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Samsung Innovation Campus

Artificial Intelligence Course

Face Mask Detection

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- Facilitator: Mohamed Abdallah

Team : Triple A

Data Used : Face Mask Images

Table of content :

About the project :

Our project is about building a model that can accurately predict whether a person in an image is wearing a face mask or not. Distinguishing between face with or without face mask by detecting them.

About the Data:

Name: Face mask detection ~12k images Dataset

Source: Kaggle

Context: This dataset is used for Face Mask Detection Classification with images. The dataset consists of almost 12K images of people with/without facemasks.

Design Thinking:

Role Play:

We were called upon by the CDC (Centers for Disease Control and Prevention)

To investigate an already hazardous situation which is the increase in numbers of the people infected by Covid-19 variants. We were told to list all the problems we are facing and analyze them using the help of experts to come up with a reliable solution.

Design Thinking:

1- **Empathize :**

As we all know the situation of the pandemic we are in, getting infected is really easy nowadays so, after asking experts and observing our surrounding environment , we concluded that a big cause of the wide spread of the infection was the diminution in wearing face masks.

2- **Defining the problem :**

People be little the virus and do not wear face masks anymore which leads to the spread of the virus.

Design Thinking:

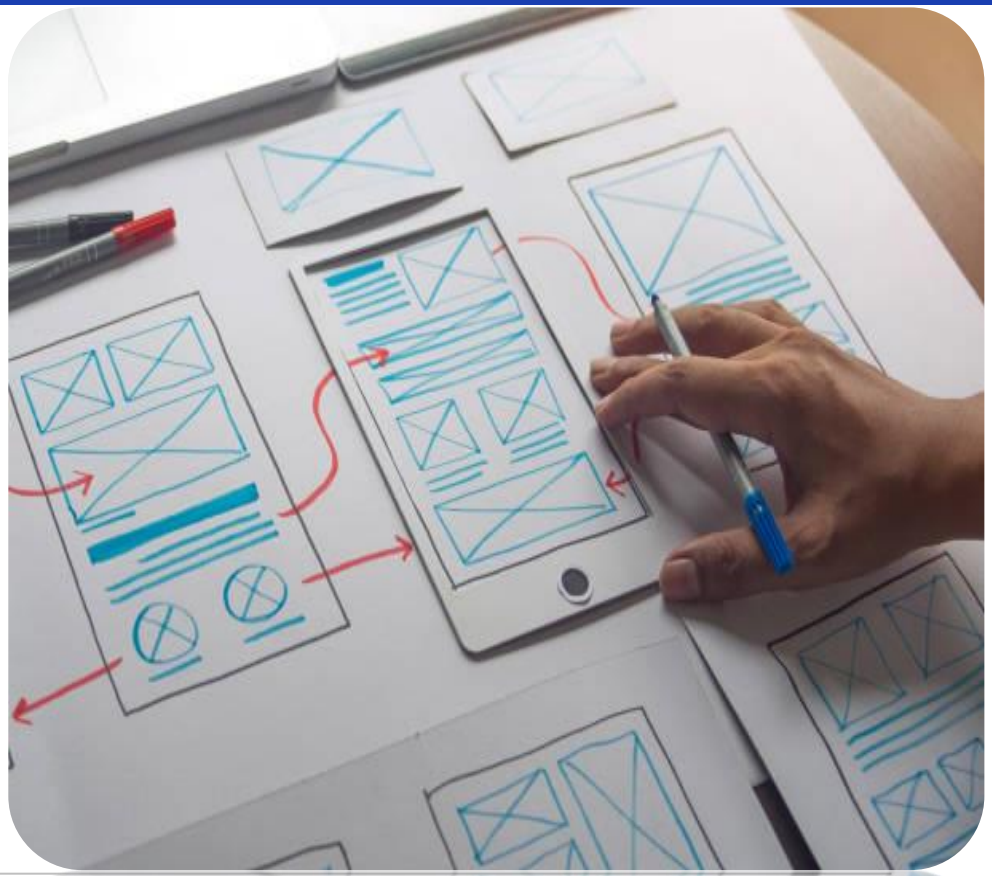
3- Ideate :

After inspecting the problem and the information that we have gathered. We thought of an idea to make a face mask detector eligible for usage in public/closed places like malls , government facilities , schools…etc. to detect people that have no mask on and fine them.

