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Face Mask Detection Using OpenCV

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Abstract— **The COVID-19 pandemic is causing a worldwide emergency in healthcare. This virus mainly spreads through droplets which emerge from a person infected with coronavirus and poses a risk to others. The risk of transmission is highest in public places. One of the best ways to stay safe from getting infected is wearing a face mask in open territories as indicated by the World Health Organization (WHO). In this project, we propose a method which employs TensorFlow and OpenCV to detect face masks on people. A bounding box drawn over the face of the person describes weather the person is wearing a mask or not. If a person's face is stored in the database, it detects the name of the person who is not wearing face mask and an email will be sent to that person warning them that they are not wearing a mask so that they can take precautions.**

Keywords - COVID-19, Tensorflow, OpenCV, Face Mask, Image Processing, Computer Vision

I. INTRODUCTION

COVID-19 had a massive impact on human lives. The pandemic lead to the loss of millions and affected the lives of billions of people. Its negative impact was felt by almost all commercial establishments, education, economy, religion, transport, tourism, employment, entertainment, food security and other industries. According to WHO(World Health Organization), 55.6 million people were infected with Coronavirus and 1.34 million people died because of it as of November 2020. This stands next to black death which almost took the lives of 60 percent of population in Europe in the 14th century. After the person gets infected, it takes almost fourteen days for the virus to grow in the body of its host and affect them and in the meantime, it spreads to almost everyone who is in contact with that person. So, it is extremely hard to keep the track of the spread of COVID-19.

COVID-19 mainly spreads through droplets produced as a result of coughing or sneezing by an infected person. This transfers the virus to any person who is in direct close contact (within one-meter distance) with the person suffering from coronavirus. Because of this, the virus spreads rapidly among the masses. With the nationwide lockdowns being lifted, it has become even harder to track and control the virus. Face masks are an effective method to control the spread of virus. It had been found that wearing face masks is 96% effective to stop the spread of virus. The governments, all over the world, have imposed strict rules the everyone should wear masks while they go out. But still, some people may not wear masks and it is hard to check weather everyone is wearing mask or not. In such cases, computer vision will be of great help.

There are no efficient face mask detection applications to detect weather the person is wearing face mask or not. This increases the demand for an efficient system for detecting face masks on people for transportation means, densely populated areas, residential districts, large-scale manufacturers and other enterprises to ensure safety. This project uses machine learning classification using OpenCV and Tensorflow to detect facemasks on people.

MACHINE LEARNING CLASSIFIERS:

These are used to predict the class/target/labels/categories of a given data points. Classification belongs to the category of supervised learning in which the targets are provided with input data. They are used in many applications like medical diagnosis, spam detection, target marketing etc. They use a mapping function (f) from input variables (X) to discrete output variables(Y).

OPENCV:

OpenCV is an open-source library which is primarily used for Computer Vision Applications. This contains many functions and algorithms for Motion tracking, Facial recognition, Object Detection, Segmentation and recognition and many other applications. Images and real time video streams can be manipulated to suit different needs using this library.

TENSORFLOW:

It is an open-source machine learning framework to build and train neural networks. It has a collection of tools, libraries and community resources which helps in easy building of deployment of ML powered applications. This is developed and maintained by Google and was released in 2015.

II. RELATED WORK

In [1] the authors used PCA (Principal Component Analysis) method to identify faces with masks, which is essential in the field of security. This is one of the few works which concentrated on detection of human faces where they are wearing masks. They found that the accuracy in human face detection decreases by 70% when a face mask is present.

In [2] the authors have developed a method to identify how a person is wearing the face mask. They were able to classify three categories of facemask-wearing condition namely correct facemask-wearing, incorrect facemask- wearing, and no facemask-wearing. This method achieved over 98% accuracy in detection.

In [3], the researchers proposed a method for the identification of faces using Generalized Intersection over Union (GIoU) based on Mask R-CNN. They proposed this method to reduce the background noise by correctly identifying the face instead of bounding box which adds noise to the face features and reduces the accuracy of detection.

Nicolae-Cătălin Ristea, Radu Tudor Ionescu [4] proposed a novel data augmentation approach for mask detection from speech.Original and translated utterances were changed over into spectrograms were given as inputs to a bunch of ResNet neural organizations with different depths. In [5] the authors have employed a GAN-based network using two discriminators for the removal of face mask from a face and reconstruct the face without the face mask using the CelebA dataset.

