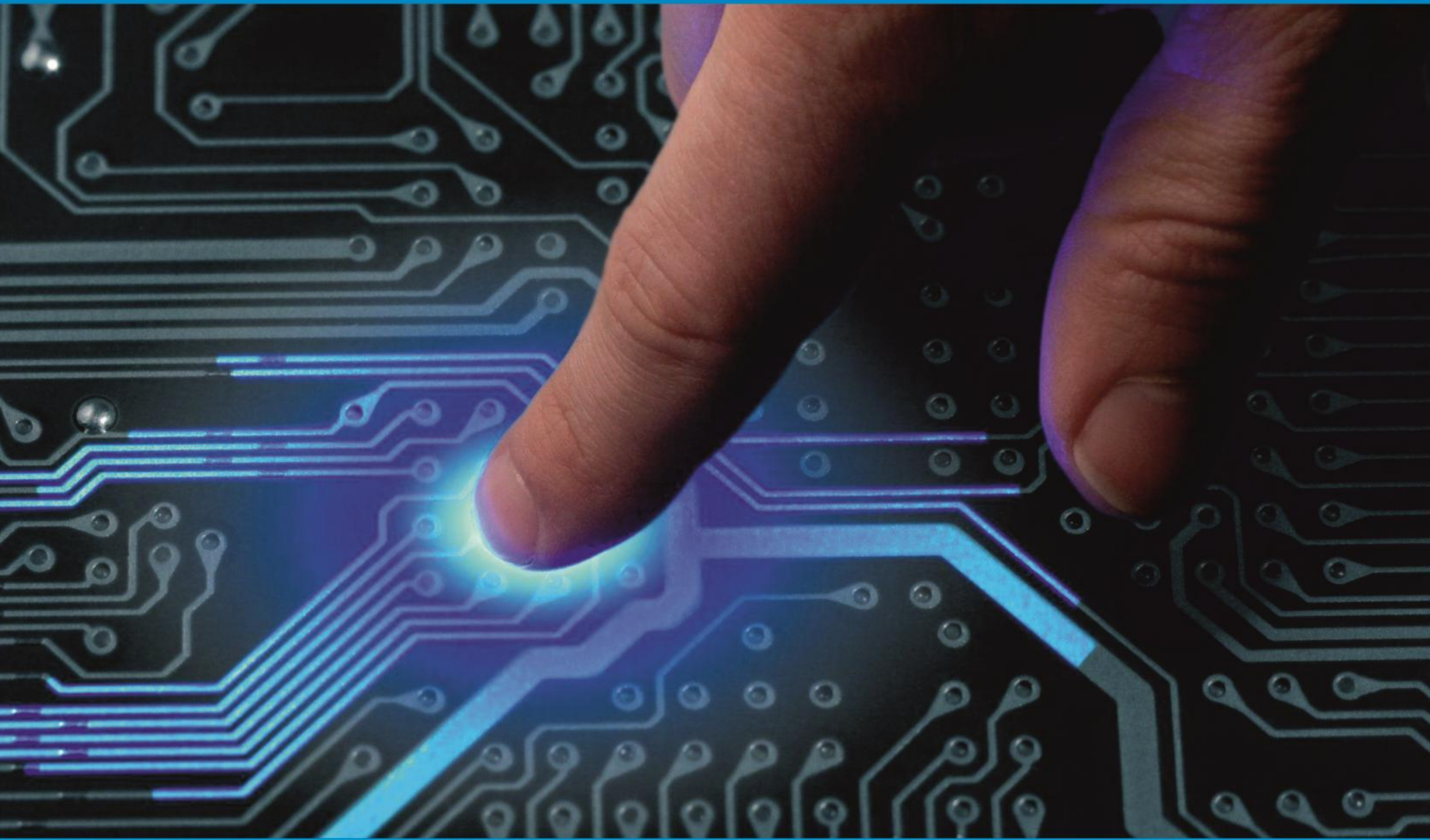
IJIRCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 9, Issue 5, May 2021

INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 7.488

9940 572 462 | 6381 907 438 | ijircce@gmail.com | www.ijircce.com

International Journal of Innovative Research in Computer and Communication Engineering

| e-ISSN: 2320-9801, p-ISSN: 2320-9798| www.ijircce.com | |Impact Factor: 7.488 |

|| Volume 9, Issue 5, May 2021 ||

| DOI: 10.15680/IJIRCCE.2021.0905129 |

Masked Face Recognition Using Convolutions Neural Network

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ABSTRACT: The World is facing a huge health crisis due to the rapid transmission of coronavirus. In order to effectively prevent the spread of COVID-19 virus , almost everyone have to wear a mask as its one of the most important element to prevent from this virus as per World Health Organization(WHO). It makes conventional facial recognition technology almost ineffective in several cases, such as community access control, face access control, facial attendance, facial security checks at airports, etc. Thus, there's an immediate requirement to improve the recognition performance of the existing technology on the masked faces. The current advanced face recognition approaches are architected based on deep learning, which depend on or requires a large number of face samples. With no publicly accessible datasets or database of face samples available, a dataset needs to be created for the recognition system.

