COVID PROTOCOL VALIDATION USING MASK DETECTION

CSE3013: ARTIFICIAL INTELLIGENCE

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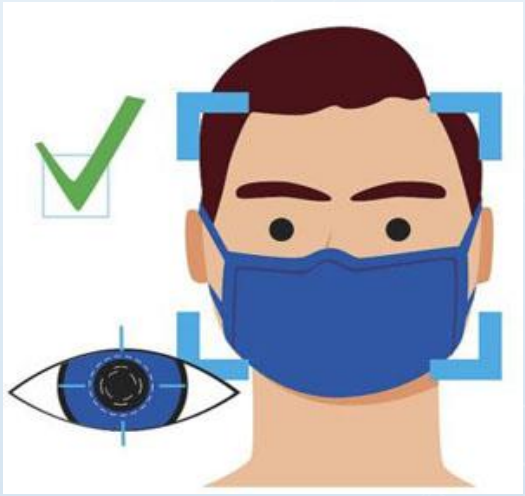
ABSTRACT

- Coronavirus disease (COVID-19) that has entered India made the government impose large-scale social restrictions to reduce the spread of the coronavirus. As the increase in patients confirmed positive, the government continues to appeal and ask the Indonesian to use masks. Whether it is a healthy people or those who are sick. This appeal is in line with the recommendations of the World Health Organization (WHO) in preventing the spread of COVID19. Therefore it is necessary to develop tools for monitor people who have not used masks in public service areas in real-time. We develop an application of mask detection using a camera that functions as photo and video input and connected to Speed Maix Bit microprocessor to process data and display it to the LCD. We purposed the tools to solve the problems regarding people who were not used masks or not immediately to minimize the spread of COVID-19. Our final experiment demonstrates that the application highly detects people using masks or not in the public area. This study contributed to the conception, design system, and rules-based for application of mask detector to prevent Covid-19.

INTRODUCTION

- Coronaviruses are enveloped RNA viruses that are distributed broadly among humans, other mammals, and birds and that cause respiratory, enteric, hepatic, and neurologic diseases. Six coronavirus species are known to cause human disease.
- COVID-19 is an acute resolved disease but it can also be deadly. Severe disease onset might result in death due to massive alveolar damage and progressive respiratory failure.
- The best prevention at times of a pandemic like this is to avoid contracting the virus. The most important thing for prevention is the use of face masks; Then, when coughing and sneezing covered with tissue which is then safely disposed of. Next, wash your hands regularly with soap or disinfection containing at least 60% alcohol (if soap and water are not available), avoiding direct contact with an infected person. The last is not to touch the eyes, nose, and mouth with unwashed hands.
- Some previous researches have relevant to our study. They are including about face-mask sampling detects, masking of random-walk motion, hyper-realistic mask detection, mask R-CNN, masking movement, 3-D face-masking detection and tracking, and immobilization mask. All of the researches relevant to our study but there is none discussed the mask detector to prevent Covid-19 in public services. In our study, the public services

APPLICATIONS



1. In crowded places like markets, malls, railway stations it becomes very difficult for the officials to identify people without mask. People roaming without masks can cause COVID to increase at a faster rate especially due to high population density.

2. This system can used in hospitals and clinics to check whether people entering the health centre especially the patients' wards are wearing mask or not.