III. METHODOLOGY

Dataset Collection: The dataset was collected from Kaggle Repository and was split into training and testing data after its analysis.

Training a model to detect face masks: A default OpenCV module was used to obtain faces followed by training a Keras model to identify face mask.

Detecting the person not wearing a mask: A open CV model was trained to detect the names of the people who are not wearing masks by referring the database.

Sending the e-mail: The system was designed to send an e-mail to the person not wearing a mask using smtplib.

IV. WORKING

This project makes the use of OpenCV,Caffe-based face detector, Keras, TensorFlow and MobileNetV2 for the detection of face mask on humans. The dataset which is being used contains 3835 images out of which 1916 images have people with masks in them and 1919 people without masks in them.

First a base model is generated. This is done my using Keras and MobileNetV2. First a base model is generated and a head model is generated on top of that. The head model consists of a network with 128 layers, an activation function of "Relu" and a dropout of 0.5 followed by another network with 2 layers and an activation function "softmax". All these three layers combined, will give out model which will be trained.

The generated model is then trained with the labeled dataset by splitting it into two portions. One portion contains 75 percent images and it is used for training. The remaining portion contains the remaining 25 percent of images and is used for testing the model accuracy. After the model is trained, it can be used for detection of facemask on human faces.

The trained model is loaded and image which contains human faces with or without masks or a continuous video stream with humans is given as input. The image or a frame of the video, in case the input is a video stream, is first sent to the default face detector module for the detection of human faces. This is done by resizing the image or the video frame first, followed by detecting the blob in it. This detected blob is sent to the face detector model which outputs only the cropped face of a person without the background. This face is given as the input to the model which we trained earlier. This outputs weather there is a mask or not.

Another model is trained with the faces of humans. The images used for the training of the model are provided with the name and email address of that person as the labels of those images. This is done by using Open CV. When an input image is given to the CV model, it detects the face of a person and asks the user to provide the name and email address of that person which will be stored in the database. The output of the first model is given as the input to this model. This face will be compared with the persons present in the database. And if his face matches, then a bounding box will be drawn over his face with his name on it and an email and Sms will be sent to him that he is not wearing a mask. Else, only the words "Mask" will be present below the bounding box if the person is wearing a mask and "No Mask" if the person is not wearing one.

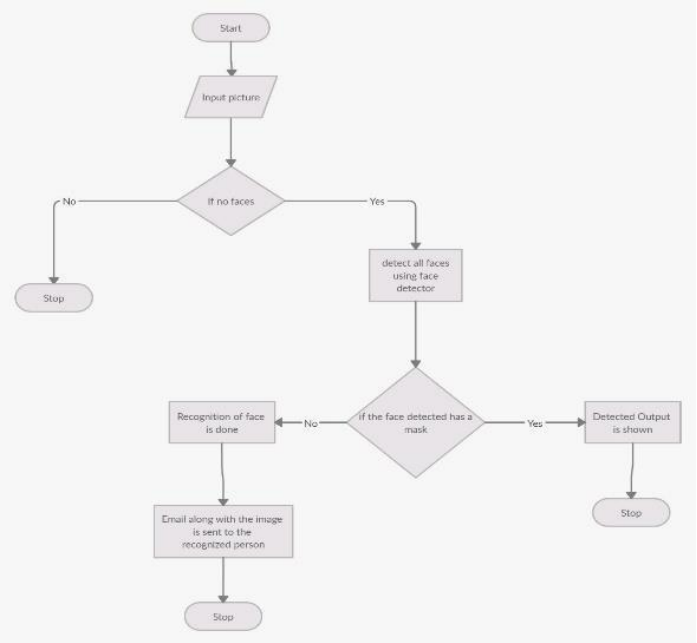

Figure 4.1: Flowchart of the Project

Figure 5.2:When Person Wearing Mask.A Bounding Box Drawn Over the Face of the Person Describes The Person Wearing Mask.