KEYWORDS*:* Face Recognition, Convolution Neural Network, Machine Learning, Deep Learning

I. INTRODUCTION

The infectious disease called COVID-19 is caused by the new discovered corona virus. Mild to moderate respiratory problems that recover without special care or treatment is experienced by most infected people. People with underlying diseases such as cardiovascular disease, diabetes, chronic respiratory disease, cancer or with old age more likely develop serious illness due to COVID-19. The spread of covid-19 is through droplets of saliva or discharge from nose primarily, when an infected person coughs or sneezes; so practice of respiratory etiquette is important. Keeping that in mind, the World Health Organization advised to ensure that their citizens are wearing masks in public places to various countries. After being advised, to avoid spreading of infection, people are wearing masks constantly. Prior to COVID-19, a few numbers of people for health reasons and for protection against air pollution along with practitioners at hospitals wore mask. COVID-19 was declared as a global pandemic by WHO, as it rapidly transmitted. As reported by WHO, the numbers of cases are close to 2 million around the world. The positive cases are found in crowded and overcrowded areas in majority. Therefore, wearing masks in public places which prevents the transmission of virus was prescribed by the scientists. As the current recognition system is not applicable for mask based face recognition, wearing masks caused a massive security issue in surveillance systems. The most important means of identification, which is the face recognition techniques, have nearly failed. The authentication applications that rely on face recognition, such as community entry and exit, face access control, face attendance, face gates at train stations, face authentication based mobile payment, face recognition based social security investigation, etc. ; is in huge dilemma due to this. Removing mask for the purpose of passing authentication is too big a risk for the fear of getting infected. Unlocking systems based on passwords or fingerprints are unsafe, as COVID-19 virus also spreads through contact. Face recognition without touching is much safer, but when wearing a mask existing face recognition solutions are no longer reliable. An optimized face recognition system using convolutional neural networks for persons wearing masks is proposed to solve above mentioned difficulties. This system uses vignette based CNN so as to improve face recognition accuracy.

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II. PROPOSED WORK

Facial recognition is the essential first step of facial recognition, and it is used to detect faces in images.It is part of object detection and can be used in many domains such as security, biological measures, law enforcement, personal security. The proposed system is based on an age data set to recognize masked faces, which are folders composed of images of a person wearing a mask clicked from different angles. Each person has a folder of his images. After these folders are created the CNN is formed based on the VGG network architecture. CNN training consists of matching images of an individual with their name. CNN involves all processes like functionality extraction, fragmentation, specification etc. The system now has a new image and provides output when comparing and matching the image with the stored data set.

Facial detection algorithms focus on detecting front end human faces.It is analogous to image detection in which an individual's image is gradually matched. Image matches the image that is stored in the database. Any changes to facial traits in the database will invalidate the mapping process.

Input facial image with mask at different angles. Create an anaysis set for each user at different angles and different types of mask. Analyze the convolutional neural array with this image. Test the system with the old and the new image. Produce an image with facial recognition to the users.

