IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 2, Issue 2, April 2022
Impact Factor: 6.252

Effective Face Mask Detection by Deep ConvNeuralNets Learning for Covid-19 Prevention

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Abstract: *In Recent years, COVID-19 is the buzzword in our society, since it is too much dangerous, believed as it is originated from China from the place of Wuhan in December 2019. This Disease is spreading from humans to humans through droplets and airborne. A methodology has to be developed recognize whether the people are wearing mask or not. Therefore, this paper proposes a framework to recognize the mask. Based on the features proposes a machine learning basis system which recognizes the mask from the inputted image. Existing system Only detecting the person who is not using a mask apart from that system will not predict whether the used mask safe or not. A better deep learning framework which predicts the people with mask or not so it will be helping the society is discussed and apart from that this, it extends the mean of finding what type of mask they are wearing also predicts the efficiency of mask so user can protect themselves from the dreadful corona virus.*

Keywords: Deep Learning, Covid-19, Machine Learning, Convolutional Neural networks

I. INTRODUCTION

COVID-19 is first ever notified in Wuhan state of China on 31st of December of year 2019. In this particular day, very first covid case was also notified in Thailand also. A survey was conducted by World Health Organization (WHO) on 18th April, 2020 on People who were effected with Covid -19. The result of survey was shocking in such a way that more than 21,64,111 people were dead and more than 1,46,198 people were found affected with covid-19 virus in more than 200 countries in the entire world. The covid-19 population was outbreak by Public Health Emergency by International Concern (PHEIC) on 30th January, 2020.

Many of the Countries were not still unable to come out of financial downfall raised by Covid-19 Pandemic Situations. Due to this, a lot of human loss occurred in worldwide, it also made human living more difficult in terms of food cycle, health sectors and career breaks. Covid-19 resulted in huge loss of human lives and many were still not getting recovered from the disease. Many of them lost their jobs and business and it is affecting the education system and mental health of the people [2]. Due to pandemic, the entire world is closed with that it affects the Poor people, Farmers, Children, Shopkeepers [3]. Without the income during this pandemic, many of the people and animals are unable to feed themselves and their families. Shortly we can say, no income means no food, or less food and less nutritious food.

1.1 Deep Learning Techniques

Artificial Intelligence was derived into machine learning by implementing computational models and the machine learning is derived into another field known as Deep Learning Otherwise Deep Neural Networks. Deep learning was adopted nowadays, since it is providing improved accuracy with less complexity in design. It works based on emulating the working nature of human brain to convert human intelligence into machine intelligence based on problem artifacts [3,4]. The deep learning field is also utilized in data science by including certain probability and statistical models for effective prediction. It benefits the programmers to process the information in terms of computations with reduced complexity. It also helps the data scientists in the process of accumulating, processing and integrating huge data repositories together.

To reduce the complexity of machine learning algorithms, deep learning emerged based on the operating principle of human brain, in which its implementation is known as artificial neural networks. Deep learning is defined as the study and implementation of human brain for converting human intelligence into machine intelligence. Machine learning tasks like clustering, classification, and regression can also be performed in deep learning by applying it on time series dataset of

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different types such as audio, video, pictures and text completely [4]. It is used in Automatic Text Generation, Healthcare, Automatic Machine Translation, Image Recognition, Predicting Earthquakes. The technologies used in deep learning are Keras, TensorFlow, Scikitlearn, etc.

1.2 Convolutional Neural Network

Convolutional Neural Network is an integration of both supervised and unsupervised learning algorithms for ouputs training. CNN's were first developed and it is used around the 1980s. The Convolutional Neural Networks is used to find the hidden layers from input based on the techniques it classifies the output. CNN is considered as popular deep neural network as it can be applied on time series data [1].CNN takes images as input and then differentiate one from the other by assigning some weights on the image based on various aspects.