3. This system can also be used to detect people who try to fool the officials by not wearing a proper mask.

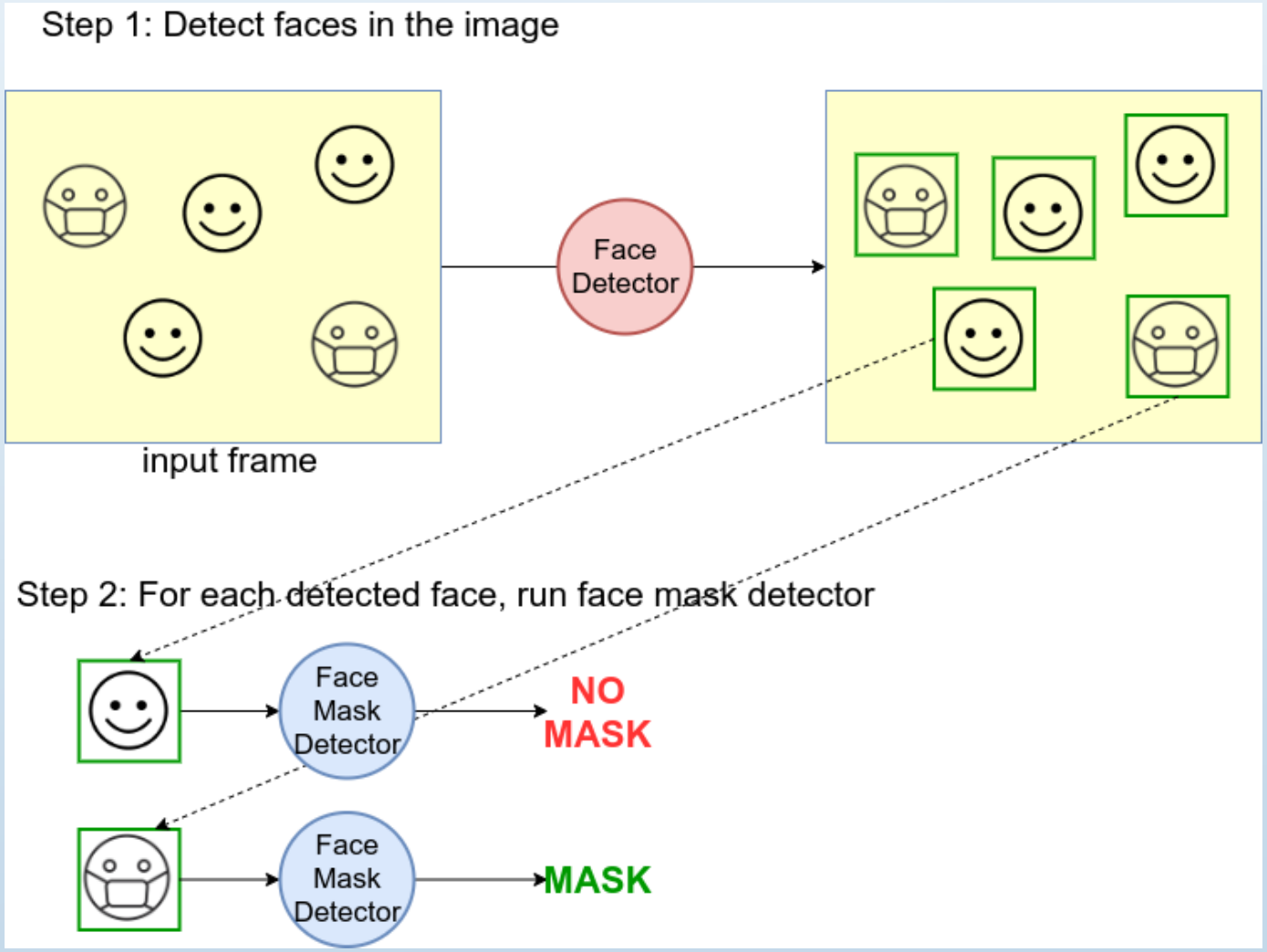
CHALLENGES/ ISSUES

1. Quality/ Type of mask cannot be detected. It will be difficult to tell whether the person is really wearing a standard mask such as N-95

2. The system may fail if the person somehow hides his/her face and does not wear a mask, then the person may go undetected in public.

3. In case of overcrowded places, bad weather or night time(in absence of enough lighting), the accuracy of the system may be reduced and it may not detect masks accurately.

WHY AI IS NEEDED FOR THIS PROJECT ?



