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Face Mask Detection Model for the identification of non-masked faces using an Artificial Neural Network

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ABSTRACT

The corona virus, COVID-19 pandemic is causing a global health crisis. The outbreak of COVID-19 has taught everyone the importance of face masks in their lives. SARS-COV-2 (severe acute respiratory syndrome) is a communicable virus that is transmitted from person to person while speaking, sneezing in the form of respiratory droplets. It spreads on coming in close proximity with an infected person. Governments of different countries did impose a fully- fledged lockdown to minimize the risk of transmission. As stated by World Health Organization (WHO), the effective protection method to prevent the spread of Covid is wearing a proper face mask. With the advancement of newer technologies, deep learning and computer vision have proved to be an effective way in facial recognition through image processing. In our project, we propose to build a COVID-19 face mask detector system with computer vision using Python, OpenCV, and Tensor Flow and Keras. In our presented system, we will use live video stream and finally the person who is not wearing face masks can be recognized using advanced image processing technique with the help of Computer Vision and Deep Learning. If case a person is not wearing the face mask, then a SMS alert is sent to the concerned person's mobile. The proposed model provided excellent test accuracy of 99%.

Key words: Covid19, Image Processing, Face mask, Deep learning.

INTRODUCTION

Wearing masks in public is not just a trend now but an absolute necessity. Due to this COVID-19 pandemic, governments from different countries have forged absolute laws. In India, with the help of various hoardings, advertisements, even in the mobile caller tunes, the absolute necessity of wearing a face mask is shown.

Though, various steps have been taken, their lies loopholesas well. There comes our technology into play.

Technologies like Machine Learning, Artificial Intelligence are the ones with which we can easily tackle our problems.

The veryfirst step is Face Detection.

The main aim of face detection can be divided into: -

1. To find out whether there is any face in the givenscreen/image or stream or not and
2. If, yes whether the person is wearing a face mask ornot. The face MASK detection model is based on

computer vision and deep learning. The model isdeveloped with the help of Open CV, Keras, Tensorflow in Python. [1]

We have used the Open CV Haar Cascade Model to detect face within frames and the Residual Net Architecture is used to detect mask on a face. Our project can be implemented on traffic cameras to get frames and predict whether a person wears a mask or not.

There are several other procedures that can build a Facial Mask Detection for instance,[2] used electromagnetic and radiometry techniques for facial masks detection. [3] Employed deep neural networks (ANN) using machine learning techniques in Facial Masks detection.[4] Neural Networks are used to exacted information from ultrasound toclassify the abnormal lesions.[5] Presented a face feature detection method based on Ultrasound RF Time series and SVM Classifier. The characteristics curve of 0.86 using support vector machine (SVM) and 0.81using RF classification algorithm on 22 subjects was determined.

EASE OF USE

A. Data Collection

We have collected 1800 images of people wearing mask and unmask from various sources to build our dataset to train our model.

B. Data Preparation

We performed processing of images by using the above mentioned OpenCV functionalities to make it appropriate as per the requirements of our model. Finally, saving the dataset so that it can be used for future reference.

What is Neural Network?

A neural network is a series of algorithms that endeavour to recognize underlying relationships in a set of data through a process that mimics the way human brain operates. In this sense, neural network refer to a system of neurons organic or artificial in nature . [6].

C. Choosing the right Architecture

A Neural Network Architecture helps us to establish complex non linear relastionships between an inputs and outputs, thus providing us a generalized solution to make un- biased predictions in real life scenario. It derives its own features from the input to make better and more accurrate predicitons.

Therefore, choosing the right architecture plays avaluable role in making predictions.

The different architectures which we have trained are NasNet, ResNet, Dense Network, Mobile Net Architectures and the model giving us the best possible accuracy is used in our final implementation.

Training algorithm Used – Adam's Optimization

D. Testing Our Model

We have used 80 % of our dataset for training our model and 20 % of dataset to test our model. For testing purposes, we have calculated the Jaccard score of the predicted result w.r.t. the actual result.

Let, P = Predicted Set

A = Actual Set

then, Jaccard Index = $J(P , A) = (P \cap A) / (P \cup A)$

E. Comparative analysis

POINTS	DENSE_NET ARCHITECTURE	MOBILE_NET ARCHITECTURE	RES_NET ARCHITETURE (Proposed Model)	NAS_NET ARCHITECTURE
Definition	A dense network is a network in which the number of links of each node is close to the maximal number of nodes.	Mobile Net is a streamlined architecture that uses depth wise separable convolutions to construct lightweight deep convolutional neural networks and provides an efficient model for mobile and embedded vision applications.	A residual neural network (Res Net) is an artificial neural network (ANN) of a kind that builds on constructs known from pyramidal cells in the cerebral cortex. This architecture works by utilizing skip connections or shortcuts to change or jump over layers.	Neural architecture search (NAS) is a technique for automating the design of artificial neural networks (ANN), a widely used model in the field of machine learning.
Number of hidden layers	8	154(BASE) + 3(ADDED)	190(BASE) + 4(ADDED)	769(BASE) + 3(ADDED)
Optimization algorithm	Adams algorithm	Adams algorithm	Adams algorithm	Adams algorithm
Test accuracy	86 %	97 %	99 %	84 %
Size	2.45 GB	34.1 MB	120 MB	24.1 MB