1.3 Dataset Used

Dataset consists of nearly 30 images in one folder with different types of masks and people images wearing mask and not wearing masks. Images are named as label with types of masks

2.4 Types of existing Face Masks

A. Cloth Face Masks

A cloth face mask is made of cloths. Cloth masks are different types that are single layer, two layer and three layers. the safeness of masks will increase with respect to increasing the number of layers. For the protection from the corona virus health authorities only given the last priority to cloth masks[11]. cloth masks are also reusable.

B. Surgical Face Masks

Surgical face masks are majorly used in healthcare industries, since it is easily decomposable and disposable. It is designed as very thin in breadth, flat in structure and also found like papers and are manufactured in light blue or white in color.It is made from a disposable material. Medical professionals are usually wearing this kind of masks[11]. Due to this pandemic health authorities are mainly suggesting surgical masks for resist the virus attack. Surgical masks are single use.

C. N95 Face Masks

Health authorities are recommending that N95 face masks for public. N95 face masks are providing more safety than the cloth masks. It will avoid the tiny particles to enter in to human body, hence it is the best mask for resist the corona virus[11]. A N-95 mask can reuse Up to 5 times.

D. Bandana Face Masks

A bandana face mask is a square or triangular piece of cloth that's often worn as a head or neck covering. wearing a bandana mask over mouth and nose is an old way to keep dust and other particles out of the respiratory system. So it is a useful mask for the lungs diseased people it also provides some protection from droplets and cough. It is also one of the types of cloth masks hence it is reusable and it will not be providing much safeness from the virus attacks.

E. Cone-style Masks

Cone-style face masks are moulded face masks that fit over the mouth and nose. According to the scientific study cone-style face masks are less effective at containing droplets and spray than cloth face masks constructed of quilting cotton. The cone-style masks are more effective than a bandana face masks. But it is not much effective for resisting a virus, hence the health authorities are not suggesting for using cone-style masks.

II. TRANSFER LEARNING

Transfer learning is a machine learning method where a model developed for a task is reused as the starting point for a model on a second task. It is a popular approach for pre-trained models in deep learning. The transfer learning, first trains a base network on a base dataset and task, and then it transfers them, to a second target network to be trained on a target dataset and task [1]. This process will tend to work if the features are general, meaning suitable to both base and target tasks, instead of specific to the base task.

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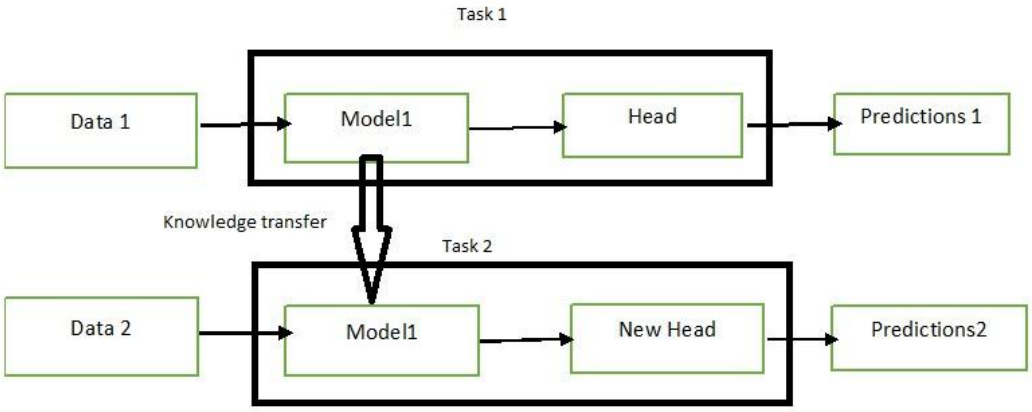

Figure 1: Architecture diagram for Transfer Learning in Image recognition

III. PROPOSED FRAMEWORK

The below figure.2 explains the implementation of convolutional neural network for image processing for detecting mask types to prevent covid-19 impact. Suitable feature engineering process is adopted in image analysis to retrieve image vectors for finalization of masks and face. In the first phase construction of dataset by selecting the suitable images of different categories. Categories that included with mask and without mask, different types of masks that are cotton masks, N95 masks, Surgical masks, etc.

