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Smart Entrance System – Face MaskDetection Using Mobile Net

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Abstract— *this paper establishes a 'Safety system for mask detection during this COVID-19 pandemic'. However, because of the current epidemic, wearing masks is everyone's responsibility in the community. This system operates intelligently and monitors the person passing by wearing a mask or not. Facial recognition will meet such a problem as it removes facial features due to the resulting blockage of the face due to the mask. So, it will lower the level of recognition. The method proposed in this paper uses TensorFlow libraries, Keras, and OpenCV for real-time face masking. The collected database contains two categories namely Masked face and Unmasked face. This dataset was taken from the Kaggle website. The LeNet algorithm was used to prepare a proper training dataset. The proposed approach was successful to achieve 98.21% accuracy with the LeNet algorithm. The image was focused on the facial area without taking the full-size image.*

Keywords——Convolution Neural Network, MobileNetV2, OpenCV, Keras.

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I. INTRODUCTION

Global outbreaks of coronavirus have necessitated wearing of face masks. As COVID-19 has proven to be widely distributed by air droplets, wearing of masks has become necessary to combat the spread of the virus. In the past, people wore masks to protect themselves from the dirty elements but from now on, wearing a mask is important to prevent germs from entering the nose. The World Health Organization (WHO) has declared COVID-19 as a global epidemic and it has ensured that the face wears the mask can help contain the COVID-19 transmission rate. However, a few people are irrational and often run away from wearing a mask. Regular observation to see people who have been exposed and masks inappropriately are important.

Face recognition is a famous biometric technique in this modern technology. This is because face recognition is a contactless method other than any biometrics such as fingerprint, entering a password, etc. Generally, face recognition is a kind of identifying and verifying the person from an unknown face and will be matched the face from the database. Basically, this technology has been widely used for security, surveillance, and any other important fields where the asset needs to be protected. Furthermore, face recognition system, has a unique and reliable technology in which each face has its own unique features that could not be duplicated from a each.

Computer vision is one of the elements that emerges in the system object acquisition field and is widely used in various fields aspects of research in practical intelligence. There has been both supervised and unchecked machine modes learning in the past to find something in a picture. An advanced machine learning method of object discovery is included in this paper. To be found mask, initially the model is trained using Multi-Task Cascade Convolutional Neural Network (MTCNN) an algorithm with a given face website. The face is the first obtained using OpenCV (Open-Source Computer Vision) as well those photo frames are stored and transferred tothe acquisition of the mask divides into categories. With facial recognition, Viola Jones The algorithm used is also known as the Haar Cascade algorithm. We used the mask partition model to separate face masks with or without masks. RGB images (Red Green Blue) are used as classification data. The images are given to the modelafter processing and are trained. This model provided the best accuracy than regular CNNs. This model can also use to identify criminal suspects who partially cover their faces while committing illegal acts.

II. RELATED WORKS

In this paper [2], an in-depth study algorithm for obtaining a facial facial mask is proposed. It uses YOLO-v2 with the ResNet-50 model to achieve a central view and two categories are used here. First, extraction based on ResNet-50 and secondly, the recovery of the facial surgery mask using YOLO-v2. Medium accuracy and log-loss average are used as performance metrics. The parallel distance between the target binding boxes is determined using the IoU (Intersection over Union). Using Adam optimizer, the YOLO-v2 model gets an Average Precision (AP) of 81%.

With reference to [3], a mathematical reduction method called Principal Component Analysis (PCA) was used for facial recognition to obtain a masked and unmasked faces. The proposed system is trained to detect front faces in the image. The Viola Jones' discovery algorithm, which combines Haar features and the Adaboost algorithm was used. Feature extraction is performed using the PCA algorithm on training images. The result of the PCA facial feature is also called the Eigen face. This Eigen face has been used for an additional recognition process. In this recognition process, the target image is compared to the corresponding image image. The level of recognition obtained is 72% on the covered surface and 95% on the uncovered surface. The level of recognition obtained is very low on the covered face and it performs satisfactorily on the uncovered surface.

In this paper [4], the SSDMNV2 model is designed for facial mask detection using OpenCV Deep Neural Network (DNN), TensorFlow and Keras libraries. It uses MobileNetV2(Nguyen, 2020) to classify. This model plays well in separating images with mask and without mask and finds out whether the mask is properly worn or not. Since only a few databases are either artificially created or full of sound or have incorrect labels, data cleaning, error detection and correction are essential in the pre-processing phase. The database is provided with input and all files are converted to the same size according to the SSDMV2 model requirements. NumPy array is used for fast mathematical performance. Using multibox, many objects on the scene are shot in a single shot withhigh speed and high accuracy.