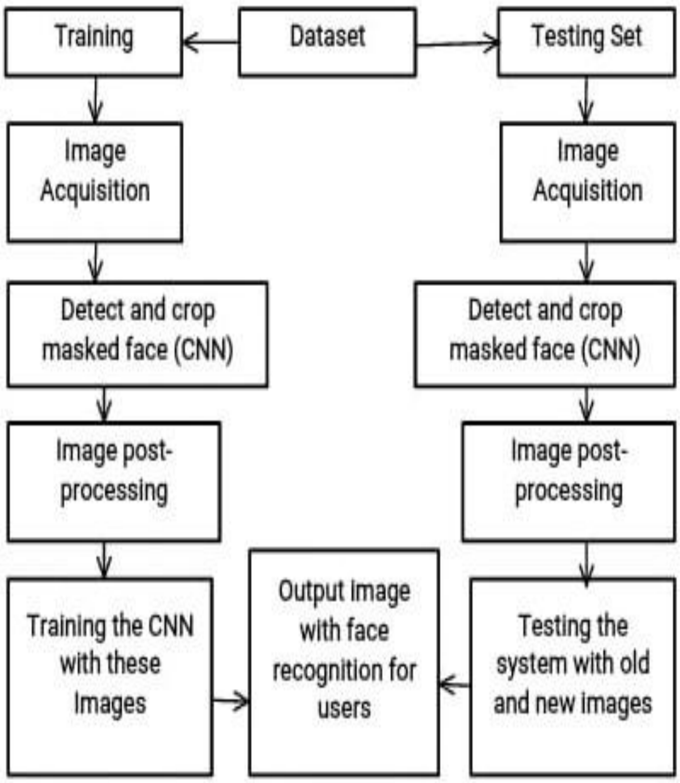

Figure: Working flowchart

III. PROPOSED ALGORITHM

A. *Design consideration* :

- A convolutional neural network is used in image recognition and processing that is specifically designed to process pixel data.
- A Convolutional Neural Network (CNN) is a multi-layered neural network with a special architecture to detect complex features in data.

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- First proposed using neural network to detect the faces in this work conventional neural network is used to classify each pixel is a part of face and then determined the location of the face through another conventional neural network.
- Even if the mask covers part of the face, features of upper half of the face such as eyes and eyebrows can still be used to improve the availability of the face recognition CNN system.
- Convolutions neural network has seven types of layers to build architecture apart from input layers.

B. *Description of the proposed Algorithm*

Algorithm1 :-Face Detection Algorithm Convolutions Neural Network

Start

1. Enter scene id
2. Determine lighting, L : Day or Night or Artificial
3. Read a video frame Vid(L)
4. Compute histogram of Vid (L) : Histogram (Vid(L))
5. Take a video of the actual scene now: Vnow.
6. For each frame i of Vnow

   a. Read a video frame Vi.

   b. Compare Vi with Vid (L) using substraction algorithm

      Residue= Histogram (Vi-Vid(L))

   c. If (Residue - Histogram (Vid(L))>€). //€ is a threshold

      Then

         { Call procedure : Perform Face Detection (Vi);

      Else

         { i=i+1;

         Continue;)

End

Procedure: Perform Face Detection (Vi)

Start

1. Call procedure : Image Fusion (Vi, Vid(L), IMAGE futilized);
2. Get histogram of IMAGEfutilized: Histogram (IMAGE futilized)
3. Compare clusters of Vid(L) and IMAGE futilized
4. Determine all new n clusters from step 5 that are found in IMAGE futilized and not in Vid (L) : Clus (i), i=1 to n
5. for i=1 to n

{Extract Height (Clus(i));

Extract Width ((Clus(i));

If (Height (Clus (i)) - Average Height (Person)<€human

And width (Clus (i)) - Average Height (Person)<€human

Then

Call Procedure Determine Head-and Shoulder (Clus(i))}

End

Algorithm 2:- Face Detection Algorithm VGG Architecture

#initialize the VGG

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```
# Load the VGG16 model, use the ILSVRC competition weights
#include_top = False, means only include the convolution Base.
conv_base = VGG16(weights='imagenet',
                  include_top=False,
                  input_shape=(rows,cols,3))
conv_base.trianable = False;
model = models.Sequential()

#Add the VGGNet model
model.add(conv_base)

