Intelligent Vehicle Damage Assessment & Cost Estimator For Insurance Companies

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Introduction

1.1 Overview

Nowadays, a lot of money is being wasted in the car insurance business due to leakage claims. Claims leakage /Underwriting leakage is characterized as the discrepancy between the actual payment of claims made and the sum that should have been paid if all of the industry's leading practices were applied. Visual examination and testing have been used to may these results. However, they impose delays in the processing of claims.

The aim of this project is to build a VGG16 model that can detect the area of damage on a car. The rationale for such a model is that it can be used by insurance companies for faster processing of claims if users can upload pics and the model can assess damage(be it dent from scratch, from and estimate the cost of damage. This model can also be used by lenders if they are underwriting a car loan especially for a used car

1.2 Purpose

In order to strive for a better and safe world to live in, empowering the safe passage of people from hitherto to anywhere willed without any hindrance.

Enabling us to assess the damage done by an unfortunate event unfold, analyzing the damage done and its reparations digitally with almost almost mechanical and human touch accuracy is what is the need of the hour.

Many left off the decision making and consultations which cost enormous amounts of money as assessment by a mechanic and a dealer would result in, can be further avoided by utilizing the already available algorithm at our disposal.

Project Objectives:

By the end of this project we will:

Know fundamental concepts and techniques of VGG16.

Gain a broad understanding of image data.

Know how to per-process/clean the data using different data preprocessing techniques.

Know how to build a web application using the Flask framework.

Project Flow:

The user interacts with the UI (User Interface) to choose the image.

The chosen image is analyzed by the model which is integrated with the flask application.

VGG16 Model analyzes the image, then the prediction is showcased on the Flask UI.

To accomplish this, we have to complete all the activities and tasks listed below

Data Collection.

Create Train and Test Folders.

Image Preprocessing.

Import the ImageDataGenerator library

Configure ImageDataGenerator class

ApplyImageDataGenerator functionality to Trainset and Testset

Model Building

Import the model building Libraries

Loading the model

Adding Flatten layers

Adding Output Layer

Creating Model Object

Configure the Learning Process

Train the Model

Save the Model

Test The Model

Cloudant DB

Register & Login to IBM Cloud

Create Service Instance

Creating Service Credentials

Launch Cloudant DB

Create Database

Application Building

Building HTML Pages

Build Python Code

Run The Application
Literature Survey

2.1 Existing Problem

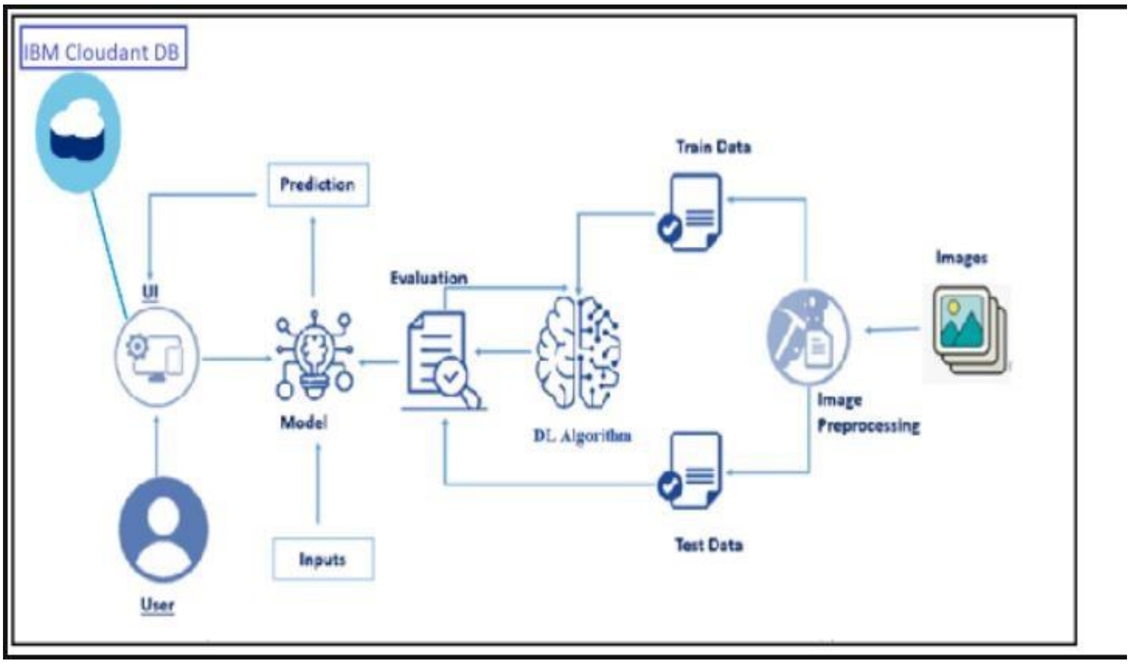
With the popularity of the concept of sharing, car sharing has become a new hot spot. Currently, there are more than 100 brands operating car sharing in the market. The group composition of car rental is relatively complex, and most of them are novices in driving technology. Some minor scratches and other injuries are easy to occur during the driving of rental vehicles, which poses new challenges to the car-sharing operation platform. Therefore, in the operation of the car-sharing business, it is very important to realize the automatic determination of vehicle damage in the process of each use.

