Face Mask Detection

Mayuresh Kadam
Department of Information Technology
K J Somaiya College of Engineering
Roll: 1814001
kadam.ms@somaiya.edu

Jainam Mehta
Department of Information Technology
K J Somaiya College of Engineering
Roll: 1814008
jainam.tm@somaiya.edu

Sourabh Bujawade
Department of Information Technology
K J Somaiya College of Engineering
Roll: 1814009
sourabh.bujawade@somaiya.edu

Darshan Kalwani
Department of Information Technology
K J Somaiya College of Engineering
Roll: 1814029
darshan.kalwani@somaiya.edu

Nachiket R Moghe
Department of Information Technology
K J Somaiya College of Engineering
Roll: 1814039
nachiket.moghe@somaiya.edu

Vighnesh Naik
Department of Information Technology
K J Somaiya College of Engineering
Roll: 1814041
Vighnesh.naik@somaiya.edu

***Abstract*—The coronavirus COVID-19 epidemic poses a global health problem and therefore an effective preventive measure has been wearing a mask in public places according to the World Health Organization (WHO). The COVID-19 epidemic has forced governments around the world to impose restrictions on the transmission of the virus. Reports indicate that wearing a face mask at work significantly reduces the risk of transmission. The detection of a face mask has seen significant progress in the fields of image processing and computer vision, since the rise of the Covid-19 epidemic. Many types of facial models are performed using many algorithms and techniques. In this, both papers, proposed modes use CNN and .**

***Index Terms*—Image Processing, Convolutional Neural Network, TensorFlow Object Detection API, Face Masked Detection,**

I. INTRODUCTION

Coronavirus disease 2019 (COVID-19) has affected over 20 million people worldwide, resulting in over 0.7 million deaths, according to the World Health Organization's official Situation Report – 205. Every week, the crisis owing to COVID-19 worsens, bringing the whole planet to a halt. COVID 19 patients have registered a diverse range of symptoms, ranging from mild signs to severe illness. All of these being respiratory issues such as shortness of breath or trouble breathing. COVID-19 infection can cause severe symptoms in elderly people with lung disease, as they happen to be at a greater risk. To prevent being infected with or spreading the COVID-19 (coronavirus) pandemic, almost everyone is required to wear a face mask as a precaution. To avoid the transmission of the COVID-19 pandemic, wearing a face mask has been made mandatory in public areas such as buses and trains. Authorities have designated special caretakers to monitor whether or not an individual is wearing a face mask. Manual oversight, on the other hand, is inefficient, inadequate, and difficult to scale.

Developing countries like India and Brazil lack the human and financial capacity to effectively track their commuter populations. As a result, there is a pressing need for artificial intelligence-based technology that is capable of detecting the aforementioned issue without the need for human intervention. The above problem statement can be solved using concepts from the field of computer vision, such as target recognition, translation, and classification. Object recognition is a widely used term for teaching a system to recognise any target object in an image. Item recognition methods may be applied to static images as well as video frames. Masked and non-masked face detection aims to classify each face in an image and to localize each detection identified in parallel. Face mask detection has since become a critical role in today's global society. Face mask identification involves identifying the orientation of a person's face and then assessing whether or not they are wearing a mask. The problem is related to general object recognition, which is used to identify different types of objects. Face identity is the process of categorising and identifying a particular category of entities, namely faces. It has a wide range of uses, including autonomous driving, schooling, and surveillance. The simple Machine Learning (ML) packages such as TensorFlow, Keras, OpenCV, and Scikit-Learn are used in this paper to present a simpler approach to fulfil the above purpose.

II. MAIN IDEA OF THE PAPER

A. Paper I - Detecting Masked Faces using Region-based Convolutional Neural Network

This paper proposes a method for detecting both masked and non-masked faces in an image to address the problem of minimal work in the face mask detection domain. The aim is to advance the field of masked and non-masked face detection study. It proposes a Convolutional Neural Network model based on regions to achieve this goal.To increase the depth of the neural network model without triggering disappearing or bursting gradients, the proposed model employs area proposals and residual skip connections.

Since the COCO dataset includes common artefacts, this paper uses pre-trained models that were trained on it. The

proposed model was able to reliably detect low-level facial features after being pre-trained on the COCO dataset. The task of detecting high-level facial features, such as the appearance of a mask on the face, was then transferred to this learning.