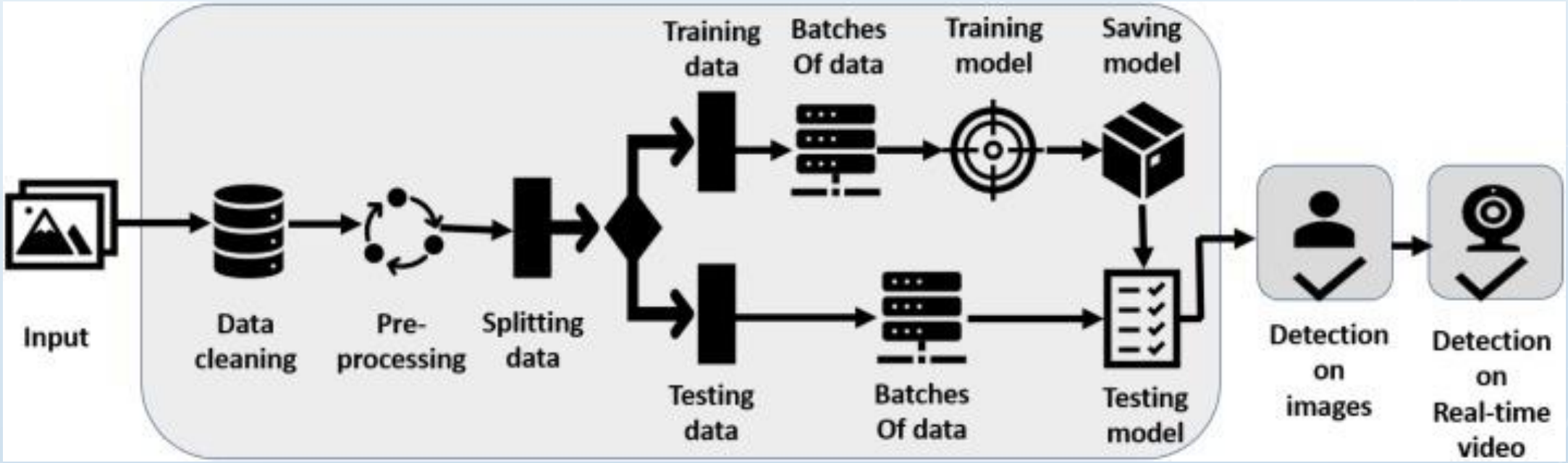
WHY AI IS NEEDED FOR THIS PROJECT ?

- For better performance of the system i.e better accuracy in detection.
- Faster and efficient detection.
- Cost efficient system in the long run.
- This system can also be used to detect people who try to fool the officials by not wearing a proper mask.
- AI trained models can detect people wearing masks more efficiently than human eye especially in situations like crowded places, moving vehicles etc.
- Using AI, we can track certain people who may have broken the protocol before by not wearing masks.

