FACE MASK DETECTION USING CNN

A Anush Goud
Artificial Intelligence and Machine learning
Malla Reddy University Hyderabad, India

R Shiva Shanker Goud
Artificial Intelligence and Machine learning
Malla Reddy University Hyderabad, India

R Vishnu Teja
Artificial Intelligence and Machine learning
Malla Reddy University Hyderabad, India

R yashaswini
Artificial Intelligence and Machine learning
Malla Reddy University Hyderabad, India

ABSTRACT

The spread of Coronavirus started at the end of the year 2019 from the city of China, Wuhan. The continuous spread of the virus forced governments of various countries to put lockdown for several months. It has been observed that wearing a face mask can actually prevent the transmission of this deadly virus. In the future, we have to use a face mask as a preventive measure for any such viruses. However, manually it is very difficult to keep track of a person wearing a mask or not. And here technology plays a very crucial role. This paper highlights the importance of deep learning especially object detection.

KEYWORDS

Face mask detection, Convolutional Neural Networks, CNN, Transfer learning, COVID-19, Pandemic.

INTRODUCTION

Many countries are declared some rules or mechanisms such as country-wise emergency (public lockdown), wearing a mask, social distancing, using sanitizers, washing hands, and other important mechanisms are applied in order to reduce the spread of this pandemic. In addition to these rules, countries use different technologies to control and detect whether people are following the rules or not, especially in business shops, airlines, universities, and other crowded places.

This study's main motivation is detecting the people whether they are wearing a mask or not with the help of a deep learning algorithm and real-time data (image processing). The proposed model will be trained on the image dataset and real-time live streaming dataset to detect whether the people are wearing a mask or not wearing a mask. The proposed model will be used deep learning Convolutional Neural Network (CNN) and OpenCV object detection techniques and HTML. The users blood test data will be entered in web app front end and the back end will process the data using model.

As already discussed that wearing face masks is the most effective protective measure against Coronavirus transmission the wearing of face masks in public places just by detecting face masks in real-time with the help of an already installed camera network (surveillance camera network or any other). It is an easy method to manage the people in the society, to maintain social distancing, and to make sure that everyone has worn a face mask.

METHODOLOGY

The proposed face mask detection system consists of three main stages: face detection, face region cropping, and mask classification. Initially, a Haar Cascade classifier is employed to detect and extract faces from the input images or video frames. Subsequently, the extracted face regions are preprocessed, including resizing and normalization, to facilitate further analysis. A CNN model is then trained using a dataset comprising labeled images of individuals wearing and not wearing masks. The CNN model is responsible for distinguishing between masked and unmasked faces.

The architecture of the CNN model comprises multiple convolutional layers, pooling layers, and fully connected layers. Transfer learning is employed by using a pre-trained CNN model, such as VGG16 or ResNet, as a starting point. The model is fine-tuned by training it on the labeled dataset specific to face mask detection. The training process involves forward and backward propagation, optimizing the model's parameters using gradient descent and a suitable loss function.

DATA COLLECTION

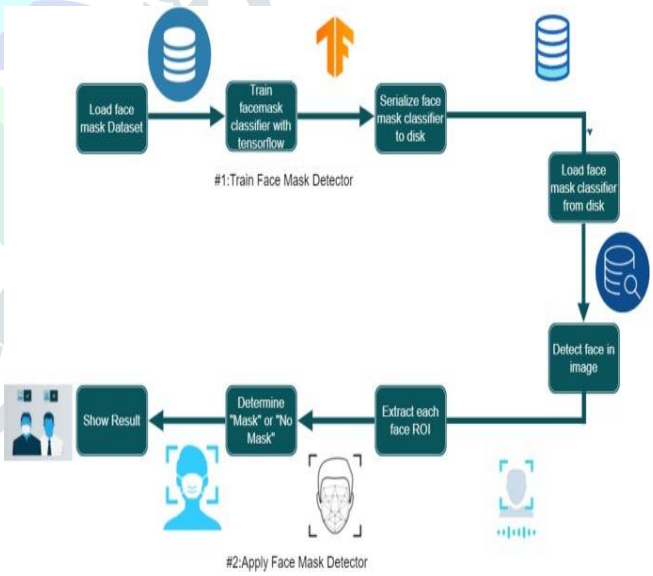
For mask detection, we used three different datasets with a total of 1340 photographs. Using mobile cameras, webcams, and CCTV video, another 120 photographs were taken. For detecting masks from video used CCTV footage and Webcam, both of the photos are in RGB. To avoid overfitting, we collected data from different datasets and generated our datasets, the Real-World Masked Face Dataset (RMFD) [28] and the Simulated Masked Face Dataset (SMFD) [29], which we used for training and testing purpose.