B. Paper II - Covid-19 Face Mask Detection Using TensorFlow, Keras and OpenCV

Face mask detection has become a crucial task to help global society in the current scenario. This paper presents a simplified approach to achieve the purpose using some basic Machine Learning packages like TensorFlow, Keras, OpenCV and Scikit-Learn. The proposed method detects the face from the image correctly and then identifies if it has a mask on it or not. As a surveillance task performer, it can also detect a face along with a mask in motion. The paper explores optimized values of parameters using the Sequential Convolutional Neural Network model to detect the presence of masks correctly without causing over-fitting. This paper presents a simplified approach to serve the above purpose using the basic Machine Learning (ML) packages such as TensorFlow, Keras, OpenCV and Scikit-Learn. The paper broadly discusses the dataset, data visualization, conversion of RGB image to grey-scale image, image reshaping. It further builds and trains the CNN model and analyses the results.

III. METHODOLOGY

A. Paper I - Detecting Masked Faces using Region-based Convolutional Neural Network

The process for creating a custom is described in the current section. Face files, both masked and unmasked, are included in this dataset:
The non-masked photos were collected from the internet using web scraping. Keywords like 'people without a mask' and 'face picture of people' were used to retrieve over two thousand photos from Google, Bing, and websites like gettyimages.com, pixels.com, and unsplash.com during this process. Images with a width and height greater than 600 pixels were chosen. There were a total of 1,047 pictures of masked and non-masked faces in the final dataset. The dataset was divided into a train and test set, with 999 images in the training set and 47 images in the test set.

All of the faces on these images were manually annotated and then cross-verified several times to ensure that the annotation was correct. To annotate the files, a labelling tool was used.

B. Paper II - Covid-19 Face Mask Detection Using TensorFlow, Keras and OpenCV

Technological aid has been paramount since the onset of this pandemic. Many technology communities have suggest using facial detection for verifying if individuals are wearing a mask. This paper deals with identifying if a person is wearing the mask or not.The following methodology is followed by the paper. The model inputs two data-set where each data-set includes faces that are classified as wearing a mask and not wearing a mask.

Fig. 1. Example images of the custom dataset containing masked and non-masked Faces.

Fig. 2. Data-set 1

Fig. 3. Data-set 2

Then, the images in these data-sets are converted from the RGB image to Gray-scale image. This done to reduce the size of the data that we are using as RGB images have more features than a Gray-scale images. However, the features that the color carries is unnecessary.

Further, the gray-scale image is compressed to the size

of100*100.

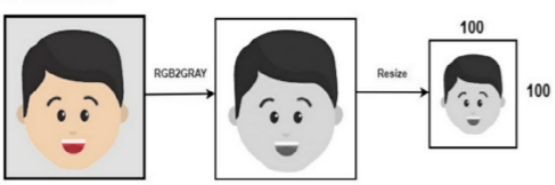

Fig. 4. Conversion of a RGB image to a Gray Scale image of 100x100 size

Then, the image is normalized and converted into a 4 dimensional array. Now, a CNN is model built which has a convolution layer of 100 filters. Then the second convolution layer is built which has 100 filters. Then a flatten layer is added to the network classifier. A dense layer having 64 neurons is added. The final Dense layer has 2 outputs to classify if the person in the image is wearing a mask or not.

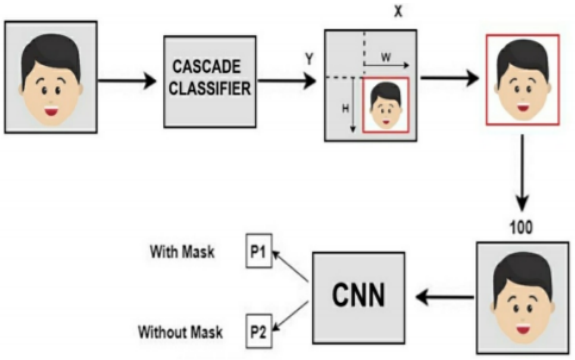

Fig. 5. Convolutional Neural Network architecture

The entire Machine learning model's flow can be summarized as shown below.