#NN Layers
model.add(keras.layers.Flatten())
model.add(keras.layers.Dense(256, activation='relu'))
model.add(keras.layers.Dense(len(os.listdir(train_dir)), activation
print(model.summary())
```

C.*Architecture layers*

1. Convolution

A convolution is a combined integration of two functions that shows you how one function modifies the other.

$$(f * g)(t) \stackrel{\text{def}}{=} \int_{-\infty}^{\infty} f(\tau) g(t-\tau)\, d\tau = \int_{-\infty}^{\infty} f(t-\tau) g(\tau)\, d\tau.$$

There are three important items to mention in this process: the input image, the feature detector, and the feature map. The input image is the image being detected. The feature detector is a matrix, usually 3x3 (it could also be 7x7). A feature detector is also referred to as a kernel or a filter.

2. Apply the ReLu (Rectified Linear Unit)

In this step we apply the rectifier function to increase non-linearity in the CNN. Images are made of different objects that are not linear to each other. Without applying this function the image classification will be treated as a linear problem while it is actually a non-linear one.

3. Pooling

Spatial invariance is a concept where the location of an object in an image doesn’t affect the ability of the neural network to detect its specific features. Pooling enables the CNN to detect features in various images irrespective of the difference in lighting in the pictures and different angles of the images.

4. Flattening

Once the pooled featured map is obtained, the next step is to flatten it. Flattening involves transforming the entire pooled feature map matrix into a single column which is then fed to the neural network for processing.

5. Full connection

After flattening, the flattened feature map is passed through a neural network. This step is made up of the input layer, the fully connected layer, and the output layer. The fully connected layer is similar to the hidden layer in ANNs but in this case it’s fully connected. The output layer is where we get the predicted classes. The information is passed through the network and the error of prediction is calculated. The error is then back propagated through the system to improve the prediction.

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6. Compiling CNN

The compile CNN using the *compile* function. This function expects three parameters: the optimizer, the loss function, and the metrics of performance. The optimizer is the gradient descent algorithm are going to use. The *binary_crossentropy* loss function since we are doing a binary classification.

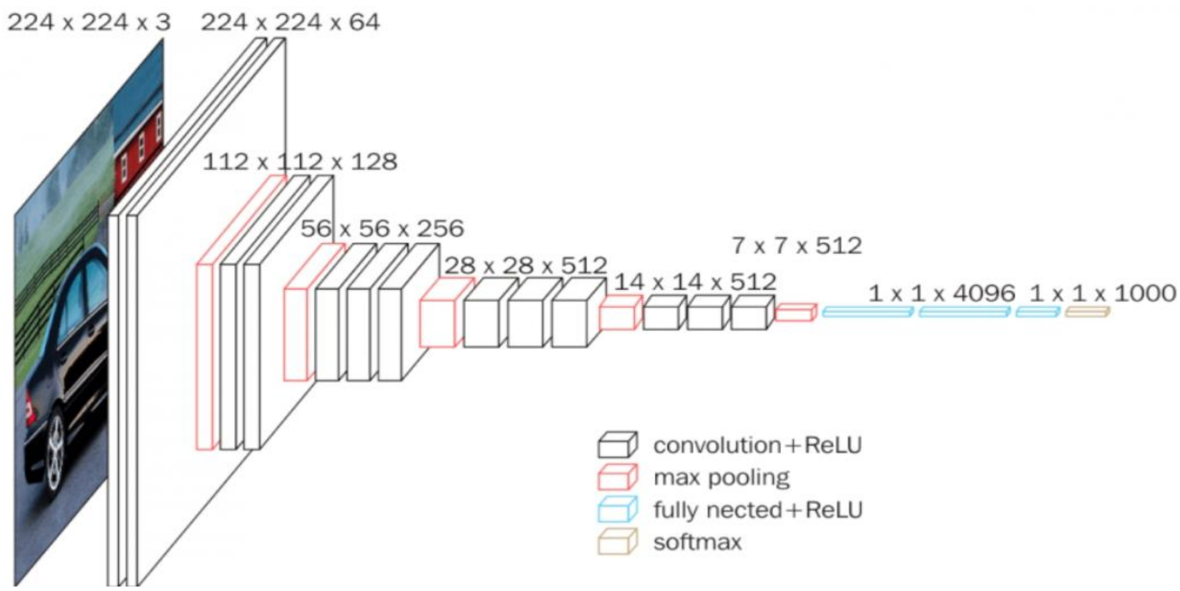
$$\sigma(\mathbf{z})_j = \frac{e^{z_j}}{\sum_{k=1}^{K} e^{z_k}} \quad \text{for } j = 1, \ldots, K.$$

$$\sigma : \mathbb{R}^K \to (0,1)^K$$

classifier.compile(optimizer='adam', loss='binary_crossentropy',metrics=['accuracy'])

7. Fitting the CNN

The CNN going to pre-process the images using Keras to prevent over fitting. This processing is known as image augmentation. The Keras utility we use for this purpose is *ImageDataGenerator*.



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V. SIMULATION RESULTS

Fig 1:- Dataset images for No Mask Class

Fig 2:- Dataset images for Mask Class

VI. CONCLUSION AND FEATURE SCOPE

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, we used the dataset that consisted of 1916 masked faces images and 1919 unmasked faces images. These images were taken from various resources like Kaggle and RMFD datasets. The model was inferred on images and live video streams.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, we used the dataset that consisted of 1916 masked faces images and 1919 unmasked faces images. These images were taken from various resources like Kaggle and RMFD datasets. 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

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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.More than fifty countries around the world have recently initiated wearing face masks compulsory. People have to cover their faces in public, supermarkets, public transports, offices, and stores. Retail companies often use software to count the number of people entering their stores. They may also like to measure impressions on digital displays and promotional screens. We are planning to improve our Face Mask Detection tool and release it as an open-source project. Our software can be equated to any existing USB, IP cameras, and CCTV cameras to detect people without a mask.

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