTRODUCTION

Corona virus disease 2019 (COVID-19) has affected the globe seriously. One major protection technique for people is to wear masks in public areas. Moreover, many public service providers need customers to use the service only if they wear masks properly. To avoid global tragedy, a practical and straight forward approach to preventing the spread of the virus is crucially desired worldwide. The effectiveness of facemasks in restraining the spread of air borne diseases in the society has been reduced, mostly due to improper way of using facemask. Therefore, it is necessary to develop an automatic detection approach for face mask wearing conditions, which can contribute to personal protection and public epidemic prevention.

Artificial intelligence and machine learning are playing very important role in the automation of various things. In this project we are using an effective and simplified application to resolve the above purpose by using the basic machine such as Tensor flow, Keras and OpenCV and building a system for face mask detection using several classifier available on CNN. Also, we will be discussing briefly about various algorithms used for image recognition and we will be focusing on histogram of oriented gradient for detection of license plate of car.

II. MAJOR MODULES OF PROPOSED SYSTEM

A. *Artificial Neural Network*

Artificial Neural Networks is one of the most important computational algorithm used in machine learning. The word “neural” implies that they are brain-inspired systems that are made to work in the way that we humans learn. Neural networks is made up of input and output layers, as well as a hidden layer consisting of units that resolves the input into something that can be used by the output. They can be perfectly used for finding patterns that are more complex for individual developer to extract and instruct the machine to recognize.

An artificial neural network is the collection of nodes known as artificial neurons which are almost similar to the neurons in the human mind. An artificial neural network contains layers of interconnected hubs or neurons which are made through epoch or iteration (the way that we humans think). A neuron is a function that accumulates the data and classifies the data as per a specific pattern. In a neural there are three types of layers:

1. **Input layer** contains inputs data that we need to feed the neural network. No of inputs depend on the data samples.

2. **Hidden layer** contains sub hidden nodes and bias nodes. Number of nodes depends on user and complexity of network and can be increased accordingly.

   Not just nodes but hidden layers can also be increased as per requirements. This network will be called as multilayer neural network.

3. **Output layer** contain output nodes. Number of node depends on the classes of data, number of classes and output nodes will remain same.

B. *Deep Learning*

Deep learning refers to a subfield of machine learning algorithms that employ multiple layers to progressively withdraw higher-level techniques from the raw data. Deep learning is a type of machine learning that mimics how humans acquire knowledge, and it has grown in popularity over time in comparison to standard models. Deep learning models, such as Neural Networks, are built in a hierarchy of increasing complexity and abstraction, whereas typical methods are linear.

C. *Optical character recognition(OCR)*

The operation of mechanically or electronically extracting data from scanned images of handwritten, typed, or printed text into a machine-encoded text is known as optical character recognition. It is the basic technology for number plate identification and it allows data to be stored and sorted.

The software captures a series of 'snapshots' when a vehicle approaches the camera and stores them as a data. When the number plate is large enough for the OCR to peruse, the frame is analyzed by the OCR software, and the registration number of the vehicle is then customized into ASCII code and get stored in a database. A 'favourite' is chosen from the list after it is examined for similarities. Typically, the OCR system would scan and analogize 10 to 15 images, with 5 being taken the minimum for high accuracy.

III. METHEDOLOGY

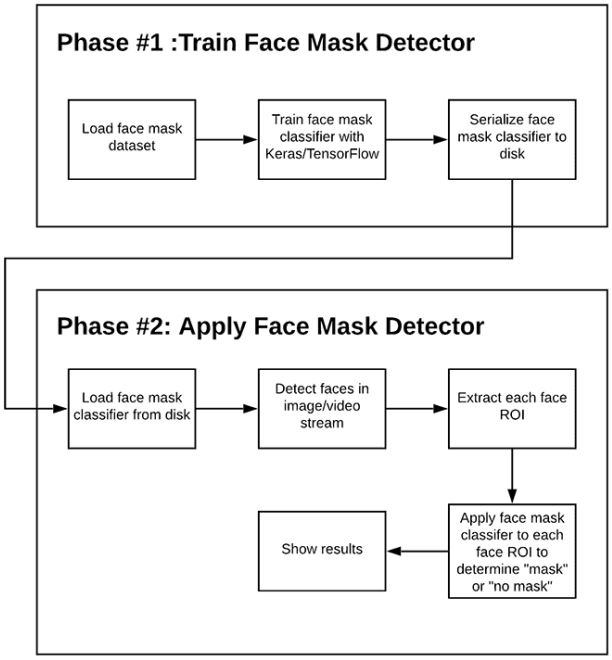
3.1 Face mask detection system

We developed an efficient network for identifying face masks using python script, Tensor flow and CNN as deep learning frameworks. Our goal is to upskill a specific CNN model that can detect whether a person is wearing a mask or not. From every angle, this project can effectively and instantly distinguish the masked faces. It creates output from any RGB input image regardless of orientation. This function's main task is to capture features from images and determine which class they belong to. The feature extraction method sketches the image and then turns it into a new image, which is more suitable than the previous one. The camera could be used to recognize the face mask in our proposed model. When the training process is complete, we will send model data along with their accuracy level.