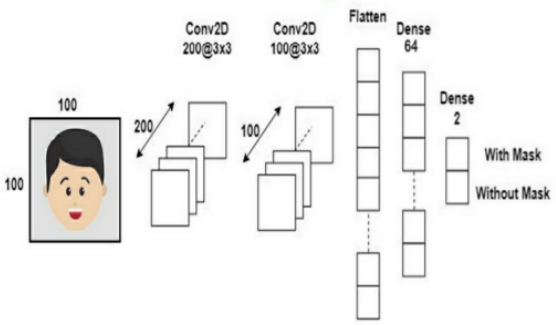

Fig. 6. Model overview

IV. RESULTS AND ANALYSIS

A. Paper I - Detecting Masked Faces using Region-based Convolutional Neural Network

Figures 7, 8, 9 show the total loss graphs for proposed model, SSD Inception V2 and SSD MobileNet V2 respectively. Figure 10 displays some selected outputs based on the proposed model.

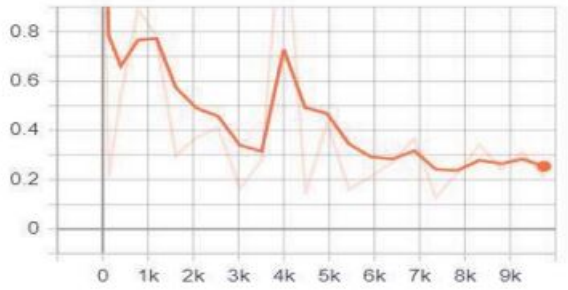

Fig. 7. Total Loss based on Proposed Model

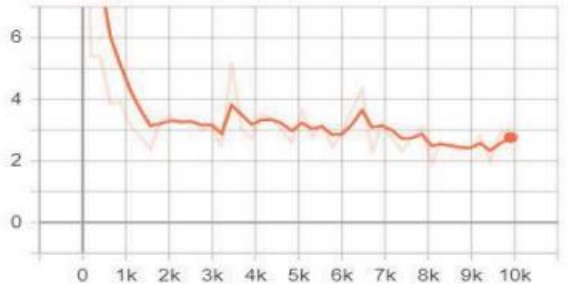

Fig. 8. Total Loss based on SSD Inception V2 Model

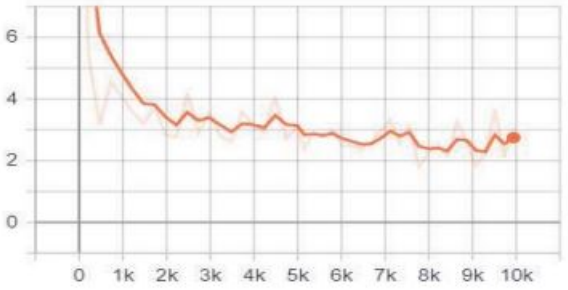

Fig. 9. Total Loss based on SSD MobileNet V2 Model

B. Paper II - Covid-19 Face Mask Detection Using TensorFlow, Keras and OpenCV

The AI model used is capable to determine with a substantial accuracy on both the data sets if an individual is wearing a mask or not.