2.1 Proposed Solution

This paper presents a method and system for automatic damage determination of vehicles based on the shared vehicle four-corner images. By comparing the damage information before and after renting each vehicle, this scheme can effectively save labor cost, realize rapid damage recognition, clear responsibility definition, and improve user experience and damage treatment efficiency

Theoretical Analysis

3.1 Block Diagram



3.2 Hardware/Software Requirements

Anaconda Navigator

Python & R

Windows/ Linux/ macOS

Jupyter Notebook

Rstudio

Visual Studio Code

Numpy package

Scikit learn package

Flask

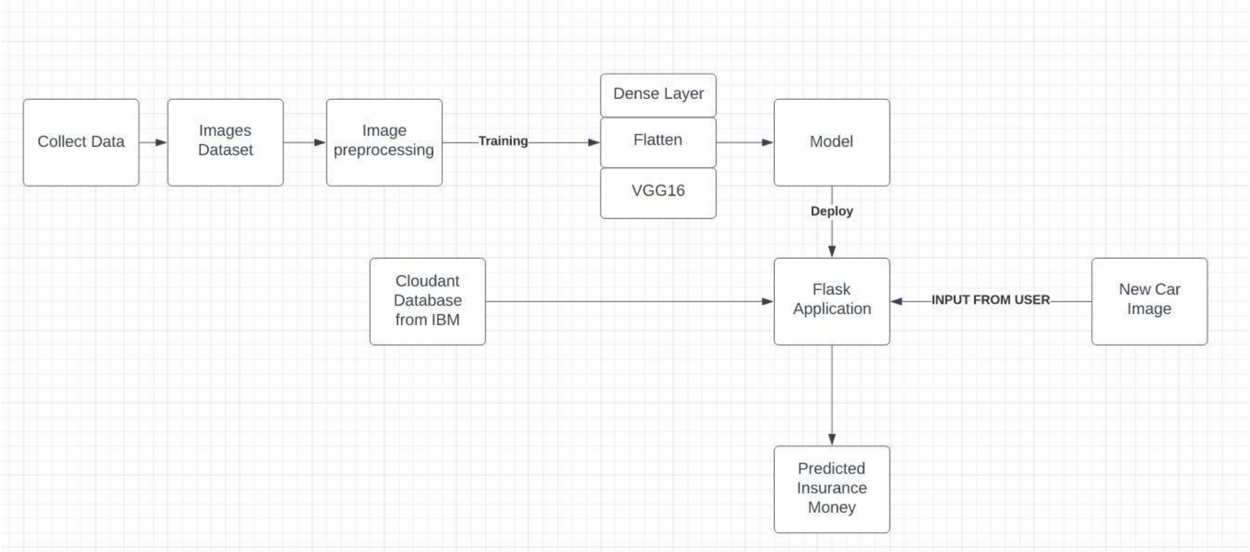
VGG16 Deep learning transfer learning method

Cloudant DB

EXPERIMENTAL INVESTIGATIONS:

- The survey says about 450000 number of car accidents take place in an year in India.With these rates it is important to for insurance companies to agree on the perfect amount that can be given to the injured damage in case of an accident
- Thus the importance cannot be stated more.After performing come investigations on the data set we have got the following conclusions
- Firstly we have 2 different things to consider about a damaged vehicle.One is the location of damage and the severity.So a front damaged car might need more insure amount than a side or rear damaged car.
- With these two factors into consideration we can assess the amount of insurance money that can be given to the damaged car
- Images contain cars that need higher number of convolution layers for the detection.Its not only hard to create such complex classifier it is also hard to train it and get a good accuracy score in it
- So for that reason we are building our model based on a base model.We have used VGG16 model for this purpose.It is found that having large models will take lot of time to train.As its not simple shape recognition
- We are recognizing both the place of damage and the amount of damage as well.So VGG16 is a very good option to base our model after.After investigation it is found that the number of images is not by themselves enough to get a good model.So we have done some image transformation for this purpose.
- In this problem its not possible to use the vertical flip transform on the data set.So we have used transforms like horizontal flip,Zoom ,brightness change etc.The brightness of the image captured can vary based on the condition so we have applied that transform as well
- One issue that we might face will be the model or vendor of that car.Which will determine the amount need for repair of the damaged vehicle.

FLOW CHART



1. Collect the Required data set which is the image data set
2. Perform per-processing steps such as scaling the image.And generating newer variations of the image
3. Build the model based on VGG16 and train the model with the generated data set.Use Local-machine/IBM Watson service for this purpose
4. Build Flask application for the user interface with the option to upload image which will be used by the model for predicting the insurance amount
5. Deploy the model and the flack application
6. Connect the flask application with the cloudant database for recording users
7. Use the model and the input Image from the user end to predict the place and level of damage and output the Insured amount to be given to the car

Result

Thus we have successfully implemented a machine learning based solution for the given problem.

1. Thus we have collected data set of images and performed pre processing on them to generate more variation of these images

2. We have build a VGG16 based model for predicting the level of damage and the location of damage from the image of the car

3. We have trained the model both on IBM and local machine and have built a flask application for the same

4. We have achieved an accuracy of about 90 percentage in the model and have integrated it with the flask application

5. We have successfully demonstrated the working of the model in predicting the insurance amount and the level and location of the damage

ADVANTAGES

1. So the first and for most advantage is the fact that we can use a ML based solution is that its more consistent than having a human inspect it.

There is a lot of possibility for being biased or making errors while estimating the cost of damage.But when it comes to a ml based solution it is sure that the assessment will be consistent across different scenarios and will be based on level and location which is more reliable

2. The second advantage is that its very robust and can be handled by anyone.There will not be any scope for confusion and even an untrained employee who has no expertise in automobile can just with a click of picture can estimate the amount of money.

3. The third advantage is that it lies as a middle ground between customers and insurance companies.There have been many cases where customers were not satisfied with the estimate made by the insurance company for their damage.they would have expected more money and might have got disappointed due to less coating.So this can lie as a middle ground between customers and insurance company for the sake of proof of estimate quoted by either party.

4. This model can be a base for solving some other similar problem where we are required to find the location or the level of damage this gives us scope for future works

DISADVANTAGES

1. Like the advantages there are a few disadvantages when it comes to a ML based algorithm rather than a traditional method through human inspection.The main one being is that the images that we are to predict upon is very hard to classify and the training and data collection process is hard to perform

2. The second thing is that we are not able to judge based on the model of the car.So each car needs different amount of money to mend repairs for the same amount of damage based on which manufacturer made that particular car in the first place.To say as an example consider an Audi car and a Maurithi car. According to our model let us say that both these cars took damage to the front section and the level is moderate.Though they both have same damage we can say that an Audi car will need higher amount of money for the repairs than the Mauriti car

3. The third and main disadvantage is that the possibility of misclassifiction that can happen in the ML model.Firstly if the damage is severe and the amount predicted by the machine learning model is under the actual value needed for the repairs of the damage this would cause an unhappy customer for the insurance company.While if the estimate is higher than that present then the insurance company that has equipped the model would be at loss.Thirdly it needs an human intervention into the matter as users directly accessing the model might forge the picture uploaded which might lead to false classification

APPLICATION:

1. In the car rental business it is a problem when the customers return the car the management has to inspect and identify possible damages done to the car while the person rented the car was using it.This would mean that we can imply the same solution or rather the same model in that case to find out the amount of damage done to the car by the user and charge accordingly.