V.RESULTS

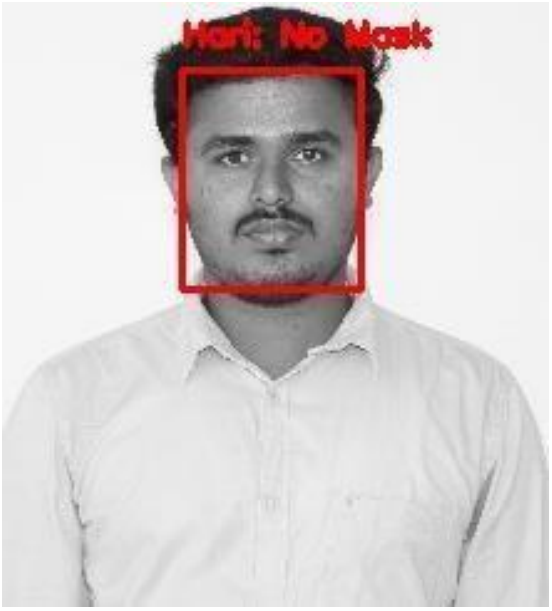

Figure 5.1: When The Person Not Wearing the Mask . A bounding box drawn over the face of the person describes weather the person is wearing a mask or not. If a person's face is stored in the database, it detects the name of the person who is not wearing face mask.

Fig5.4: when a person Identifies the not wearing Mask And those details not in the database it try's Match faces in the database. A bounding box drawn over the face of the person describes weather the person is wearing a mask.

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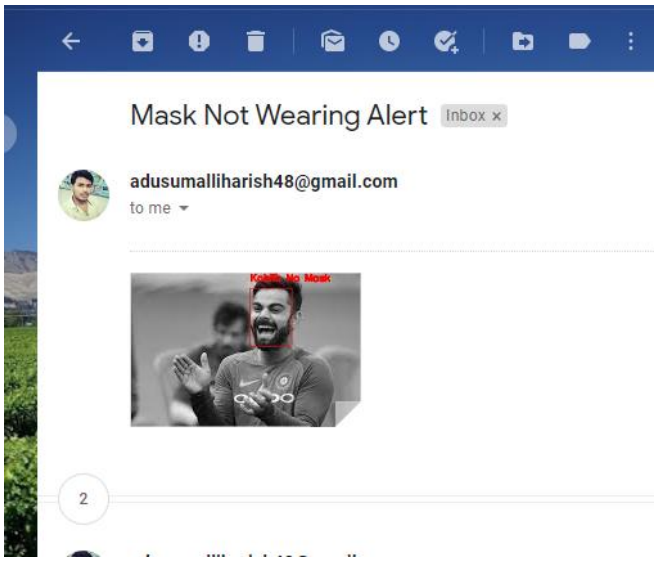

Figure 5.4: A bounding box drawn over the face of the person describes weather the person is wearing a mask or not. If a person's face is stored in the database, it detects the name of the person who is not wearing face mask and an email will be sent to that person warning them that they are not wearing a mask so that they can take precautions.

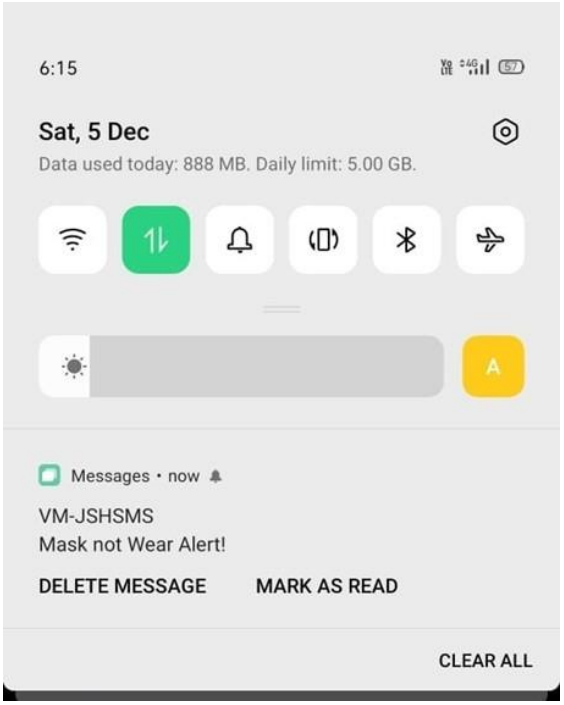

Figure 5.5:A bounding box drawn over the face of the person describes weather the person is wearing a mask or not. If a person's face is stored in the database, it detects the name of the person who is not wearing face mask and SMS will be sent to that person warning them that they are not wearing a mask so that they can take precautions.