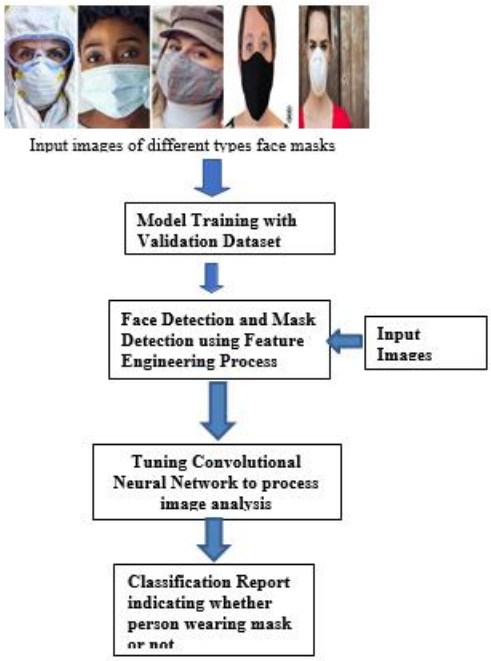

Figure 2: Face mask detection framework

In this system, many datasets have been constructed to assess the models for face detection. In Existing system datasets mainly consist of images of peoples wearing masks and not wearing masks. In this proposed system uploading the images of peoples who are wearing masks and also not wearing masks, also including images of peoples wearing different types of masks (Cotton masks, Surgical masks, N95 Masks, etc). The safety of each type masks is different from each other.

Images that are taken for the model have a very high dimensionality, and hence to recognize images training a standard feed-forward network would require large amount of input neurons, this will make many problems associated with the

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dimensionality in image networks. The main solution of this problem is using the convolutional Neural Networks. The CNN provides a better solution by reducing the dimensionality of an image by utilizing convolutional and pooling layers.

Convolutional layers are basically trainable but they have significantly less parameters than a standard hidden layer. Convolutional layers can able to highlighting the important parts of the image and pass each part of the image forward. CNN also perform well on image classifications also such as classifying an image so in this proposed system CNN used to classifying the images as with mask or without masks.

With respect to taken the input images system will detect whether the person using a mask or not. If a person uses a mask, then the system will be checking the type of mask. Based on that it will predict the safety of that mask.

IV. METHODOLOGY

Our Proposed system to construction of this Face mask efficiency prediction model is conduct mainly in four steps:

- Dataset Exploration
- Build and apply CNN model
- Test the model with test dataset
- Test on Input Image

4.1 Dataset Exploration

In Our model 'train-Dataset' folder contains 13 folders and in each of these 13-folder representing a different class. The range of this folder is from 0 to 13. For iterating all the classes and appending the images in this model using OS module. With the help of this OS module, iteration is done in their respective labels in the data and labels list. The shape of data is in the form of (3, 30, 30, 3) which means that there are 3 images of size 30×30 pixels and the last 3 in the format showing that the data contains coloured images (RGB value).

