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Face Mask Detection Using Machine Learning Techniques

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ABSTRACT— Coronavirus pandemic brought about by novel Covid is ceaselessly spreading up to this point everywhere in the world. The effect of COVID-19 has been fallen on practically all areas of advancement. The medical services are going through an emergency. Numerous prudent steps have been taken to diminish the spread of this sickness where wearing a mask is one of them. In this project we have used ML, OpenCV and TensorFlow to recognize face masks. This model can be utilized for security purposes since it is very resource efficient to deploy. In this approach MobilenetV2 architecture is used which has BN layer and is very lightweight and we have embedded this model with Raspberry pi to perform real-time mask detection, where, structure of SSD is used and backbone network is lite.The datasets used for this CNN based face mask detection are prepared by Prajna Bhandary and AIZOOTech which are available on Github. These datasets can be used by other researchers for further advanced models such as those of face recognition, facial landmarks, and facial part detection process.

Keywords: SSD (Single Shot Detector), COVID-19 (Corona Virus disease), OpenCV (Open Source Computer Vision Library), CNN (Convolutional Neural Network), ML (Machine Learning), BN (bottleneck).

I. INTRODUCTION

Everyone has been affected by the COVID-19 coronavirus pandemic on a global scale. It crippled the economic growth of the entire nation around the world Coronavirus disease 2019 (COVID-19) is an emerging respiratory disease caused by severe acute respiratory syndrome coronavirus 2 or SARS-CoV2. As of June 10, 2020, the virus reached nearly eight million infected patients and half million died from the virus To combat the transmission of the virus there are enforced protocols set by the World Health Organization (WHO) like compulsory wearing of face mask observing strict social distancing in public places and washing of hands or sanitizing hands with disinfectants frequently.

There are studies conducted that wearing facemask is important to prevent the spread of the virus Research studies show the effectiveness of N95 and surgical masks in preventing virus transmission are 91% and 68% respectively Wearing these masks will effectively disrupt airborne viruses so that such infections cannot reach a human being's respiratory system and it is an inexpensive way to mitigate fatalities and respiratory infection disorders.

Nevertheless, the efficacy of facemasks in preventing disease transmission in the public has generally been lessened due to inadequate facemask use. It is essential to develop an automatic detection for wearing facemask which will provide individual protection and prevent the local epidemic.

This paper explains a efficient system called as Face mask detection alert system using raspberry Pi which detects whether the person have worn a face mask or not. The proposed structure of the face mask detection and alert system performs following tasks:
1)Face Detection (using Pi camera input).

M .2) Mask Detection (if person has worn face mask or not).

We perform face detection using CNN i.e. a structure of SSD (Single Shot Detector) and another model called as MobileNetV2 to detect people in a video frame. We perform this face mask detection system on a Raspberry Pi 4.The proposed algorithm for face mask detection system consists of preprocessing, training the CNN, face mask detection. The dataset we are using consists of images with different sizes, colors and orientations.

Therefore,the preprocessing step is to convert all the pictures into grayscale because we'd like to make certain that color shouldn't be a problem for detecting masks. After that, we need to have all the images in the same size before applying it to the neural network. Training the CNN: We used the structure of SSD. The backbone network is lite. The total model only has

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1.01M parameters. Input size of the model is 260x260 and the backbone network (BN Network) only has 8 convolution layers.
The total model has only 24 layers with the location and classification layers counted and we have also used another CNN architecture called MobileNetV2. We merge the Backbone network to Convolutional layers in order to accelerate the inference speed. The last step is to recognize whether the person is wearing the mask or not using the model trained.

We used Machine learning language for developing this Project; Machine Learning is the science of getting computers to learn without being explicitly programmed. It is closely related to computational statistics, which focuses on making prediction using computer. In its application across business problems, machine learning is also referred as predictive analysis. Machine Learning is closely related to computational statistics. Machine Learning focuses on the development of computer programs that can access data and use it to learn themselves. The process of learning begins with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future based on the examples that we provide. The primary aim is to allow the computers learn automatically without human intervention or assistance and adjust actions accordingly.

