FACE MASK DETECTION USING ARTIFICIAL INTELLIGENCE

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Abstract - *According to the reports of the WHO (World Health Organization), COVID-19 has emerged as the global pandemic over the year and it is prescribed to wear facial mask as a precautionary measure because it is the only thing one can do to avoid the pandemic. For the sake of stopping the transmission of virus various organizations has made it mandatory to wear face mask at their premises and it will be difficult for any person to check one by one whether everyone in an organization is wearing facial mask or not. So, I am proposing a theoretical model using deep and classical machine learning for detecting the facial mask. Our main objective is to detect the facial mask. A data set containing with and without facial mask images will be used to do real time detection, with the help of OpenCV, whether the person in image or video stream is wearing facial mask or not. After detection if the person is found not wearing facial mask, then the system will show warning. This automated inspection technique can be used at any place and it reduces the manpower required for inspection. Thus, the proposed model saves time and aware people about the use of facial mask in this pandemic situation.*

Key Words: *COVID-19, Artificial Intelligence, Machine Learning, Deep Learning, OpenCV, MobilenetV2.*

1.INTRODUCTION

[1] COVID-19 stands for Corona Virus Disease-2019, also known as coronavirus pandemic and it has emerged as the global pandemic in almost a year. COVID- 19 was firstly observed in Wuhan province of China in December 2019. It is caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-COVID- 19). The COVID-19 outbreak was declared Public Health Emergency of International Concern in January 2020 and later it was declared global pandemic in March 2020. More than 38.5 million cases have been confirmed till 15th October 2020 out of which more than 1.09 million have lost their lives. This disease easily spreads through air primarily via droplets when an infected person coughs, sneezes or talks. It can also be transmitted when an infected person contaminates any surface. An infected person can be infectious for weeks or even dies in worst cases. So, WHO recommends that the person should wear face mask in public places as a precautionary measure.

Thus, face mask detection has become a crucial computer vision task to help the society.

This paper describes an efficient computer vision-based approach for real time automated monitoring of a person to detect face mask in an organization. This model can be integrated with surveillance cameras to break the chain of COVID- 19 transmission by allowing the detection of face masks. The proposed model is alliance of deep and classical machine learning techniques with OpenCV, Tensor flow and Keras. This model uses deep transfer learning for extraction of features and combines it with classical machine learning algorithm for the training and detection in minimum time with highest accuracy.

1.1 COMPUTER VISION

[2] Computer Vision, often abbreviated as CV, is a branch of artificial intelligence that deals with how computers can achieve high level understandings from images or video streams. According to designing perspective, it tries to comprehend and computerize undertakings that the human visual framework can do. Computer vision tasks comprises of methods for receiving, filtering, exploring and understanding digital images, and derivation of high-dimensional data from the real world in order to extract numerical or symbolic information, in the forms of decisions. Here understanding refers to the conversion of visual images (the input of the retina) into descriptions of the world that make sense to thought processes and can elicit appropriate action. This image comprehension can be viewed as the trapping of emblematic data from image data utilizing models built with the assistance of calculation, material science, measurements, and learning hypothesis.

Figure 1: Working of Computer Vision

The logical order of computer vision worries for the hypothesis behind artificial intelligence that derive data from images. The image information can take numerous structures, for example, video successions, visuals from different cameras, multi-dimensional information from a 3D scanner or clinical scanning gadget. The innovative order of computer vision tries to apply its hypothesis and models to the development of computer vision frameworks.

1.2 Machine Learning

[3] Machine Learning (ML) is the analysis of computer algorithms that gets better consequently through experience. It is viewed as a subdivision of artificial intelligence. Machine Learning algorithms assemble a numerical model dependent on test information, known as "training data", so as to settle on expectations or choices without being unequivocally programmed to do as such.

Figure 2: Machine Learning

The order of machine learning utilizes different ways to instruct PCs to achieve undertakings where no up to the mark algorithm is accessible. Machine Learning is closely related with computational measurements, which centers around making forecasts using PCs. Data mining is a connected field of study, focusing on exploratory data examination through unaided learning. In its application across business issues, machine learning is likewise alluded to as predictive analytics. Machine Learning approaches are generally isolated into three general classes, contingent upon the idea of the "signal" or "feedback" accessible to the learning framework:

- Administered learning: The computer is given model sources of inputs and their ideal outputs, given by a "teacher", and the objective is to get familiar with an overall guideline that guides inputs to outputs.
- Un-administered learning: No marks are given to the learning algorithm, leaving it all alone to discover structure in its inputs. Unaided learning can be an

objective in itself (finding concealed examples in data) or a method towards an end (include learning).
- Augmented learning: A computer program interfaces with a unique environment in which it must play out a specific objective, (for example, driving a vehicle or playing a game against an adversary). As it explores its difficult space, the program is given feedback that is closely resembling rewards, which it attempts to maximize.