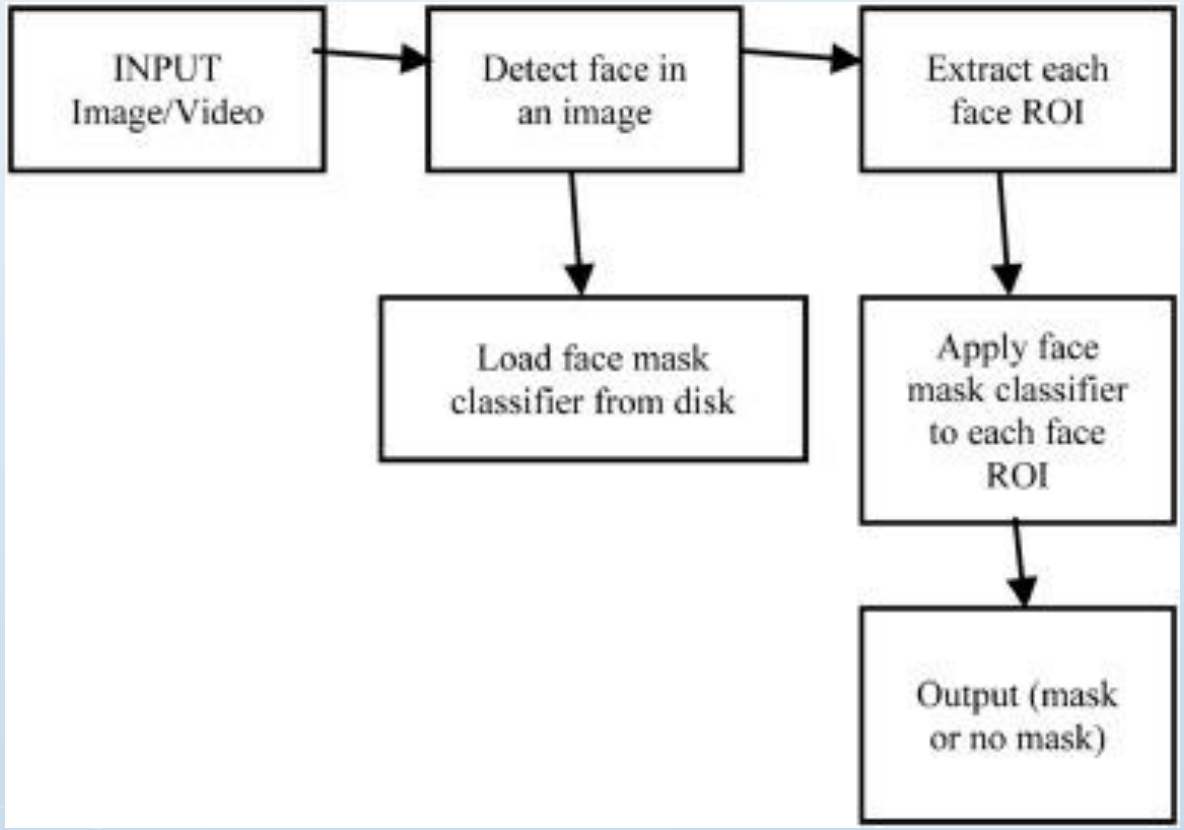
PEAS DESCRIPTION

- Performance Measure – Accuracy measure
- Environment – Input of images or videos from various sources such as recorded videos etc.
- Actuators – Detection of people with or without masks along with percentage area of face covered.
- Sensors – As of now static image files are input to the software. But in the future, live video feeds from CCTVs input can be made common.

ARCHITECTURE TYPE



ARCHITECTURE TYPE



ENVIRONMENT TYPE

1. Deterministic
2. Dynamic
3. Complete Observation
4. Single Object Detection
5. Continuous

EXISTING WORK

- Since the infectious coronavirus disease (COVID-19) was first reported in Wuhan, it has become a public health problem in China and even around the world. This pandemic is having devastating effects on societies and economies around the world. The increase in the number of COVID-19 tests gives more information about the epidemic spread, which may lead to the possibility of surrounding it to prevent further infections. However, wearing a face mask that prevents the transmission of droplets in the air and maintaining an appropriate physical distance between people, and reducing close contact with each other can still be beneficial in combating this pandemic. Therefore, this research paper focuses on implementing a Face Mask and Social Distancing Detection model as an embedded vision system.
- The pre-trained models such as the MobileNet, ResNet Classifier, and VGG are used in our context. People violating social distancing or not wearing masks were detected. After implementing and deploying the models, the selected one achieved a confidence score of 100%. This paper also provides a comparative study of different face detection and face mask classification models. The system performance is evaluated in terms of precision, recall, F1-score, support, sensitivity, specificity, and accuracy that demonstrate the practical applicability. The system performs with F1-score of 99%, sensitivity of 99%, specificity of 99%, and an accuracy of 100%. Hence, this solution tracks the people with or without masks in a real-time scenario and ensures social distancing by generating an alarm if there is a violation in the scene or in public places. This can be used with the existing embedded camera infrastructure to enable these analytics which can be applied to various verticals, as well as in an office building or at airport terminals/gates.