IMPLEMENTATION

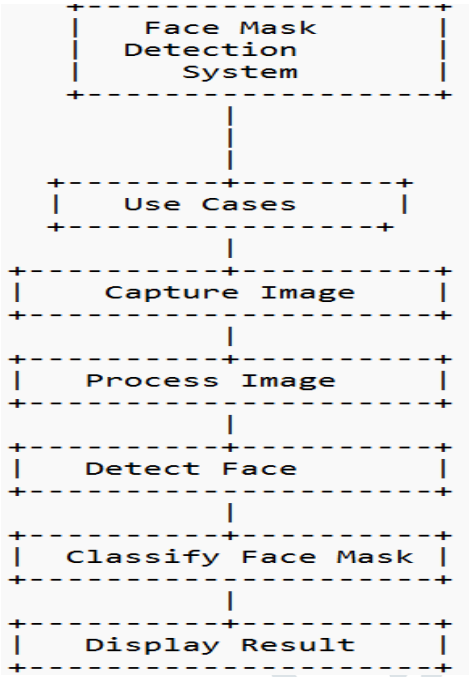
Face mask detection using Convolutional Neural Networks (CNN) is a popular
application of computer vision that aims to identify whether a person is wearing a face mask or not. In this task, we'll assume a binary classification problem where the
model needs to classify images into two categories: "with mask" or "without mask."

Collect a dataset of face images labeled as "with mask" or "without mask. "Ensure that the dataset is balanced, with an equal number of images for each class. Split the dataset into training and testing sets. A common split ratio is around 80% for training and 20% for testing .Resize the images to a fixed size, such as 224x224 pixels, to ensure consistent input dimensions for the CNN. Normalize the pixel values of the images between 0 and 1. This step helps the CNN converge faster during training. Model Architecture: Build a CNN model using popular deep learning frameworks such as TensorFlow or PyTorch. The model should consist of multiple convolutional layers followed by pooling layers to extract features from the input images. Use activation functions like ReLU (Rectified Linear Unit) to introduce non-linearity. Add fully connected layers at the end of the CNN to classify the extracted features. Finally, include a softmax activation function to obtain class probabilities.

ARCHITECTURE



USECASE DIAGRAM



The use case diagram depicts the primary functionalities of the face mask detection system. Here's a brief description of each use case:

Capture Image: This use case represents the ability to capture an image using a camera or any image source. It allows the system to obtain an image for face mask detection.

Process Image: After capturing the image, this use case involves preprocessing the image to prepare it for face detection and classification. It includes tasks like resizing, normalization, and any other necessary preprocessing steps.

Detect Face: This use case involves detecting the presence of faces in the processed image. It utilizes face detection algorithms or models to identify the location and boundaries of faces in the image.

Classify Face Mask: Once the face is detected, this use case applies the trained CNN model to classify whether the detected face is wearing a mask or not. It involves passing the face image through the CNN model for classification.

Display Result: After the classification is performed, this use case displays the result of face mask detection to the user. It could be shown as a visual output on a screen or conveyed through other means, such as text or audio.

These use cases represent the core functionalities of the face mask detection system using CNN. Depending on the specific requirements and implementation details, there could be additional use cases or interactions with external systems.