VI. CONCLUSION

With the increasing number of COVID cases all over the world, a system to replace humans to check masks on the faces of people is greatly needed. This system satisfies that need. This system can be employed in public places like railway stations and malls. It will be of a great help in companies and huge establishments where there will be a lot of workers. This system will be of a great help there because it is easy to obtain and store the data of the employees working in that Company and will very easy find the people who are not wearing the mask and a mail will sent to that respective person to take Precautions not wearing mask.

REFERENCES:

[1] M. S. Ejaz, M. R. Islam, M. Sifatullah and A. Sarker, "Implementation of Principal Component Analysis on Masked and Non-masked Face Recognition," 2019 1st International Conference on Advances in Science, Engineering and Robotics Technology (ICASERT), Dhaka, Bangladesh,2019, pp. 1-5, doi: 10.1109/ICASERT.2019.8934543.

[2] BOSHENG QIN, DONGXIAO LI. Identifying Facemask-wearing Condition Using Image Super-Resolution with Classification Network to Prevent COVID-19, 13 May 2020, PREPRINT (Version 1) available at Research Square [+https://doi.org/10.21203/rs.3.rs- 28668/v1+]

[3] Kaihan Lin, Huimin Zhao, Jujian Lv(&)Jin Zhan, Xiaoyong Liu, Rongjun Chen, Canyao Li, and Zhihui Huang, "Face Detection and Segmentation with Generalized Intersection over Union Based on Mask R-CNN",Advances in Brain Inspired Cognitive System J. Ren et al. (Eds.):
BICS 2019, LNAI 11691, pp. 106–116, 2020

[4] N. Ud Din, K. Javed, S. Bae and J. Yi, "A Novel GAN-Based Network for Unmasking of Masked Face," in IEEE Access, vol. 8, pp. 44276-44287, 2020, doi: 10.1109/ACCESS.2020.2977386.

[5] Nicolae-Cătălin Ristea, Radu Tudor Ionescu, Are you wearing a mask? Improving mask detection from speech using augmentation by cycle-consistent GANs, arXiv:2006.10147v2 [eess.AS]

[6]"Paris Tests Face-Mask Recognition Software on Metro Riders," Bloomberg.com, May 07, 2020.

[7] "Datakalab | Analyse de l'image par ordinateur." https://www.datakalab.com/ (accessed Jun. 29, 2020)

[8] Jeong-Seon Park, You Hwa Oh, Sang Chul Ahn, and Seong-Whan Lee, Glasses removal from facial image using recursive error compensation, IEEE Trans. Pattern Anal. Mach. Intell. 27 (5) (2005) 805–811, doi: 10.1109/TPAMI.2005.103.

[9] C. Li, R. Wang, J. Li, L. Fei, Face detection based on YOLOv3, in:: Recent Trends in Intelligent Computing, Communication and Devices, Singapore, 2020, pp. 277–284, doi: 10.1007/978-981-13-9406-5_34.

[10] A. Nieto-Rodríguez, M. Mucientes, V.M. Brea, System for medical mask detection in the operating room through facial attributes, Pattern Recogn. Image Anal. Cham (2015), pp. 138-145, 10.1007/978-3-319-19390-8_16

[11] M.K.J. Khan, N. Ud Din, S. Bae, J. Yi, Interactive removal of microphone object in facial images, Electronics 8 (10) (2019) , Art. no. 10, doi: 10.3390/electronics8101115.

[12] S. A. Hussain, A.S.A.A. Balushi, A real time face emotion classification and recognition using deep learning model, J. Phys.: Conf. Ser. 1432 (2020) 012087, doi: 10.1088/1742-6596/1432/1/012087.

[13] Z. Wang, et al., Masked face recognition dataset and application, arXiv preprint arXiv:2003.09093, 2020.

[14] prajnasb, "observations," observations. https://github.com/prajnasb/observations (accessed May 21, 2020).