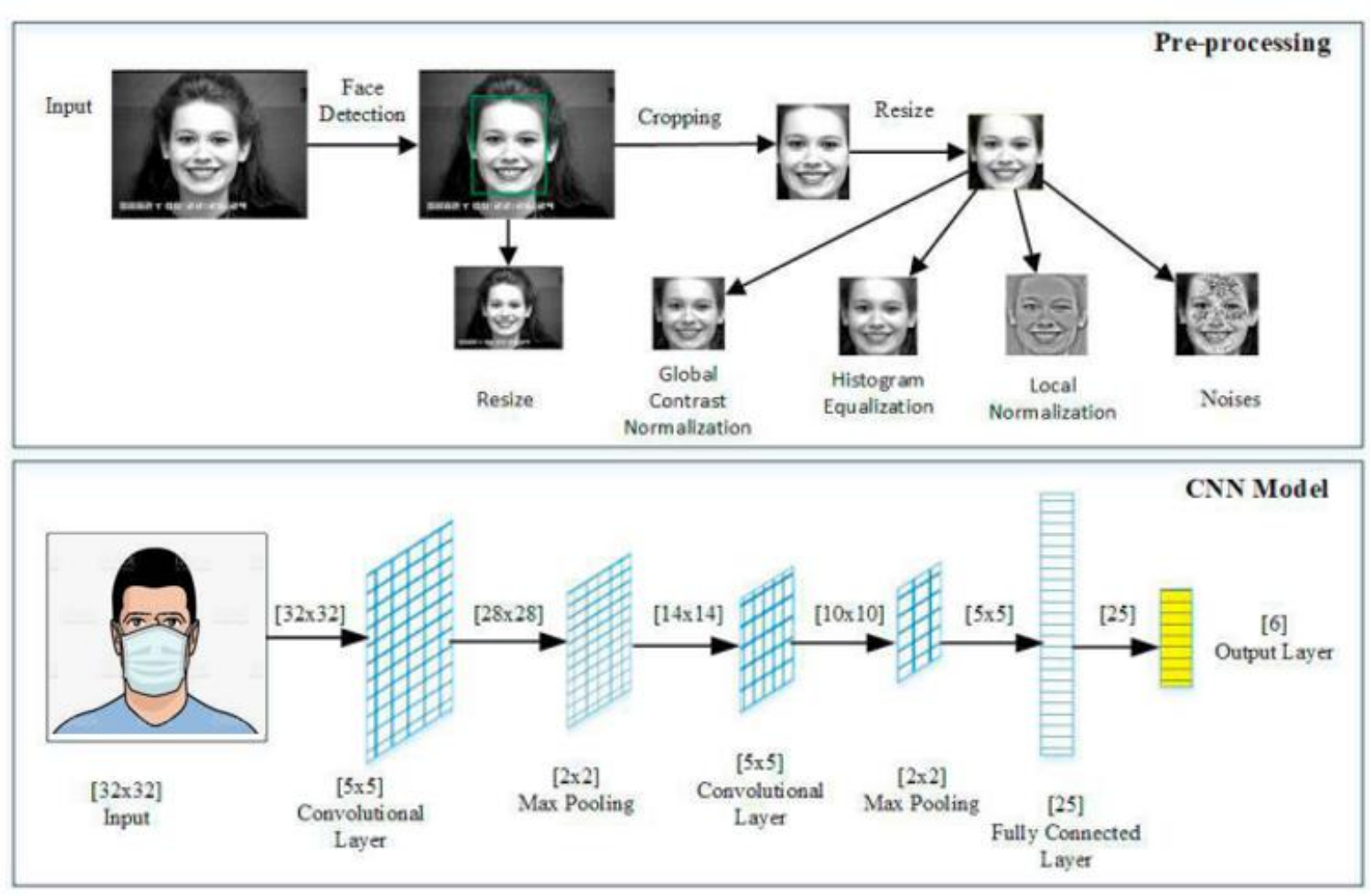
RELATED LINKS

- https://iopscience.iop.org/article/10.1088/1742-6596/1641/1/012063/pdf
- Zhu, N., Zhang, D., Wang, W., Li, X., Yang, B., Song, J. & Niu, P. 2020 A novel coronavirus from patients
- Xu, Z., Shi, L., Wang, Y., Zhang, J., Huang, L., Zhang, C. & Tai, Y. 2020 Pathological findings of COVID-19