As in [5], the authors have developed a new facemask detection technique that is able to distinguish three types of mask categories namely masking, improperly covered face, and exposure. The proposed method achieved 98.70% as accuracy in the face detection phase and uses two parts. First, the Deep Transfer learning component is used to decipher feature and learn with the old machine as part two. Model performance is enhanced using three traditional phase dividers (Vector Support Machine, Decision Tree and Ensemble). The model produces 94.54% accuracy of decision tree separation and 99.49% SVM separator. The machine learning algorithm that creates a group of dividers is used in the Ensemble.

In this paper [6], the authors used different types of classifiers for developing face mask detection system. The training process is relatively low. The types of classifiers used are Ensemble and Support Vector machine. The model produced an accuracy of 98.95% and 98.78% for Ensemble and SVM respectively. The detection was restricted to one person per image.

III. PROPOSED METHOD

1. Hardware Component

A webcam has been employed as the hardware component in this paper.

Web Camera

A webcam is an input display tool that helps to feed a live photo or video in real time on a personal computer (PC). Webcams are usually small cameras connected to a built-in PC or externally connected via USB cables. Webcam software enables users to take a picture or record a video or stream a video online. In this paper, a webcam with high definition (FHD, 1080p) view and a 16: 9 rectangular aspect ratio was used to test the proposed model in real time.

2. Software Component

The code for this paper was executed in Google Collaboratory.

2.1. *Google Collaboratory*

Google Collab is an online version of the Integrated Development Environment (IDE) notebook that works with a machine-readable library that uses python codes within a browser and works within the cloud completely. The output is located at the bottom of the usable code cell in a separate window as in the software version of IDE. Collab notebooks are heavily integrated with google drive. Numpy package used to generate random data and visualize, matplotlib library is used. Several other libraries have been pre-installed in the toolkit which makes it ideal for machine learning projects and reduces human activity. Image data set can be uploaded or imported via google drive locally for instruction and measurement model. In the ML community this notebook has included many application features such as TensorFlow, neural network model, GPUs testing (Graphics Unit Units).

3. Methodology

In this paper we describe the new formation of a convolutional neural network called the MobileNet Convolutional Neural Network, a feature that produces a highly efficient object detection feature that works well with mobile models. The neural network is initially trained using available data to create a model to distinguish

the covered and uncovered faces in an image. A trained cascade section will determine whether a person is wearing a mask or not. The accuracy of the mask acquisition is considered in this paper. OpenCV, a real-time computer library used for pre-processing purposes. The function flow of the operating system is shown in diagram in Figure 1.