We must break our project into two steps in order to train the face mask detector:

Training: we'll use a hard drive to store our facial mask detection records, create a model (using keras/ tensor flow), and then install the facial mask detector on the disc.

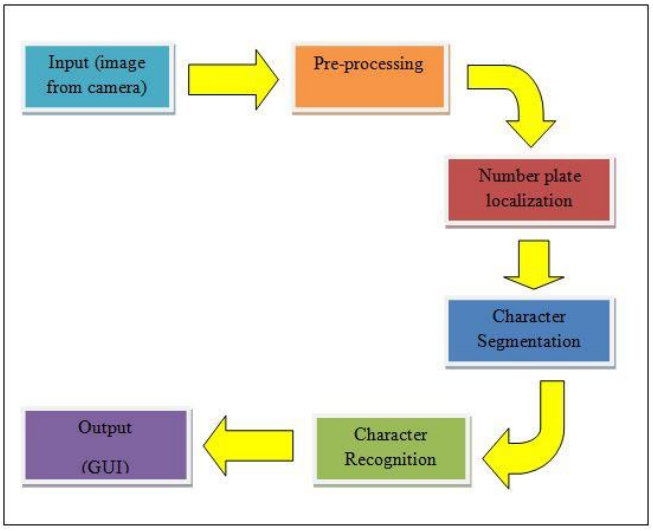
Deployment: After training the face mask detector, we charge it, perform face recognition function, and then determine if each face is wearing a mask or not. it will also necessitate the use of a webcam.



3.2 Number plate recognition

One of the approaches applied for vehicle recognition is license plate recognition. The major aim of this project is to identify the most effective approach to extract the information from a digital image (obtained from the camera).Three steps are normally involved in this procedure. The First step, regardless of license plate size or orientation, is to locate the plate. The characters are segmented in the second phase, and the characters are recognized from the license plate in the last step. As a result, this project elucidates the foundations, concepts, and ideas behind several algorithms that are required to achieve character recognition from a license plate during template matching.

The above mentioned characteristic of the algorithm contributed in the faster character detection of the license plate. Image processing, defragmentation, scaling, and character localization are all phases in the character recognition process that must be performed on the image in order for template matching to take place.



IV. LIBRARIES AND PACKAGES

4.1 Keras

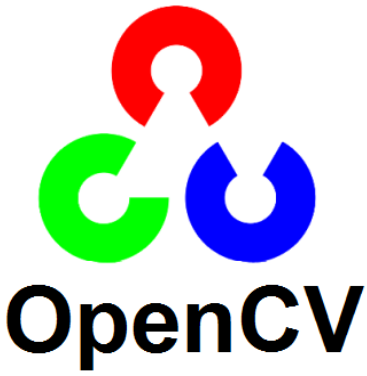
Keras is an open-source model-level library written in python and provides an interface for artificial neural networks in python. Keras acts as an interface for the Tensor Flow library. The core data structures of keras are layers and models. It has inbuilt modules for all neural networks computations hence deep learning could be performed faster using Keras. It supports frameworks like Theano and Tensor Flow, allowing you to write and train neural network models in minimum lines of code.

4.2 Tensor Flow

Tensor Flow is the rise of AI library and deep learning has fostered the rise of tensor flow, an open source AI library that allows users to build models using data flow graphs. Tensor flow is used at the back end of the proposed model's sequential CNN architecture. In image processing, it is also used to reshape the image.

4.3 Open CV

Open CV is a programming library focusing mainly on real-time computer vision. It is used to distinguish and recognize faces and objects, classify activities in recordings, trace progressive modules, trace eye gestures, track camera actions, remove red eyes from images taken using flash, picking comparative images from an image database and draw markers to overlay it with increased reality.