ALGORITHMS USED

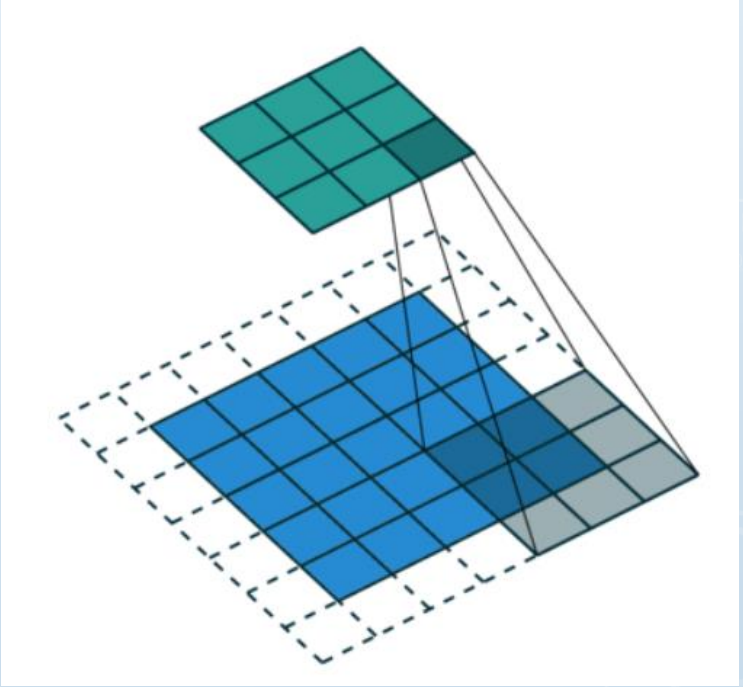
- ***CNN – Convolutional Neural Networks***
- ***Transfer Learning***
- ***VGG19***

CNN - CONVOLUTIONAL NEURAL NETWORKS



CNN - CONVOLUTIONAL NEURAL NETWORKS

- A **Convolutional Neural Network (ConvNet/CNN)** is a Deep Learning algorithm which can take in an input image, assign importance (learnable weights and biases) to various aspects/objects in the image and be able to differentiate one from the other. The pre-processing required in a ConvNet is much lower as compared to other classification algorithms. While in primitive methods filters are hand-engineered, with enough training, ConvNets have the ability to learn these filters/characteristics.

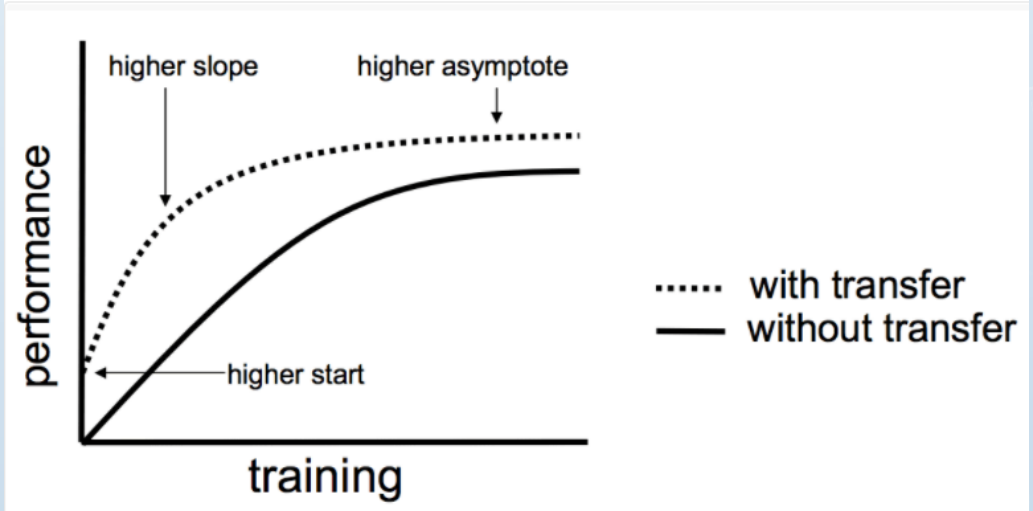


- A ConvNet is able to **successfully capture the Spatial and Temporal dependencies** in an image through the application of relevant filters. The architecture performs a better fitting to the image dataset due to the reduction in the number of parameters involved and reusability of weights. In other words, the network can be trained to understand the sophistication of the image better.