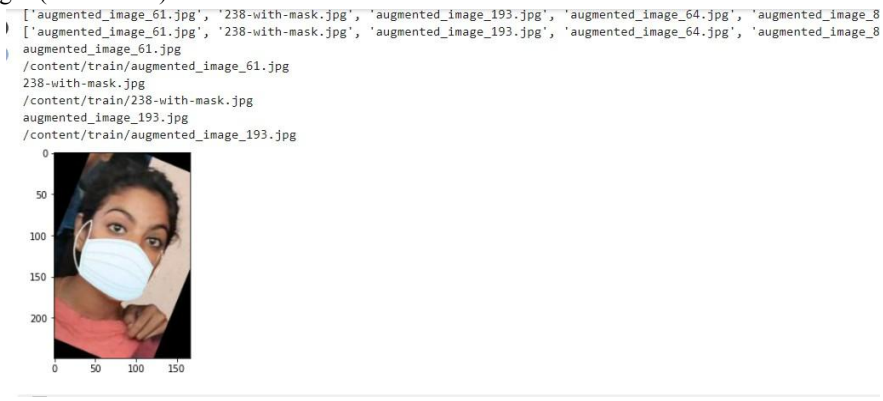

Figure 3: Creating Augmented Reality

4.2 Building and Applying CNN Model

Basically, a CNN model receives an image as an input in the form of a 3D matrix. In this model the first two dimensions are showing to the width and height of the image. And they are in pixels while the third one corresponds to each pixel RGB values of the input images that are given to the model. In this system the deep CNN is implemented in python using TensorFlow and Keras libraries. We have multiple classes to categorise compile the model with Adam optimizer which performs good and loss is categorical crossen tropy.

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```
[ ]  model = Sequential()
     model.add(Conv2D(filters=32, kernel_size=(5,5), activation='relu', input_shape=X_train.shape[1:]))
     model.add(Conv2D(filters=32, kernel_size=(5,5), activation='relu'))
     model.add(MaxPool2D(pool_size=(2, 2)))
     model.add(Dropout(rate=0.25))
     model.add(Conv2D(filters=64, kernel_size=(3, 3), activation='relu'))
     model.add(Conv2D(filters=64, kernel_size=(3, 3), activation='relu'))
     model.add(MaxPool2D(pool_size=(2, 2)))
     model.add(Dropout(rate=0.25))
     model.add(Flatten())
     model.add(Dense(256, activation='relu'))
     model.add(Dropout(rate=0.5))
     # We have 43 classes that's why we have defined 43 in the dense
     model.add(Dense(0, activation='softmax'))
```

```
[ ]  #Compilation of the model
     model.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])
```

Figure 4: Implementation of CNN Model

4.3 Model Testing

In the Collected dataset contains a testdataset.csv file and a test folder. In that folder we can get the details related to the image class labels and their respective image path. By using panda's library system will Extract the labels and image path. Resize the dataset images to 30×30 pixels for predict the model. After that make a NumPy array that containing all image data.

```
[ ]  from PIL import Image
     import numpy as np
     import matplotlib.pyplot as plt
     def test_on_img(img):
         data=[]
         image = Image.open(img)
         image = image.resize((30,30))
         data.append(np.array(image))
         X_test=np.array(data)
         Y_pred = model.predict_classes(X_test)
         return image,Y_pred
```

```
plot,prediction = test_on_img('/Disposable Surgical mask.jpg')
print("mask is : ", classes["Disposable Surgical mask"])
```

```
/usr/local/lib/python3.7/dist-packages/keras/engine/sequential.py:45
  warnings.warn('`model.predict_classes()` is deprecated and '
mask is :  It is 60% secure when we use only once
```

Figure 4: Model Testing

V. CONCLUSION

This paper introduces a system for reduce the spread of coronavirus disease by identifying whether the person is wearing the secured masks or not. Convolutional Neural Networks used in this system; it is performed well on image classifications. So, in this proposed system CNN used to classifying the images as with mask or without mask. The CNN provides a better solution by reducing the dimensionality of an image by utilizing convolutional and pooling layers. With respect to taken the input images system will detect whether the person using a mask or not. If a person uses a mask, then the system will be checking the type of mask. Based on that it will predict the safety of that mask. This system will also suggest the type of mask to the person for protect themselves. The results show that from the images the proposed model is capable of detecting the type of masks peoples are wearing based on that system predict the efficiency of the mask. So, the system will be offering a good help to the society and health system. This system only using input images for predicting the type of mask

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and efficiency of masks, for future enhancement can use video images as inputs for detecting the type of masks and efficiency of masks. It will more useful for the public and also the health authorities.

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