II. LITERATURE SURVEY

1)Improving Human Face Recognition using Deep Learning based Image Registration and MultiClassifier Approaches:

Author: Mohammad Abuzneid

Face recognition has become a fascinating field for researchers. The motivation behind the enormous interest in the topic is the need to improve the accuracy of many real-time applications. The complexity of the human face and the changes due to different effects make it more challenging to design as well as implement a powerful computational system for human face recognition. In this work, we presented an enhanced approach to improve human face recognition using a Back-Propagation Neural Network (BPNN) and features extraction based on the correlation between the training images. A key contribution of this work is the generation of a new set called the T-Dataset from the original training dataset, which is used to train the BPNN. We generated the T-Dataset utilizing the correlation between the training images without using a conventional technique of image density. The correlated T-Dataset provides a high distinction layer between the training images, which helps the BPNN to converge faster and achieve better accuracy. Data and features reduction is essential in the face recognition process, and researchers have recently focused on the modern Neural Network (NN). Therefore, we used a Principal Component Analysis (PCA) descriptor to prove that there is a potential improvement even using traditional methods. We applied five distance measurement algorithms and then combined them to obtain the T-Dataset, which we fed into the BPNN. We achieved higher face recognition accuracy with less computational cost compared to the current approach by using reduced image features. We test the proposed framework on two small datasets, the YALE and AT&T datasets, as the ground truth.

2) Face Recognition System Based on Raspberry Pi Platform:

Authors: Nafis Mustakim, Noushad Hossain, Mohammad Mustafizur Rahman,
Nadimul Islam, Zayed Hossain Sayem, Md. Asaduz Zaman Mamun

Human face recognition plays an impo4rtant role in video surveillance, human-computer interface, personalizing different applications. In this paper, we present an approach to detect and identify a human face from the real-time video that tracks a face and compares it with stored data of known individuals. Our approach recognizes an individual within a fraction of a second which completely ignores any background effect. It also shows additional information about that individual. Besides, this method also works on different lighting conditions which make it suitable to execute its purpose in a wide variety of environment without encountering any significant error. We have implemented our work using a Raspberry Pi. And this approach utilizes the benefits offered by different python libraries like OpenCV and numPy. SQLite database management system is used as the backbone of its memory. Through its faster and authentic performance, this system is worthy enough to be integrated with any applications to boost up automation and user-friendliness. INDEX TERMS Real-time Face Detection, OpenCV, NumPY, SQlite, Gray-scaling, Raspberry pi.

3) Face Time – Deep Learning Based Face Recognition Attendance System:

Author: Marko Arsenovic, Srdjan Sladojevic, Andras Anderla, Darko Stefanovic.

In the interest of recent accomplishments in the development of deep convolutional neural networks (CNNs) for face detection and recognition tasks, a new deep learning based face recognition attendance system is proposed in this paper. The

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entire process of developing a face recognition model is described in detail.

This model is composed of several essential steps developed using today's most advanced techniques: CNN cascade for face detection and CNN for generating face embeddings. The primary goal of this research was the practical employment of these state-of-the-art deep learning approaches for face recognition tasks. Due to the fact that CNNs achieve the best results for larger datasets, which is not the case in production environment, the main challenge was applying these methods on smaller datasets. A new approach for image augmentation for face recognition tasks is proposed. The overall accuracy was 95.02% on a small dataset of the original face images of employees in the real-time environment. The proposed face recognition model could be integrated in another system with or without some minor alternations as a supporting or a main component for monitoring purposes.

4) Real-Time Implementation of Face Recognition System:

Author: Neel Ramakant Borkar, Sonia Kuwelkar.

Face Recognition is the ability to detect and recognize a person by their facial characteristics. Face is a multidimensional and hence requires a lot of mathematical computations. Face recognition system is very essential and important for providing security, mug shot matching, law enforcement applications, user verification, user access control, etc and is mostly used for recognition for various applications. These all applications require an efficient Face recognition system. There are many methods that are already proposed and have low recognition capability, high false alarm rate. Hence the major task of the research is to develop face recognition system with improved accuracy and improved recognition time of an face recognition system. This paper proposes a hybrid face recognition algorithm by combining two face recognition techniques by integrating (PCA) principle Component Analysis, (LDA) Linear Discriminant Analysis. Jacobi method is used to compute Eigenvector that are necessary for PCA and LDA algorithms. Face Recognition system will be implemented on embedded system based Raspberry pi 3 board.

5)Implementation of Principal Component Analysis on Masked and Non-masked Face Recognition:

Author: Md. Sabbir Ejaz, Sifatullah, Md. Rabiul Islam, Ananya Sarker.