Design Thinking:

4- **Prototype :**

After generating our ideas using brainstorming meetings. We have decided to create a model to determine the accuracy of predicting whether a person is wearing a mask or not then, implementing this model in an algorithm to detect the face masks in photos and label people with the correct label.



Design Thinking:

5- Test :

To test our algorithm and model we inserted a number of images to see whether our model was successful or not in detecting face masks

Problem Definition & Solution:

Problems:

Less people tend to wear face masks day by day which affects businesses like in

Malls : people are packed and it is hard to notice who is wearing a mask and who is not.

Schools : we all know children could not care less about wearing masks so, most of the students dismiss wearing them which then leads to a wide spread of the virus in schools.

Problem Definition & Solution:

Problems (Cont.):

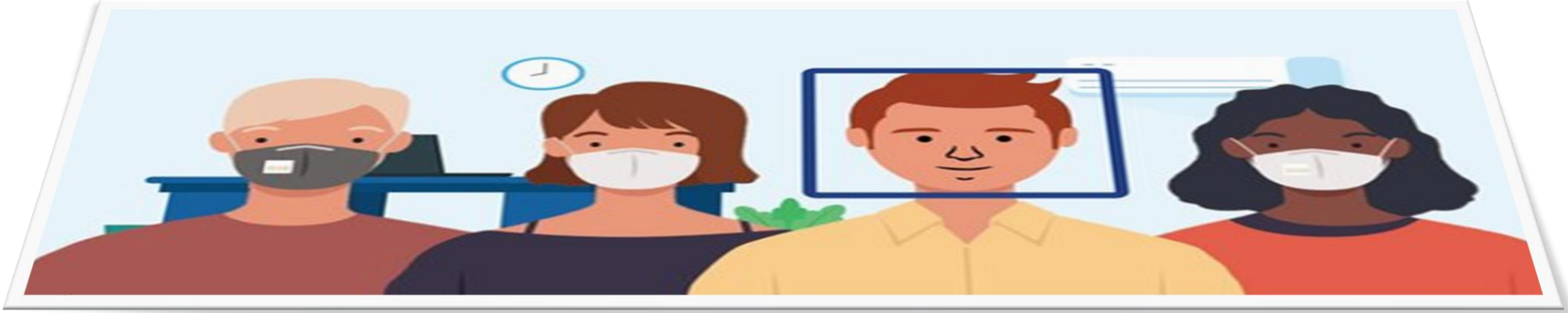
Hospitals : It would be a disaster if someone infected was not wearing a mask in a place like a hospital as, people there are already sick and this surely would not help them.

Government Facilities : These places are known to gather people from everywhere around city which leads to a really easy infection cycle.

Problem Definition & Solution:

Solution:

Consider it as the new traffic monitoring system which catches drivers doing illegal actions while driving , we will integrate our model in all of the places mentioned above and also in the streets just to increase the awareness of the people to how important it is to stick with the precautions and if they do not they will get fined.