Different methodologies have been created which don't fit flawlessly into this three-overlay categorization, and once in a while more than one is utilized by a similar machine learning framework. As of 2020, deep learning has become the prevailing methodology for much progressing work in the field of machine learning.

1.3 Deep Learning

Deep learning (otherwise called deep structured learning) is essential for a more extensive group of machine learning strategies dependent on artificial neural networks with portrayal learning. Learning can be administered, semi-administered or un-administered. Deep learning frameworks, such as deep neural networks, deep belief networks, repetitive neural networks and convolutional neural networks have been applied to fields including computer vision, machine vision, speech recognition, regular language processing, social networks filtering, machine interpretation, bioinformatics, drug plan, clinical image processing, material review and tabletop game projects, where they have created results tantamount to and sometimes astounding human expert execution.
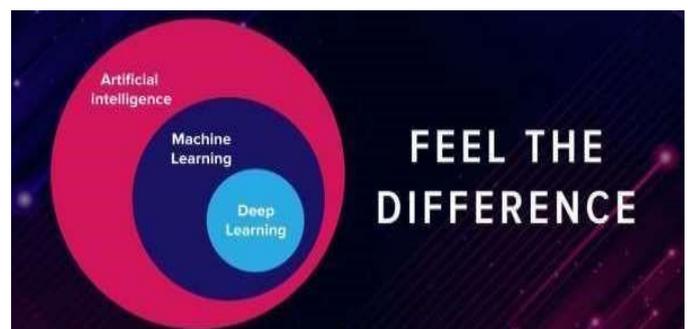
Figure 3: Deep Learning

[4] Artificial Neural Networks (ANNs) were enlivened by data processing and dispersed communication hubs in natural frameworks. ANNs have different contrasts from natural brains. In particular, neural networks will in general be static and emblematic, while the natural brain of most living creatures is dynamic and simple. The descriptive word "deep" in deep learning originates from the utilization of

different layers in the network. Early work indicated that a straight perceptron can't be a universal classifier, and afterward that an organization with a non-polynomial activation work with one shrouded layer of unbounded width can then again so be. Deep learning is an advanced variety which is worried about an unbounded number of layers of limited size, which grants viable application and upgraded usage, while holding hypothetical all-inclusiveness under gentle conditions.

1.4 OpenCV

[5] Open-Source Computer Vision Library, often abbreviated as OpenCV, is a machine learning programming library. OpenCV was created to give a typical framework to computer vision applications and to quicken the utilization of machine recognition in the business items. Being a BSD-authorized item, OpenCV makes it simple for organizations to use and adjust the code.

The library has more than 2500 advanced algorithm, which incorporates a far- reaching set of both work of art and best in class computer vision and machine learning algorithms. These algorithms can be utilized to distinguish and perceive faces, recognize objects, order human activities in recordings, track camera movements, track moving items, produce 3D point clouds from stereo cameras, find comparative images from an image database, eliminate red eyes from pictures taken using flash, follow eye movements, perceive view and build up markers to overlay it with expanded reality, and so forth OpenCV has in excess of 47 thousand individuals of client network and assessed number of downloads surpassing 18 million.

OpenCV's uses covers the reach from stitching street view pictures together, distinguishing interruptions in surveillance video in Israel, observing mine equipment in China, helping robots explore and get objects at Willow Garage, checking runways for debris in Turkey, investigating names on items in plants far and wide on to fast face detection in Japan.

It has C++, Java, Python and MATLAB interfaces and supports Windows, Linux, Android and Mac OS. OpenCV inclines generally towards ongoing vision applications and exploits MMX and SSE directions when accessible. There are more than 500 algorithm and around 10 times the number of functions that create or uphold those algorithms. OpenCV is composed locally in C++ and has a template interface that works flawlessly with STL holders.

1.5 TensorFlow

[5] TensorFlow is an open-source programming library for dataflow and differentiable programming over a scope of assignments. It is a representative number related library, and is additionally utilized for machine learning applications e.g., neural networks. TensorFlow was created by the Google Brain group for interior Google use. Tensor Flow is accessible on 64-digit Linux, macOS, Windows, also, portable platforms including Android and iOS. Its adaptable design takes into consideration the simple sending of computation over an assortment of platforms (CPUs, GPUs, TPUs), and from desktops to groups of servers to mobile and edge gadgets.