TRANSFER LEARNING

- ***The reuse of a pre-trained model on a new problem is known as transfer learning in machine learning. A machine uses the knowledge learned from a prior assignment to increase prediction about a new task in transfer learning***.

- The knowledge of an already trained machine learning model is transferred to a different but closely linked problem throughout transfer learning. For example, if you trained a simple classifier to predict whether an image contains a backpack, you could use the model's training knowledge to identify other objects such as sunglasses.



VGG19

- VGG-19 is *a convolutional neural network that is 19 layers deep.* You can load a pre-trained version of the network trained on more than a million images from the ImageNet database. The pre-trained network can classify images into 1000 object categories, such as keyboard, mouse, pencil, and many animals.

- VGG19 is *a variant of VGG model which in short consists of 19 layers (16 convolution layers, 3 Fully connected layer, 5 MaxPool layers and 1 SoftMax layer).* There are other variants of VGG like VGG11, VGG16 and others. VGG19 has 19.6 billion FLOPs.

MACHINE LEARNING ALGORITHM USED

- ***SUPERVISED ML ALGORITHM***

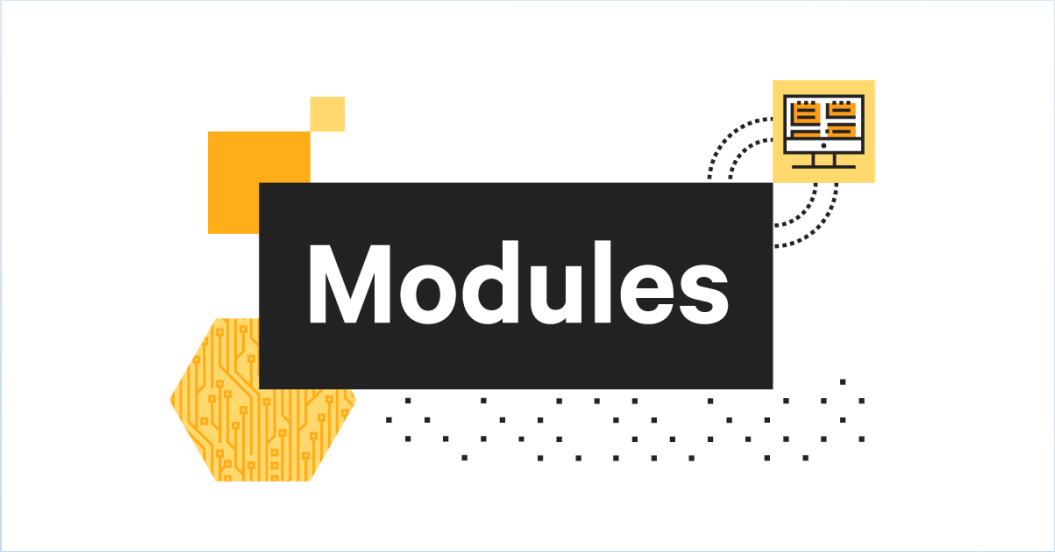
A supervised learning algorithm takes a known set of input data (the learning set) and known responses to the data (the output), and forms a model to generate reasonable predictions for the response to the new input data.

Since we are providing with the learning set of input data i.e. images of people with and without masks and our model generates responses to the provided data, therefore we can say that we are using supervised learning method.

This best approximates the relationship between input and output observable in the data.

MODULES IMPLEMENTED

1. Import necessary libraries
2. Loading, importing and pre-processing data
3. Using haar cascade to detect faces
4. Data Augmentation
5. Building transfer learning model
6. Testing model on test data



MODULES IMPLEMENTED

1. Import necessary libraries

We have imported libraries such as numpy, pandas, cv2 and distance.

```
import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
import cv2
from scipy.spatial import distance
```

MODULES IMPLEMENTED

2. Loading, importing and pre-processing data

```
[ ]  #loading haarcascade_frontalface_default.xml
     face_model = cv2.CascadeClassifier('/content/gdrive/MyDrive/Kaggle/haarcascade_frontalface_default.xml')
```