2. The second one would be using this model as a base model and building a different solution for some other problem.One example for this could be in RTO office where timely inspection on public vehicles are needed.Use of similar model to predict if a vehicle will be suitable for public transport and that the FC certificate can be provided.This can be handy as there is a possibility of bribery in this process and a consultation from a machine learning model can help us determine if the certificate given by the officer s valid or not.

3. In some companies the vehicles are purchased in a based on order fashion in such companies the dealer face a crucial problem.Sometime in shipment the vehicle might be broken or Might be scratched.In order to avoid false claims the dealers can verify each vehicle before receiving with the help of a machine learning algorithm as given by us to have a common standard to ensure quality.

Conclusion:

The Image per-processing techniques seem to improve the accuracy of the model greatly and that the have increased the amount of data that can be feed to the system in order to train it.

A user can easily register with the application in order to make use of our service that is predicting damage to their vehicle

Thus we have turned raw damaged car images and into a machine learning model that can be deployed easily.The use of VGG16 has shown great improvement over traditional options where we had to use CNN from scratch.This imprisonment is seen in training times and the impoverished accuracy of the system.

Thus we have built a Vehicle damage assessment system that will be very useful to the Insurance company staffs in predicting the insurance money.

Future Scopes:

1. Currently we have implemented the solution for car damage analysis.Though the number of cars are increasing in India,Bikes are pro dominant in India.There are almost 2 bikes in most of the households.

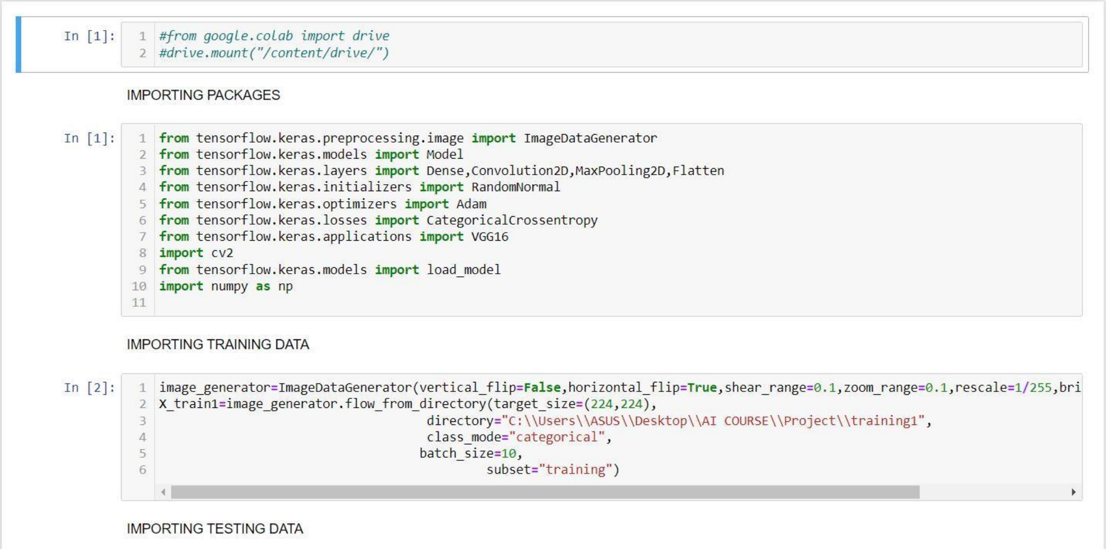
This means that as a future improvement we can implement a similar solution but for predicting bike damage and can assess the amount of insurance money that can be given to that bike

2. Since we are assessing and predicting the damage we can extend similar analysis to all the products which have insurance or where Automation of damage assessment is needed For example in home appliances or in Mobile phones.
3. This form of solution can be applied in industries other than insurance companies.Which means in Car rental and bike rental companies where assesment of vehicle damage is needed for various applications.So this solution with much modification can be applied for that purpose
4. Improvement can be made in the model itself by adding few more layers for example more dense layers before the prediction layer and the output of the flatten layer which comes after VGG16.