The name Tensor Flow originates from the activities that such neural networks perform on multidimensional informational arrays, which are alluded to as tensors. During the Google I/O Gathering in June 2016, Jeff Dean expressed that 1,500 archives on GitHub referenced TensorFlow, of which just 5 were from Google. Unlike other mathematical libraries proposed for use in Deep Learning like Theano, TensorFlow was intended for utilizing both in innovative work and underway frameworks, not least Rank Brain in Google search, the fun Deep Dream project. It can run on single CPU frameworks, GPUs just as cell phones and huge scope appropriated frameworks of several machines.

1.6 Keras

[5] Keras is an API intended for individuals, not machines. Keras follows best practices for diminishing psychological burden: it offers predictable and basic APIs, it limits the quantity of client activities needed for regular use cases, and it gives clear and significant error messages. It likewise has broad documentation and designer guides. Keras contains various executions of ordinarily utilized neural network building squares, for example, layers, destinations, actuation capacities, enhancers, and a large group of apparatuses to make working with image and text information simpler to improve the coding essential for composing deep neural system code. The code is facilitated on GitHub, and network uphold discussions incorporate the GitHub issues page, and a Slack channel. Keras is a moderate Python library for profound or deep learning that can run on roof of Theano or Tensor Flow. It was created to make actualizing profound learning models as quick and simple as feasible for examination and development. Keras was created and kept up by François Chollet, a Google engineer utilizing four core values:

- Modularity: A model can be perceived as an arrangement or a chart alone. All the worries of a profound/deep learning model are discrete segments that can be joined in discretionary manners.
- Minimalism: The library gives barely enough to accomplish a result, straightforward and amplifying clarity.
- Extensibility: New parts are purposefully simple to include and use inside the structure, proposed for specialists to preliminary and explore groundbreaking thoughts.
- Python: No different model records with custom document designs. Everything is local Python. Keras is intended for moderation and measured quality permitting you to rapidly characterize profound/deep learning models and run them on top of a Theano or TensorFlow backend.

1.7 PyTorch

PyTorch is an open-source AI library dependent on the Torch library, utilized for applications, for example, PC vision and normal language processing, basically created by Facebook's AI Research lab (FAIR). It is delivered under the Modified BSD permit. In spite of the fact that the Python interface is more cleaned and the essential focal point of improvement, PyTorch additionally has a C++ interface. Tensor figuring (like NumPy) with solid increasing speed by means of graphics processing units (GPU).

- Deep neural organizations based on a tape-based programmed separation framework PyTorch characterizes a class called Tensor (torch.Tensor) to store and work on identical multidimensional rectangular arrangements of numbers. PyTorch Tensors are like NumPy Arrays, yet can likewise be worked on a CUDA-fit Nvidia GPU. PyTorch underpins different sub- sorts of Tensors.

2. PROPOSED SYSTEM

[6][7] The proposed framework centers around how to recognize the individual on picture/video stream wearing face mask with the assistance of PC vision and machine learning algorithm by utilizing the OpenCV, TensorFlow, Keras and PyTorch library.

Approach

1. Dataset of around 300 images with & without face mask are collected out of which 150 images are used for training the model and 150 images for testing the model.
2. Apply face mask detector created using machine learning algorithm over the picture/live video stream.
3. The system will show warning to the violator.

Sequential Diagram
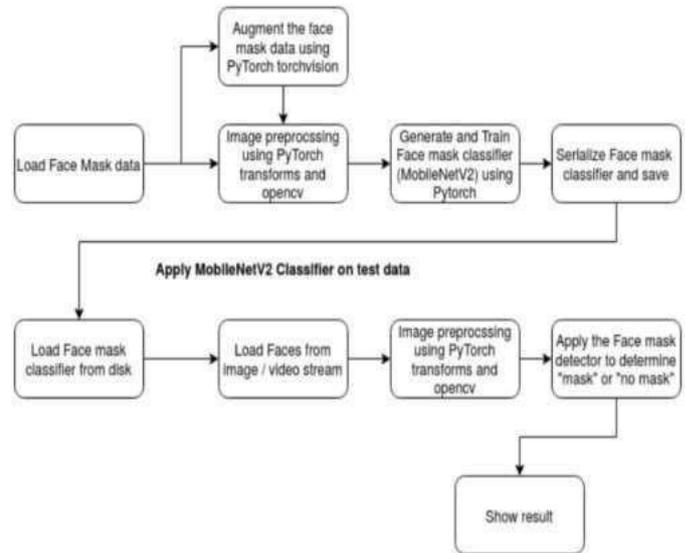
Figure 4: Flowchart of Model

Data at Source

Figure 5: Pictures at source

Most of the pictures were augmented by OpenCV. The set of pictures were already marked "Mask" and "No Mask". The pictures that were available were of various sizes and resolutions, presumably separated from various sources or from machines (cameras) of various resolutions.