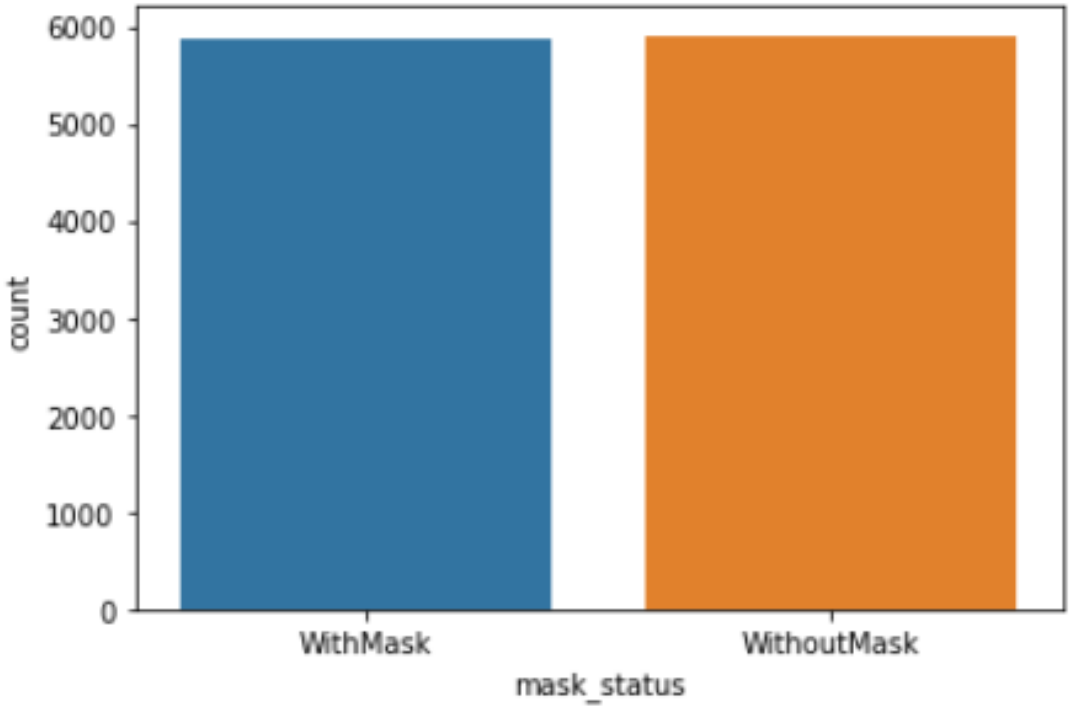


EDA:

Some random samples from the data ..

EDA:

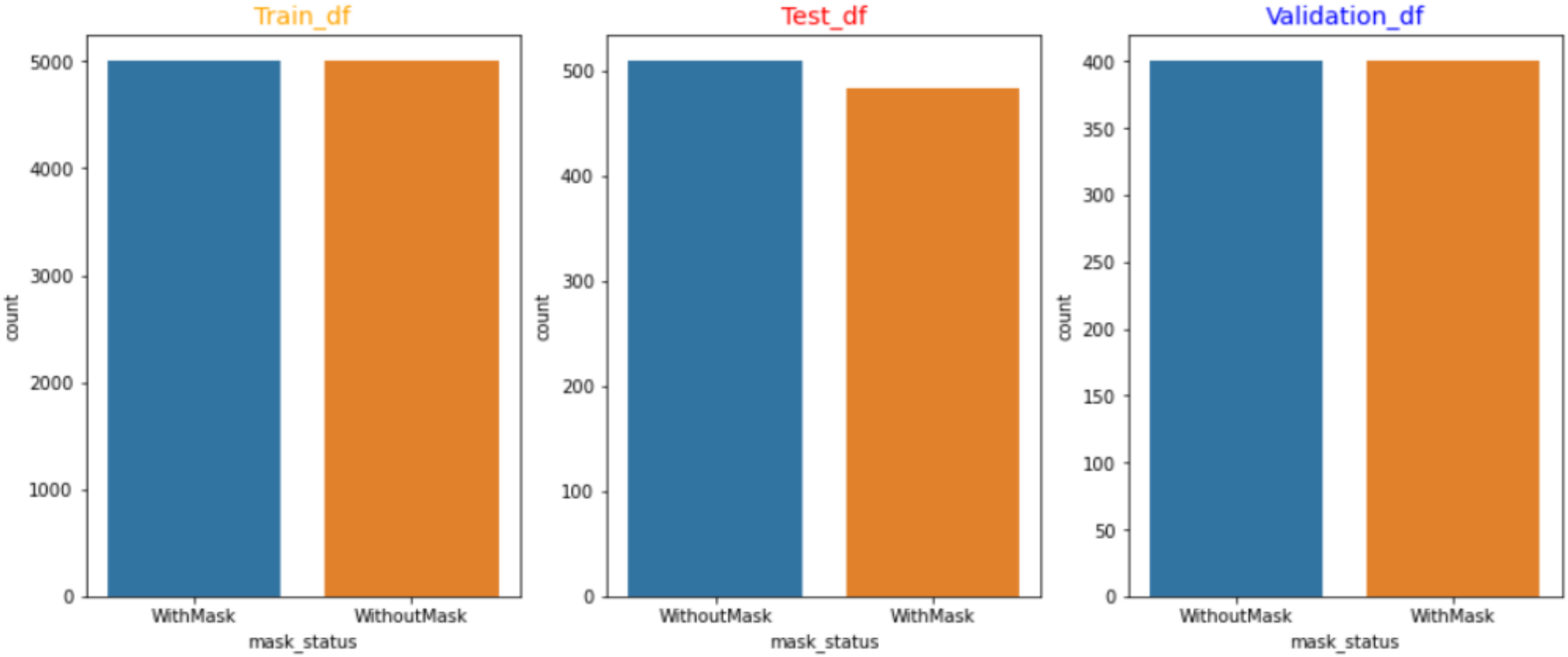
We have 11,792 images, including 5883 with the mask and 5909 without the mask, as we can see, so we can say that the data we have is balanced.