Training Data:

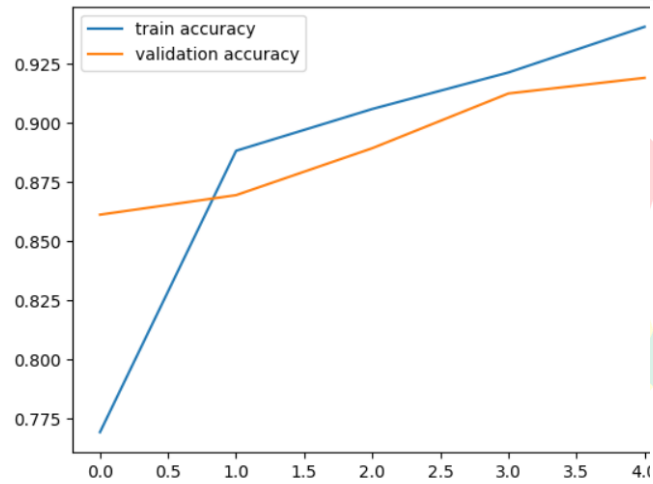
```
# training the neural network
history = model.fit(X_train_scaled, Y_train, validation_split=0.
```

```
Epoch 1/5
170/170 [==============================] - 15s 23ms/step - loss:
Epoch 2/5
170/170 [==============================] - 3s 18ms/step - loss:
Epoch 3/5
170/170 [==============================] - 3s 17ms/step - loss:
Epoch 4/5
170/170 [==============================] - 3s 17ms/step - loss:
Epoch 5/5
170/170 [==============================] - 3s 19ms/step - loss:
```

Train vs Validation Accuracy:

```
h = history

# plot the accuracy value
plt.plot(h.history['acc'], label='train accuracy')
plt.plot(h.history['val_acc'], label='validation accuracy')
plt.legend()
plt.show()
```



RESULT :

```
Path of the image to be predicted: /content/istockphoto-1310896477-17
```

```
1/1 [==============================] - 0s 23ms/step
[[0.3702357 0.6211873]]
1
The person in the image is wearing a mask
```

```
Path of the image to be predicted: /content/2.0.jpg
```

```
1/1 [==============================] - 0s 34ms/step
[[0.5862099 0.5599252]]
0
The person in the image is not wearing a mask
```

Test Accuracy Score :

```
loss, accuracy = model.evaluate(X_test_scaled, Y_test)
print('Test Accuracy =', accuracy)
```

```
48/48 [==============================] - 1s 10ms/step - loss: 0.1829 -
Test Accuracy = 0.9272005558013916
```

Test Accuracy Score : 92.72

CONCLUSION

In conclusion, face mask detection using convolutional neural networks (CNN) is a promising approach for automating the process of identifying whether a person is wearing a face mask or not. CNN is a deep learning architecture that can learn features from images and classify them based on those features.

Through the use of CNN, a model can be trained to recognize faces and distinguish between those wearing masks and those who are not. This can be a valuable tool in maintaining public health and safety during pandemics like COVID-19. The effectiveness of face mask detection using CNN depends on several factors, including the quality and quantity of training data, the choice of CNN architecture, and the hyperparameters used for training.

Despite its potential benefits, face mask detection using CNN has some limitations, including the need for high-quality training data and the potential for biases in the data that can affect the model's performance. Overall, face mask detection using CNN is a promising approach that can help in automating the process of identifying whether a person is wearing a mask or not, but further research is needed to improve its accuracy and reliability.

REFERENCES

[1] C.Jagadeeswari, M.Uday Theja, Performance Evaluation of Intelligent Face Mask Detection System with various Deep Learning Classifiers,2020

[2] Vinitha.V1, Velantina.V2, COVID-19 facemask detection with deep learning and computer vision,2020.

[3] Wei Bu, Jiangjian Xiao, Chuanhong Zhou, Minmin Yang, Chengbin Peng," A Cascade Framework for Masked Face Detection", 2017.

[4] Amit Chavda, Jason Dsouza, Sumeet Badgujar, Ankit Damani ," Multi-Stage CNN Architecture forFaceMask Detection ",2020.

[5] Aniruddha Srinivas Joshi, Shreyas Srinivas Joshi, Goutham Kanahasabai, Rudraksh Kapil, SavyasachiGupta," Deep Learning Framework to Detect Face Masks from Video Footage",2020.

[6] Reny Jose," A Convolutional Neural Network (Cnn) Approach to Detect Face Using Tensorflow And Keras",2019.