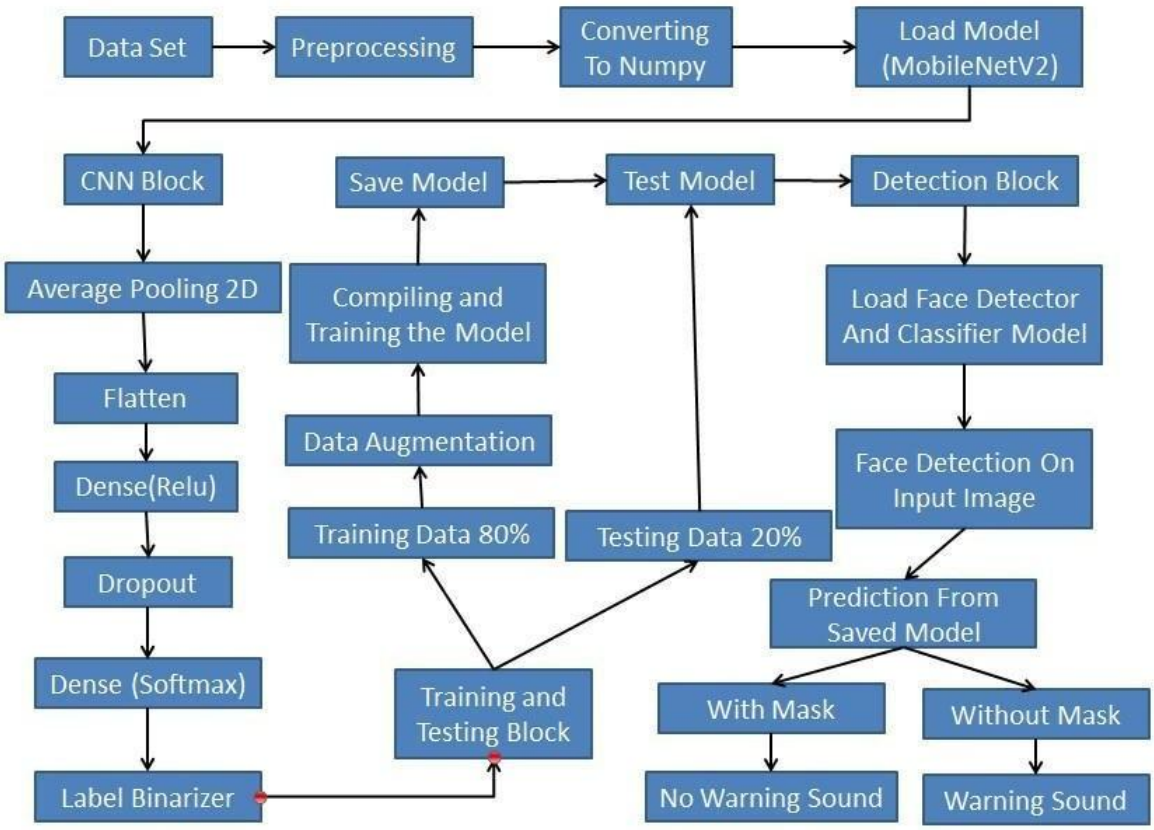

Figure 1. Workflow of the proposed system

Dataset

To provide the best accuracy from the model, input data sets play an important role. Since COVID-19 is the latest pandemic, the available data sets are limited. Due to this lack of data, a mixture of many open source databases was used for training. The first set of databases was obtained from Mikolaj Witkowski's Kaggle's Medical Mask Dataset containing images of masked men and XML files containing descriptions. The second set of databases contains a prefabricated mask database developed by Prajna Bhandary available on PyImageSearch that contains standard face images with applied face markings. This is a duplicate method of developing a database that incorporates a mask on an uncut person. The use of face mask samples collected from a variety of sources includes a highly biased and uneven model. Therefore a data set containing images of masked and unmasked people compensating for error correction was used. The database contains a total of 1,376 images divided into two classes namely 690 masked images and 686 maskless images. Facial features are allowed to determine the most important facial features of a person such as eye size, eyebrow thickness, nose shape, mouth, and jaw. Database made available for open access to the GitHub repository.

Pre-Processing

The training data set contained noise images. The accuracy of the model depends on the data selected for the training. The database must therefore be processed in advance before being presented as an input. Images are resized and the pixel representation of images is converted to list format according to the MobileNetV2 model. This list is then converted to the NumPy system for faster mathematical operations.

Data augmentation

In order to train the MobileNet V2 model, which is a deep learning framework, its functionality is enhanced by the amount of data, a large amount of data is required to block under the suitability and rapid integration of the

neural network model. Due to the lack of sufficient amount of data required for model training, a data augmentation method has been used to compensate for limited data. In this process, techniques such as rotating, zooming, rotating, cutting, and rotating the image are repeated for each image repeatedly to create multiple versions of the same image. By image enhancement, image data is generated and function is created, and then tested and trained data sets.

OPENCV-CNN

OpenCV is an open source library intended to perform computer vision functions. Provides real-time libraries, tools and machine learning framework support. . It performs many techniques such as face recognition and visibility, video surveillance, camera movement and object movement, three-dimensional design models, eye movement tracking, and face-to-face compilation. It is widely used in CNN architecture and other computer-based computer architecture. The neural network is trained by OpenCV using the TensorFlow framework. Deep learning algorithm called Convolutional neural network is often used for pattern recognition. Ithas a multi-layer perceptron model that includes input layer, multiple hidden layers and output layer. It is called a fully connected network because all the neurons in the first phase are bound to all the other neurons of the incoming layer. All mathematical calculations and convolutions are performed in the central part also known as the hidden layer. Summary of weighted inputs from each input layer is transferred to the activation function, usually ReLU, followed by a sequence of dynamic layers such as a composite layer, a fully integrated layer and dense layers.

Convolutional Layer

It is the basic block of CNN. Convolution is a combination of two tasks to get another job. Here, the input data, which is a four-dimensional tensor (number of images, length, width and number of channels) is integrated with a kernel conversion filter to get the integrated feature. Used to remove features using back propagation with the removed element can be used for pattern detection. The effect of a convolutional layer is turned into a feature map. Features followed by CNN wide and long convolution filter, total input and output channels, depth of convolution filter and convolution functions.