Data preprocessing

Preprocessing steps as referenced beneath was applied to all the crude information pictures to change over them into clean forms, which could be taken care of to a neural network AI model.

1. Resizing the input picture (256 x 256).
2. Applying the shading sifting (RGB) over the channels (Our model MobileNetV2 underpins 2D 3 channel picture).
3. Normalizing pictures utilizing the standard mean of PyTorch work in loads.
4. Center trimming the picture with the pixel estimation of 224x224x3.
5. Lastly transforming them into tensors (Similar to NumPy cluster).

Deep Learning Framework

To execute this deep learning network, we have the accompanying choices.

1. Tensor Flow
2. Keras
3. PyTorch
4. Microsoft Cognitive Tool Kit
5. Caffe

Here PyTorch is utilized in light of the fact that it runs on Python, which implies that anybody with an essential comprehension of Python can begin on building their deep learning models, and furthermore it has the accompanying advantage over the Tensor Flow.

1. Information Parallelism.
2. It would seem as a Framework.

MobileNetV2

[8] MobileNetV2 expands upon the thoughts from MobileNetV1, utilizing profundity shrewd distinguishable convolution as proficient structure blocks. In any case, V2 acquaints two new highlights with the design:

1. Linear bottlenecks between the layers, and

2. Shortcut associations between the bottlenecks.

The average MobilenetV2 architecture has the same number of layers recorded underneath, In PyTorch we can utilize the model's library in Torch Vision to make the MobileNetV2 model as opposed to characterizing/building our own model. The loads of each layer in the model are predefined dependent on the ImageNet dataset. The loads show the

cushioning, steps, kernel size, input channels and output channels. MobileNetV2 was picked as an algorithm to manufacture a model that could be conveyed on a portable gadget. A modified completely associated layer which contains four consecutive layers on top of the MobileNetV2 model was created. The layers are

1. Normal Pooling layer with 7×7 loads.
2. Direct layer with ReLu initiation work.
3. Dropout Layer.
4. Direct layer with SoftMax initiation function with the consequence of 2 qualities.

The last layer SoftMax function gives the consequence of two probabilities every one speaks to the grouping of "mask" or then again "no mask".

The essential structure is demonstrated as follows:
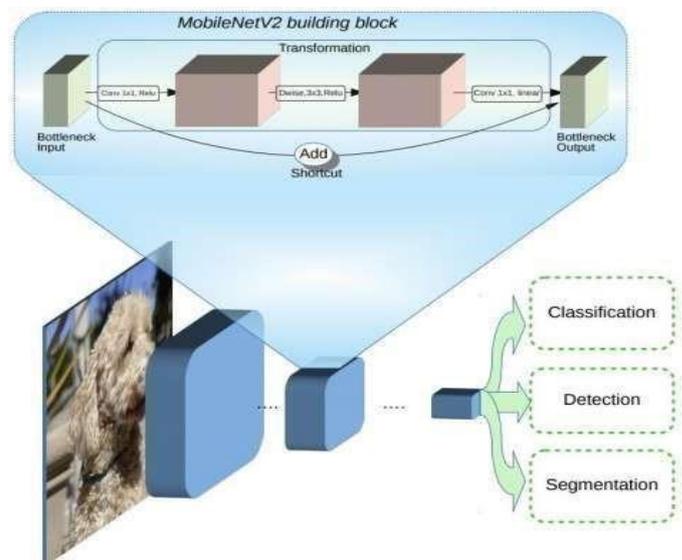
Figure 6: MobileNetV2 architecture

Face Mask detection in webcam stream

The stream to distinguish the individual in the webcam wearing the face mask or not. The cycle is two-overlap:

1. To distinguish the faces in the webcam.
2. Group the faces dependent on the mask.

To recognize the faces a pre-prepared model given by the OpenCV system was utilized. The model was prepared utilizing web pictures. OpenCV gives 2 models to this face detector:

1. Drifting point 16 version of the foremost Caffe application.
2. 8-bit quantized variant utilizing Tensor flow.

The Caffe model in this face mask detector. There has been a ton of conversation around machine learning based methodologies for person identification. This urged everyone to think of our own algorithm to take care of this issue. The work on facemask recognition includes information assortment to handle the change in sorts of face masks worn by the workers. The face cover detection model is a mix of face identification model to recognize the current appearances from camera feeds and afterward running those faces through a mask detection model.