MODULES IMPLEMENTED

3. Using Haar cascade to detect faces

It is a machine learning based approach where a cascade function is trained from a lot of positive and negative images. It is then used to detect objects in other images. We used a Haar Cascade Model trained to detect faces in order to obtain the bounding box coordinates of faces in an image.

```
#plotting
for (x,y,w,h) in faces:
    cv2.rectangle(out_img,(x,y),(x+w,y+h),(0,0,255),1)
plt.figure(figsize=(12,12))
plt.imshow(out_img)
```

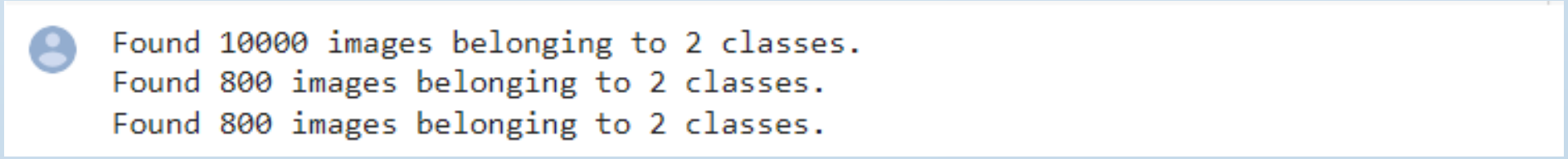
```
<matplotlib.image.AxesImage at 0x7f016ebecc90>
```

MODULES IMPLEMENTED

4. Data Augmentation

Data augmentation in data analysis are techniques used to increase the amount of data by adding slightly modified copies of already existing data or newly created synthetic data from existing data. It acts as a regularizer and helps reduce overfitting when training a machine learning model.

It is a collection of techniques that can be used to extend the dataset size and improve the quality of images in the dataset by a required amount. Logically it is used to make the deep learning model independent of the counterfeit features of the data space.



MODULES IMPLEMENTED

5. Building transfer learning model

Transfer learning (TL) is a research problem in machine learning (ML) that focuses on storing knowledge gained while solving one problem and applying it to a different but related problem. For example, knowledge gained while learning to recognize faces and masks could apply when trying to detect masks on faces.

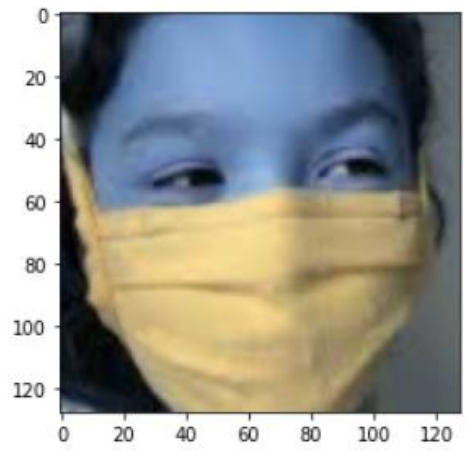
```
80142336/80134624 [==============================] - 1s 0us/step
80150528/80134624 [==============================] - 1s 0us/step
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 vgg19 (Functional)          (None, 4, 4, 512)         20024384

 flatten (Flatten)           (None, 8192)              0

 dense (Dense)               (None, 2)                 16386

=================================================================
Total params: 20,040,770
Trainable params: 16,386
Non-trainable params: 20,024,384
_________________________________________________________________
```

MODULES IMPLEMENTED

6. Testing model on test data

- Cropping image to 128 pixels to only cover the face region:

```
sample_mask_img = cv2.imread('/content/gdrive/MyDrive/Kaggle/Face Mask Dataset/Test/WithMask/1565.png')
sample_mask_img = cv2.resize(sample_mask_img,(128,128))
plt.imshow(sample_mask_img)
sample_mask_img = np.reshape(sample_mask_img,[1,128,128,3])
sample_mask_img = sample_mask_img/255.0
```



MODULES IMPLEMENTED

- Integrate with haar cascade

We now take crops of the faces detected in the image and use the model trained in the above section to determine whether the individual faces have a mask or not.