4.4 Tkinter

Tkinter is the most commonly used framework in python for developing GUI(Graphical User Interface). Tkinter has numerous advantages, it's a cross-platform ,so it works with same code on windows, Mac OS, and Linux. Applications built with Tkinter seems as if they belong to the platform they are running on, as the visual elements are created using native operating system elements.

V. RESULT AND ANALYSIS

An precise and efficient Face-Mask detection system has been created which gives excellent results. This project is completed by the use of recent technologies in the field of computer vision and deep learning algorithms. Python and its applications were used to construct a custom dataset. This can be utilized in real-time face mask detection applications at airports, hospitals, offices etc.

Performance of Face-Mask detection model:

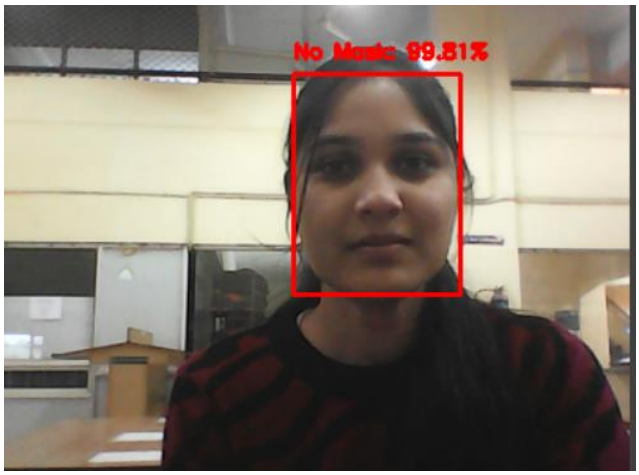


Fig.1 Face Detection without mask

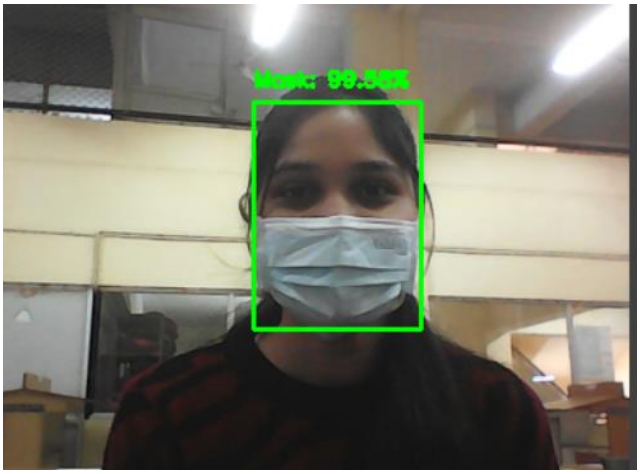


Fig.2 Face Detection with Mask

When it comes to the performance of the model, the system can detect facial images without a mask, and partial mask. The model that has been created has able to work appropriately.

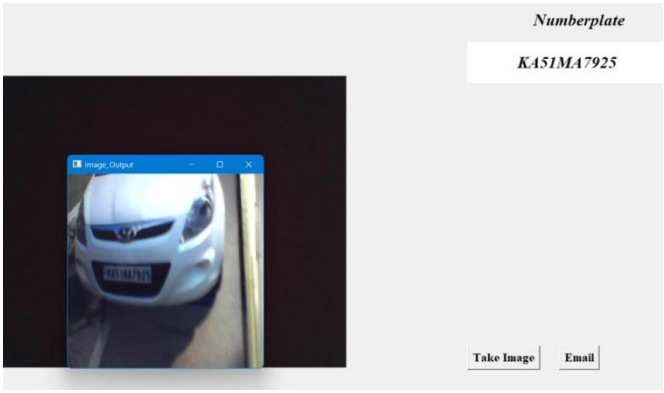


Fig.3 Number plate detection

After detecting the number plate of a vehicle, we can send E challan through email to the owner of the vehicle who hasn't wore the face mask.

VI. FUTURE SCOPE

In future we will work on data augmentation i.e. using more images to train our model to get more accurate and error free result. We can also add third label in the video feed mask detection to show improperly worn mask. Currently, only 'With mask' and 'Without mask' are being shown.

VII. CONCLUSION

Due to the increasing case of COVID-19, there is an urgency to restrain the uprising cases, therefore the application value and importance of real-time mask and social distancing detection are increasing. This model is developed to facilitate the drivers and the traffic police to manage the penalties for the covid violations, such as imposing an E challan digitally on the drivers who drive without wearing masks. The accuracy of proposed model for face-mask detection using artificial neural networks and number plate detection through image processing has been highly effective in achieving minimum error rate for the recognition.

VIII. ACKNOWLEDGMENT

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