3. CONCLUSIONS

As the innovation are blossoming with developing patterns so this model gives a novel face mask detector which can add to public medical care. The architecture comprises of MobileNet as the spine, it may be utilized for high and low computation situations. So as to extricate more vigorous highlights, here transfer learning is used to embrace loads from a comparative undertaking face recognition, which is trained on an exceptionally enormous dataset.

This model has utilized OpenCV, TensorFlow, Keras, PyTorch and CNN to identify if individuals were wearing face masks. The models were tested with pictures and continuous video streams. The exactness of the model is accomplished and, the optimization of the model is a ceaseless cycle and this model creates an exceptionally precise arrangement by tuning the hyper parameters. This particular model could be utilized as a utilization case for edge investigation. Moreover, the proposed technique accomplishes best in class results on a public face mask dataset. By the advancement of face mask detection, we can recognize if the individual is wearing a face cover and permit their entrance would be of extraordinary assistance to the general public.

4. FUTURE WORKS

1.   Coughing and Sneezing Detection: According to World Health Organization (WHO) guidelines, coughing and sneezing are key symptoms of Covid-19 furthermore they are the major transmission channels to an uninfected person. Machine learning based methodology can be demonstrated convenient here to recognize and restrict the illness spread by upgrading our proposed arrangement with body motion examination to comprehend if an individual is coughing and sneezing out in the open spots while penetrating facial cover and social distancing guidelines and dependent on result concerned offices can be alarmed.

2.   Temperature Screening: Increased body temperature is another key side effect of COVID-19 disease, at present situation thermal screening is done utilizing handheld contactless IR thermometers where wellbeing worker need to come in closeness with the individual should be screened which makes the wellbeing workers defenseless against get contaminated and furthermore its basically difficult to catch temperature for every single individual out in the open places, the proposed use-case can be furnished with thermal cameras based screening to dissect body temperature of the people in public places that can add another assistance to authorization offices to handle the pandemic adequately.

REFERENCES

[1] P. A. Rota, M. S. Oberste, S. S. Monroe, W. A. Nix, R. Campagnoli, J. P. Icenogle, S. Penaranda, B. Bankamp, K. Maher, M.-h. Chen et al., "Characterization of a novel coronavirus associated with severe acute respiratory syndrome," science, vol. 300, no. 5624, pp. 1394–1399, 2003.

[2] S. Ge, J. Li, Q. Ye and Z. Luo, "Detection of Masked Faces in the Wild with LLE-CNNs," 2017 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), Honolulu, HI, 2017, pp. 426-434.

[3] A. Kumar, A. Kaur, and M. Kumar, "Face detection techniques: a review", vol. 52, no. 2, pp. 927–948, 2019.D.-H. Lee, K.-L. Chen, K.-H. Liou, C.- L. Liu, and J.-L. Liu, "Deep learning and control algorithms of direct perception for autonomous driving, 2019

[4] S. J. Pan and Q. Yang, "A Survey of Transfer Learning," in IEEE Transactions on Knowledge and Data Engineering, vol. 22, no. 10, pp. 1345- 1359, Oct. 2010.

[5] Das, Arjya & Ansari, Mohammad & Basak, Rohini. (2020). Covid-19 Face Mask Detection Using TensorFlow, Keras and OpenCV. 10.13140/RG.2.2.21473.94565.

[6] M. S. Ejaz and M. R. Islam, "Masked Face Recognition Using Convolutional Neural Network," 2019 International Conference on Sustainable Technologies for Industry 4.0 (STI), Dhaka, Bangladesh, 2019, pp. 1-6, doi: 10.1109/STI47673.2019.9068044.

[7] N. Ozkaya and S. Sagiroglu, "Intelligent face mask prediction system," 2008 IEEE International Joint Conference on Neural Networks (IEEE World Congress on Computational Intelligence), Hong Kong, 2008, pp. 3166-3173, doi: 10.1109/IJCNN.2008.4634246.

[8] Preeti Nagrath, Rachna Jain, Agam Madan, Rohan Arora, Piyush Kataria, Jude Hemanth, SSDMNV2: A real time DNN-based face mask detection system using single shot multi-box detector and MobileNetV2, Sustainable Cities and Society, Volume 66,2021,102692, ISSN 2210-6707,