Fig. 10. Selected results based on the proposed model

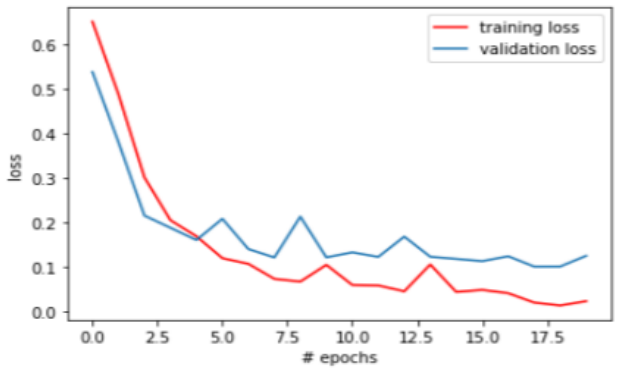

Fig.11. epochs vs loss corresponding to dataset 1

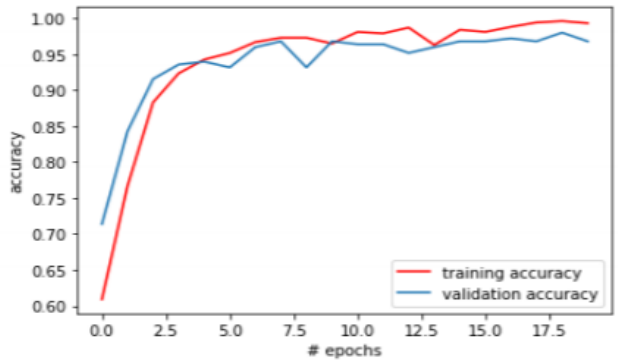

Fig.12. epochs vs accuracy corresponding to dataset 1

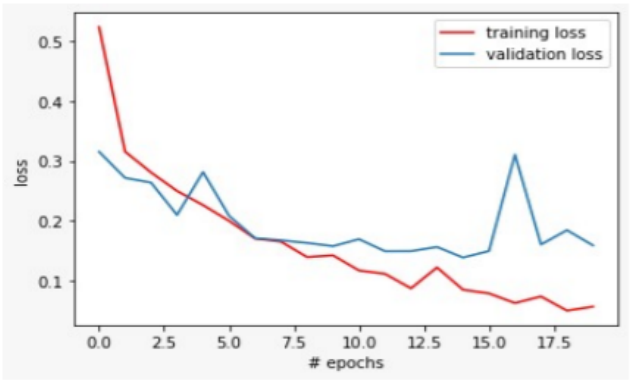

Fig.13. epochs vs loss corresponding to dataset 2

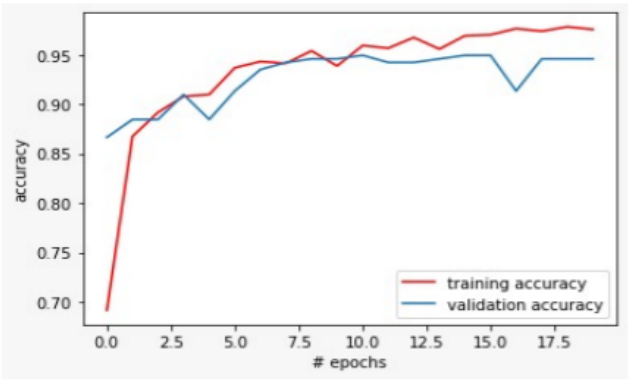

Fig.14. epochs vs accuracy corresponding to dataset 2

The model successful has used image classification techniques by using CNN.

V. CONCLUSION AND LEARNING

A Convolutional Neural Network-based model was proposed in this paper to classify masked and non-masked faces in images using zone proposals and residual skip-connections. At the outset of this article, we briefly discussed the work's inspiration. The model's learning and performance tasks were then shown. The approach has achieved a reasonable level of precision using simple machine learning methods and simpler techniques. It can be used in various application. Given the Covid-19 crisis, wearing a mask could become mandatory in the near future. Many government agencies will need people to wear masks properly in order to use their facilities. The implemented paradigm would make a significant contribution to the universal health care system. It may be enhanced in the future to detect whether or not an individual is wearing the mask properly. A new dataset of masked and non-masked faces was also developed, containing 1047 photographs. There were 1047 images in the study's dataset, and the proposed model had 2.3 106 trainable parameters. Overfitting could occur if the proposed model is trained from scratch. To prevent this problem and ensure that the model generalises well. Experiments revealed that the proposed model obtained a cumulative mAP of 85.82 percent. This was higher than the

SSD Inception V2 model's total mAP (71.03 percent) and the SSD Mobile-Net V2 model's total mAP (71.03 percent) (72.48 percent). Since the function extractor used residual blocks, the proposed implementation performed considerably better than the other two state-of-the-art implementations. As a result, the object detection network was even more fundamental. As a result, it will be able to solve the problem of vanishing and bursting gradients.

VI. FUTURE SCOPE

A. Paper I - Detecting Masked Faces using Region-based Convolutional Neural Network

Future Scope is to propose a comprehensive database collection of acquisition object training types. Better hyper-parameter tuning can be used to get the more precise location of the mask with accuracy. In addition, the proposed model can be installed and integrated with the CCTV Surveillance system which will decide who wears a mask or who not in real-time.

B. Paper II - Covid-19 Face Mask Detection Using TensorFlow, Keras and OpenCV

This model can be used at any public or private space to ensure that individuals are wearing masks. The model can be directly connected to various government's or organization's identification database, to identify and then penalize or prosecute the particular individual disobeying the law. This model can hence be a life saving tool at an unfortunate time of any pandemic, gas leak or other disaster. Also, this can be used to detect if an individual is covering their face while entering the premise. Hence, this model can also be used in identifying if a person is trying to enter in an unethical way.

VII. REFERENCES

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