This paper represents an implementation of Principal Component Analysis (PCA) on masked and non masked face recognition. Security is an essential term in our today's life. In various Biometric technologies, face recognition is widely used to secure any system because it is better than any other traditional techniques like PIN, password, fingerprint etc. and most reliable to identify or verify a person efficiently. In recent years, face recognition is a very challenging task because of different occlusion or masks like the existence of sunglasses, scarves, hats and different types of make-up or disguise ingredients. The accuracy rate of face recognition is influenced by these types of masks. Many algorithms have been developed recently for non-masked face recognition which are widely used and give better performance. Still in the field of masked face recognition, few contributions has been done. Therefore, in this work a statistical procedure has been selected which is applied in non-masked face recognition and also apply in the masked face recognition technique. PCA is more effective and successful statistical technique and widely used. For this reason in this work, PCA algorithm has been chosen. Finally, a comparative study also done here for a better understanding.

6) Face Mask Detection Using MobileNetV2 in The Era of COVID-19 Pandemic:

Author: Samuel Ady Sanjaya, Suryo Adi Rakhmawan.

Corona Virus Disease (COVID-19) pandemic is causing a health crisis. One of the effective methods against the virus is wearing a face mask. This paper introduces face mask detection that can be used by the authorities to make mitigation, evaluation, prevention, and action planning against COVID-19. The face mask recognition in this study is developed with a machine learning algorithm through the image classification method: MobileNetV2. The steps for building the model are collecting the data, pre-processing, split the data, testing the model, and implement the model. The built model can detect people who are wearing a face mask and not wearing it at an accuracy of 96.85 percent.

After the model implemented in 25 cities from various source of image, the percentage of people wearing face mask in the cities has a strong correlation to the vigilance index of COVID-19 which is 0,62.

7) Face Mask Detection Using OpenCV:

Author: Harish Adusumalli, M.Pratapteja, D. Kalyani, P V R D Prasada Rao, Vaddeswaram, R.Krishna Sri.

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

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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 persons 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.

III. PROPOSED SYSTEM

The process of CNN is to identify and categorize images from learned features. It is very effective in a multi-layered structure when obtaining and assessing the necessary features of graphical images. The outline of the proposed method for the identification of facemasks is shown in fig. 2 to fig. 4. It describes the system proposed composed entirely of acquisitions of images as shown in fig. 2. Data collection consists of a person wearing a facemask and not wearing a facemask in fig. 3 and a CNN architecture classification in fig.4.

Figure 4.1(a): Image Acquisition for the proposed computer vision to detect facemask with a person wearing and not wearing a facemask.

Figure 4.1(b): Annotated Image data collection of the proposed computer vision to detect facemask with a person wearing and not wearing a facemask.

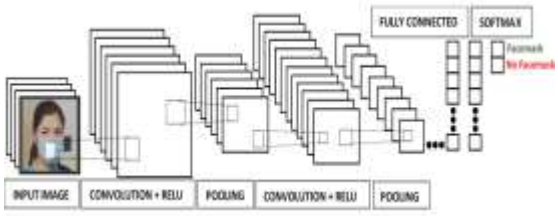

Figure 4.1©: Classification process using convolutional neural networks.

This system will help identify people on image/ video stream wearing a facemask with the help of Deep Learning and Computer Vision algorithms by using various libraries such as OpenCV, Keras, Tensor Flow etc. The images are downloaded from various open source websites and are differentiated as “mask” and “no mask”. The images that we downloaded were of different sizes and different resolutions.

The next phase is building the model. There are six steps in building the model which are constructing the training image generator for augmentation, the base model with MobileNetV2, adding model parameters, compiling the model, training the model, and the last is saving the model for the future prediction process.

The model implemented in the video. The video read from frame to frame, then the face detection algorithm works. If a face is detected, it proceeds to the next process. From detected frames containing faces, reprocessing will be carried out including resizing the image size, converting to the array, preprocessing input using MobileNetV2. The next step is predicting input data from the saved model. Predict the input image that has been processed using a previously built model. Besides, the video frame will also be labeled that the person is wearing a mask or not along with the predictive percentage.

IV. RESULT

Fig: one person with mask and another person without mask
Fig: Both person with mask
Fig: Both person without mask

V. CONCLUSION

To mitigate the spread of COVID-19 pandemic, measures must be taken. We have modeled a face mask detector using SSD architecture and transfer learning methods in neural networks. To train, validate and test the model, The model was inferred on images and live video streams. To select a base model, we evaluated the metrics like accuracy, precision and recall and selected MobileNetV2 architecture with the best performance having 100% precision and 99% recall. It is also computationally efficient using MobileNetV2 which makes it easier to install the model to embedded systems. This face mask detector can be deployed in many areas like shopping malls, airports and other heavy traffic places to monitor the public and to avoid the spread of the disease by checking who is following basic rules and who is not.

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