Pooling Layer

Acquired feature map is influenced by the location of the features in the input. This sensitivity can be exceeded when a feature map requires samples under features. This makes the resulting element map feature more speed on the variation of feature bearings in the image. Integration functions can be used to quickly compute calculations, reducing the size of the input matrix without any feature loss by summarizing the presence of the feature on the feature map. This mid-feature presence is summarized using two types of integration methods. One is Average pooling and the other is a very advanced pooling also called Max pooling. In this paper, intermediate integration has been initiated. This merge function aggregates the total value of all values in the current kernel area and produces a single value as a result. The central merging layer is placed on 2×2 pieces of feature map at a speed of (2, 2). This process involves summarizing the rating for each episode of the feature map. Which means that each 2×2 square of the feature map is taken as a sample down to the average value in the square.

Flatten Layer

The flatten layer incorporates all available native features of the previous convolutional layers without affecting the size of the collection. Every aspect of CNN's offline mapping is the result of multiple 2-D kernels being built from each layer of installation and packaging to form identical 2-D "flat" members. This layer converts a two-dimensional element of the matrix into a single-vein, vein provided in a fully connected neural network component. Layers of tf.keras. Flat function changes the tensor to a position equal to the amount of material present in the tensor.

ReLU

The Rectified Linear Unit (ReLU) is an activation function commonly used for in-depth learning models. It is a supervised learning method. The output of the ReLU function follows the input if the input is positive other than the output is zero. It is mathematically defined as: $f(x) = \max(0, x)$.

Dropout Layer

Fully connected layers make a network of neuron models more prone to balance during training. To prevent this, the drop-out layer randomly drops a few neurons in relation to the drop-out rate during training. Sets the input of neuron to 0 at a frequency during the training process.

Dense layer (Soft max)
The SoftMax layer can use multi-stage functionality. This function can change the size and direction of real K values into magnitude and direction of real K values up to 1. SoftMax converts all input data into negative, negative, zero, or more than 0, values between 0. and 1, to be mentioned as opportunities. SoftMax converts inputs into smaller possibilities, if one of the data is small or negative, and if any data is large, it will then be converted into larger probability, but the value will always remain in the range between 0 and 1.

Fully-Connected Layer
Fully connected layers are added to the model and have a full connection of the opening layers. In this layer all the inputs are connected to the next layer activation unit. The provided images are categorized as multiple categories and the functionality used by the layers and they provide the effect of the output classes limited in terms of possibilities.

MobileNetV2
Deep neural network is used for MobileNetV2 separation problem. To prevent damage to the learning features the basic layers are frozen. These layers help identify facial features for those who wear a face mask for those who do not wear a mask by training the collected data. These pre-trained models do not incur unnecessary computer costs.

IV. RESULT

The results of this test were made using a laptop computer with an Intel (R) Pentium (R) CPU N3540 @ 2.16GHz 2.16 GHz and the installed RAM is 4.00 GB. Google Collaboratory development and implementation process. The data sets from which they are extracted are categorized by masking with and without mask. These folders are loaded with their pixel values to train the model. Images are pre-processed and converted to NumPy system for quick calculation. In the separation models Keras is used. Database is divided into 4: 1 training and testing groups. There are 80% training data sets and the remaining 20% are for testing purposes. After 20 epoch, the median accuracy of the model comes from 99%. Accuracy and Accuracy counts are measured by positive predictions. The ability of the editor is determined by Remember. A rating of the accuracy of the test structure is given for F1 points. The structure of the training accuracy is shown in Figure 2. The masked and external output is shown in Figure3.

Figure 2. Training Loss and accuracy curve

Figure 3. Output with and without Mask

S.No	Comparison of Accuracy and F1 Score for different architectures			
	Architecture Used	**Year**	**Accuracy**	**F1-Score**
1	**LenNet-5**	**1998**	**84.6**	**0.85**
2	**AlexNet**	**2012**	**89.2**	**0.88**
3	**ResNet-50**	**2016**	**92.7**	**0.91**
4	**CNN (Proposed Model)**	**2021**	**99**	**0.99**

Table 1. Comparison of different algorithms

V. FUTURE WORK

The Viruses constantly change through mutation so wearing a mask is an effective way to reduce the spread. It's difficult to monitor everyone in mass gathering areas. A embedded system with temperature sensing, automatic sanitizing and mask detection can be implemented in the entrances of mass gathering areas like supermarkets, banks, malls etc.

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