[15] E. Learned-Miller, G.B. Huang, A. RoyChowdhury, H. Li, G. Hua ,Labeled faces in the wild: a survey, M. Kawulok, M.E. Celebi, B. Smolka (Eds.), Advances in Face Detection and Facial Image Analysis, Springer International Publishing, Cham (2016), pp. 189-248

[16]P. Khojasteh, et al.Exudate detection in fundus images using deeply-learnable features Comput. Biol. Med., 104 (Jan. 2019), pp. 62-69, 10.1016/j.compbiomed.2018.10.031

[17] L. Wen, X. Li, L. Gao, A transfer convolutional neural network for fault diagnosis based on ResNet-50, Neural Comput. Appl., 32 (10) (2020), pp. 6111-6124, 10.1007/s00521-019-04097-w

[18] K. He, X. Zhang, S. Ren, J. Sun, Deep residual learning for image recognition, 2016 EEE Conference on Computer Vision and Pattern Recognition (CVPR) (2016), pp. 770- 778, 10.1109/CVPR.2016.90

[19] A. Çayir, I. Yenidoğan, H. Dağ, Feature extraction based on deep learning for some traditional machine learning methods, in: 2018 3rd International Conference on Computer Science and Engineering (UBMK), Sep. 2018, pp. 494–497, doi: 10.1109/UBMK.2018.8566383.

[20] M. Jogin, Mohana, M.S. Madhulika, G.D. Divya, R.K. Meghana, S. Apoorva, Feature Extraction using Convolution Neural Networks (CNN) and Deep learning, in: 2018 3rd IEEE International Conference on Recent Trends in Electronics, Information Communication Technology (RTEICT), May 2018, pp. 2319–2323, doi: 10.1109/RTEICT42901.2018.9012507.

[21] A. Navada, A.N. Ansari, S. Patil, B.A. Sonkamble, Overview of use of decision tree algorithms in machine learning ,2011 IEEE Control and System Graduate Research Colloquium (2011), pp.37-42, 10.1109/ICSGRC.2011.59918

[22] P.-L. Tu, J.-Y. Chung, A new decision-tree classification algorithm for machine learning, in: Proceedings Fourth International Conference on Tools with Artificial Intelligence TAI '92, Nov. 1992, pp. 370–377, doi: 10.1109/TAI.1992.246431.

[23] Robi Polika, Ensemble learning, Cha Zhang, Yunqian Ma (Eds.), Ensemble Machine Learning: Methods and Applications, Springer US, Boston, MA (2012), pp. 1-34, 10.1007/978-1-4419-9326-7_1

[24]E. Mangalova, E. Agafonov, Wind power forecasting using the k-nearest neighbors algorithm, Int. J. Forecast., 30 (2) (2014), pp. 402-406, 10.1016/j.ijforecast.2013.07.008

[25] I. Naseem, R. Togneri, M. Bennamoun, Linear regression for face recognition, IEEE Trans. Pattern Anal. Mach. Intell., 32 (11) (2010), pp. 2106-2112, 10.1109/TPAMI.2010.128

[26] D.G. Kleinbaum, K. Dietz, M. Gail, M. Klein, M. Klein, Logistic Regression, Springer (2002)

[27] Y. Xiao, J. Wu, Z. Lin, X. Zhao, A deep learning-based multi-model ensemble method for cancer prediction, Comput. Methods Programs Biomed., 153 (2018), pp. 1-9, 10.1016/j.cmpb.2017.09.005

[28]C. Goutte, E. Gaussier, A Probabilistic Interpretation of Precision, Recall and F-Score, with Implication for Evaluation, 2010.

[29] A. El-Sawy, H. EL-Bakry, M. Loey, CNN for handwritten arabic digits recognition based on LeNet-5 BT, in: Proceedings of the International Conference on Advanced Intelligent Systems and Informatics 2016," Cham, 2017, pp. 566–575.

[30] A. El-Sawy, M. Loey, H. EL-Bakry, Arabic Handwritten characters recognition using convolutional neural network, WSEAS Trans. Comput. Res. 5 (2017), Available: http://www.wseas.org/multimedia/journals/computerresearch/2017/a045818-075.php (Accessed: Apr. 01, 2020).

[31] N.E.M. Khalifa, M.H.N. Taha, A.E. Hassanien, A.A. Hemedan, Deep bacteria: robust deep learning data augmentation design for limited bacterial colony dataset, Int. J. Reason.-based Intell. Syst. (2019), 10.1504/ijris.2019.102610