Fig. 1

F. Implementation

Our project works by capturing live frames from various cameras connected to the system and detecting faces within those frames. After that we need to preprocess the image as per the model's requirements and feeding the images to the model and get the prediction whether a face consist of mask or not. If a face does not have a mask on it, the face is searched in a database to get the information of the person and finally a SMS notification is sent to the concerned person.

We keep count of all the notifications sent to the concerned person and when this count exceeds the maximum limit of warning that should be sent, then the person will be marked and appropriate legal action will be taken against the person by concerned authorities.

Note: Action which will be taken against the person shall be decided by the governing body where the software is implemented.

DEFINING THE DATA STORAGE

We have used IBM DB2 as our database to store information of all users for their identification. The Schema of our database consist of two tables: -

1. USER_INFO (User Id (Primary Key), Name,Country Code, Phone no., Email, Address)).
2. USER_IMAGE (Id (Primary Key), Mask Image,Unmask Image, User Id (Foreign Key)).

A. Schema of Database

Fig. 2

B. Snapshots of Database

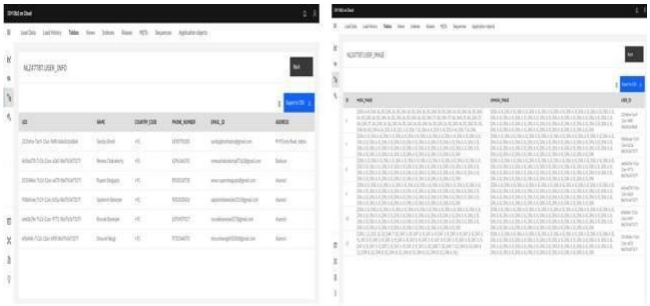

Fig. 3

C. Fetched results from database

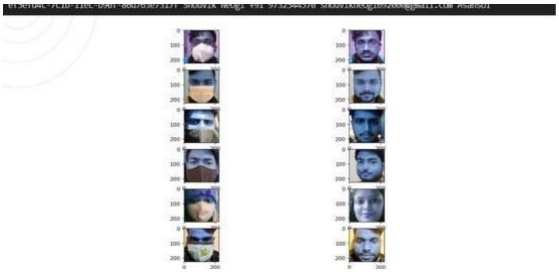

Fig. 4

FLOWCHART

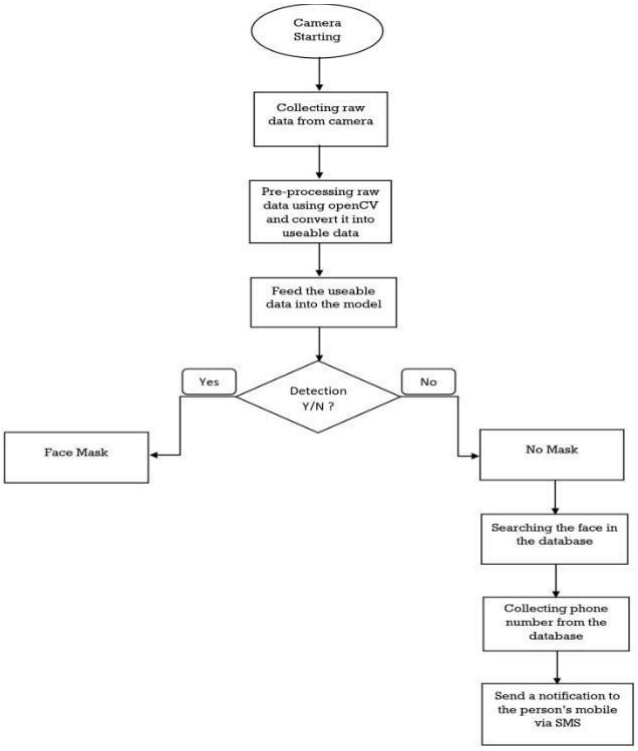

Fig. 5

RESULTS

Fig. 6

Fig. 7

CONCLUSION

On referring various articles and papers, we have come to understand the challenges faced in Face Detection. Upon development of face mask, we can detect the person wearing a face mask or not.
The main purpose is reducing people's transmission through this System.

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