EDA:

After we divided the data into train, test and validation, We can see in the next slide that the data is balanced in each one as well, so we can now work on the data without worrying.

EDA:


Train_df
Test_df
Validation_df
count
mask_status
WithMask
WithoutMask
0
1000
2000
3000
4000
5000
100
200
300
400
500
50
150
250
350

Preprocessing:

- We found that the images do not need to be pre-processed except that they are large in size, so we have rescaled them to be suitable for the model we are going to build.
- We divided the data into train, test and validation by the generator.

Modeling:

In order to build our model, we used a CNN model that contains 9 different hidden layers in order to reach an accuracy appropriate to our need.

Since the topic we're working on is a thorny one that can't be faulted, a single mistake in the model could make some people belittle it, which in turn could cost a person's life.

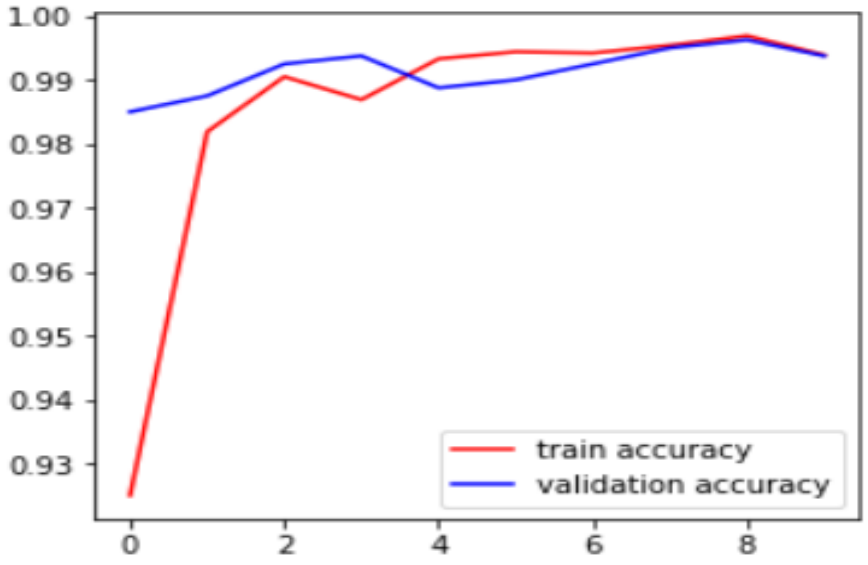
Modeling:

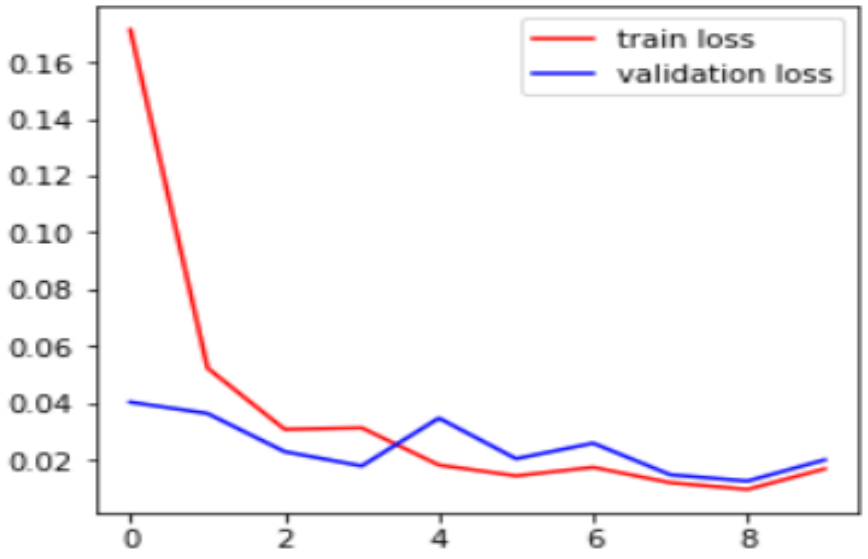
In here we can see the summary of our model.

```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 148, 148, 32)      896

 max_pooling2d (MaxPooling2D  (None, 74, 74, 32)       0
 )

 conv2d_1 (Conv2D)           (None, 72, 72, 64)        18496

 max_pooling2d_1 (MaxPooling  (None, 36, 36, 64)       0
 2D)

 conv2d_2 (Conv2D)           (None, 34, 34, 64)        36928

 max_pooling2d_2 (MaxPooling  (None, 17, 17, 64)       0
 2D)

 flatten (Flatten)           (None, 18496)             0

 dense (Dense)               (None, 128)               2367616

 activation (Activation)     (None, 128)               0

 dropout (Dropout)           (None, 128)               0

 dense_1 (Dense)             (None, 1)                 129

 activation_1 (Activation)   (None, 1)                 0

=================================================================
Total params: 2,424,065
Trainable params: 2,424,065
Non-trainable params: 0
```

Model Evaluation:

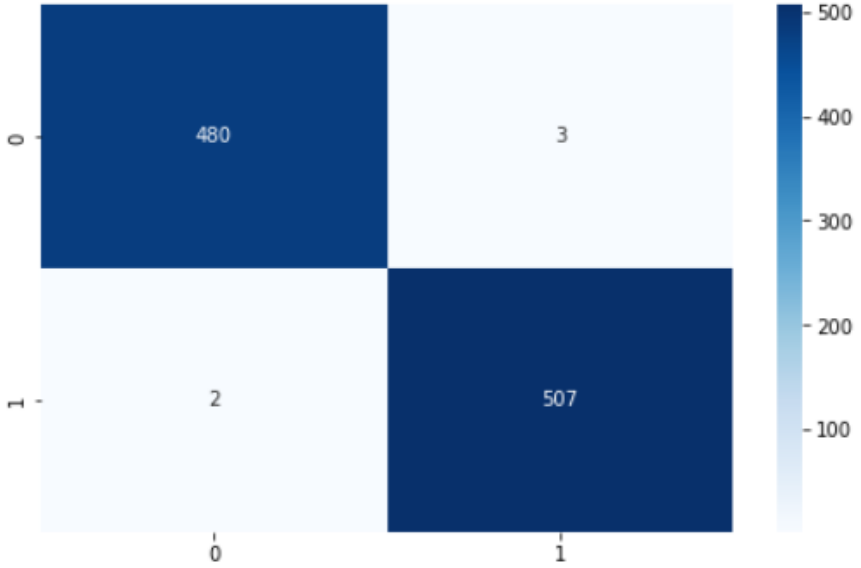
After training our model on train and validation data, We got the following:





Model Evaluation:

And here we can see the confusion matrix and the classification report to find out the accuracy of the model:



	precision	recall	f1-score	support
0	1.00	0.99	0.99	483
1	0.99	1.00	1.00	509
accuracy			0.99	992
macro avg	0.99	0.99	0.99	992
weighted avg	0.99	0.99	0.99	992

Face Detection Model:

- Now we can determine whether the person is wearing a mask or not, but we will face a new problem, how will we send the person's face only to the model to work on it and know whether he is wearing a mask or not ?!
- To do this we just made an algorithm to detect only the faces from the image using an xml file that contains face's data which will then be compared to the images that we want to use and send it to our base model.

Face Detection Model:

- And as we can see, this is the difference between the photo before and after it passes on the face detection model.
- Now we will send these faces to the mask detection model.

The Final Result:

As we can see this is the same image in the final result after face detection algorithm and face mask model. So lets try it on some complicated images.

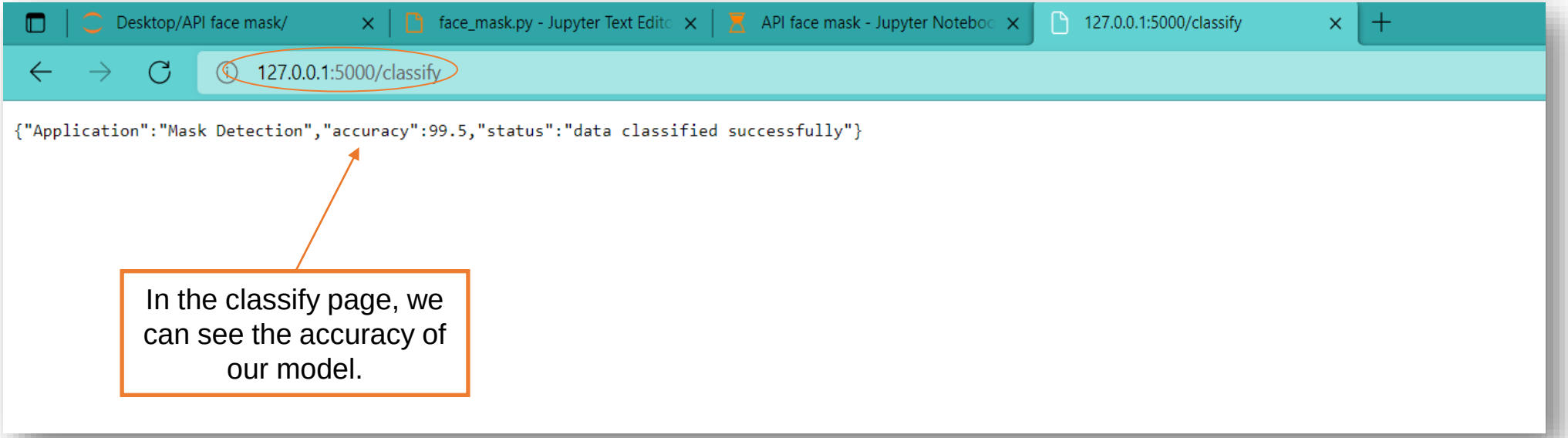
The Final Result:

The Final Result:

The Final Result:

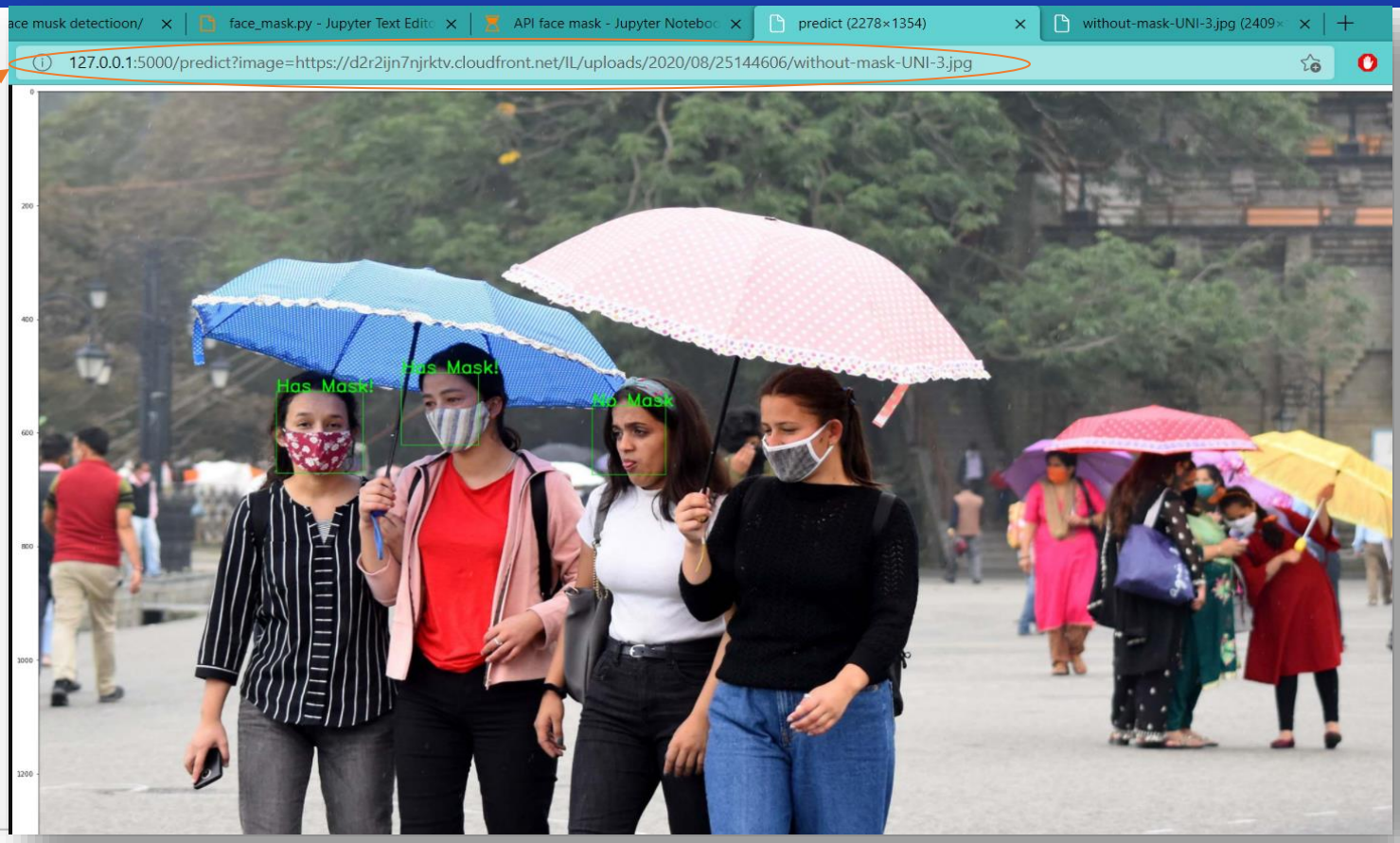
API:

We implemented our work on an API to be available as a web service like the following:



API:

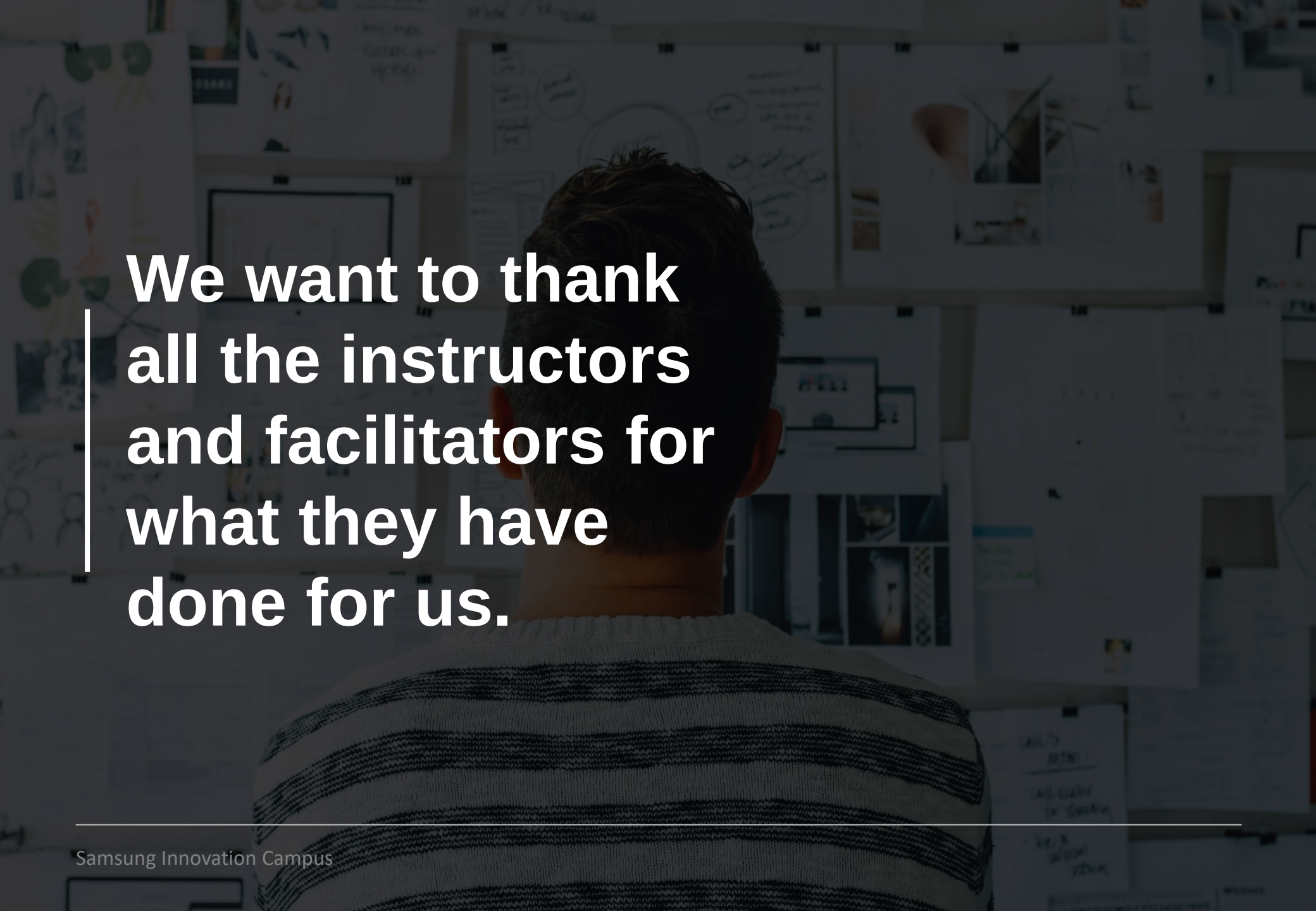
Here we input the URL of the image that we want check as a parameter.



Links:

- The NoteBook
- Kaggle

Questions?



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