Improvement can be made in the data collection and per-processing stages where in we can do full fledged high quality images of damaged vechicles can be obtained and used for training the model.

5. we can use different per-processing techniques on the already present images to improve reliability.For example cosine transform can be applied to increase the speed of training the model and other image processing techniques can be applied to make the model more reliable
6. The flask application can be improved where in more features can be added and the application can be made more feature friendly.Improvement can be made by including features that suit particular use case.For example if the solution is going to be used in insurance companies,we can provide the user with the ability to make an invoice to the customer who is trying to claim the insurance. This will come in handy for the user.

Appendix A. Source Code



In [1]:

```
#from google.colab import drive
#drive.mount("/content/drive/")
```

IMPORTING PACKAGES

In [1]:

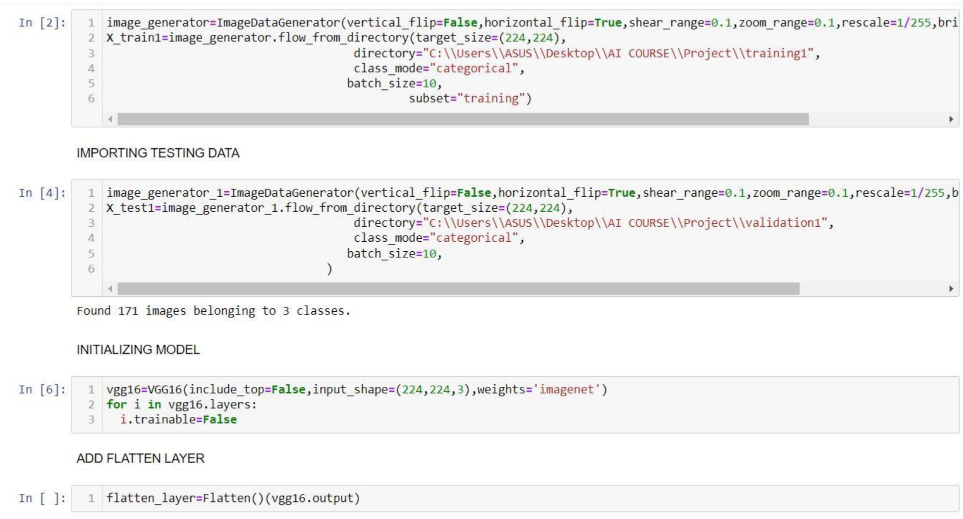
```
from tensorflow.keras.preprocessing.image import ImageDataGenerator
from tensorflow.keras.models import Model
from tensorflow.keras.layers import Dense,Convolution2D,MaxPooling2D,Flatten
from tensorflow.keras.initializers import RandomNormal
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.losses import CategoricalCrossentropy
from tensorflow.keras.applications import VGG16
import cv2
from tensorflow.keras.models import load_model
import numpy as np

```

IMPORTING TRAINING DATA

In [2]:

```
image_generator=ImageDataGenerator(vertical_flip=False,horizontal_flip=True,shear_range=0.1,zoom_range=0.1,rescale=1/255,bri
X_train1=image_generator.flow_from_directory(target_size=(224,224),
                                    directory="C:\\Users\\ASUS\\Desktop\\AI COURSE\\Project\\training1",
                                    class_mode="categorical",
                                   batch_size=10,
                                            subset="training")
```

IMPORTING TESTING DATA



```
In [2]:
image_generator=ImageDataGenerator(vertical_flip=False,horizontal_flip=True,shear_range=0.1,zoom_range=0.1,rescale=1/255,bri
X_train1=image_generator.flow_from_directory(target_size=(224,224),
                                    directory="C:\\Users\\ASUS\\Desktop\\AI COURSE\\Project\\training1",
                                    class_mode="categorical",
                                   batch_size=10,
                                            subset="training")
```

IMPORTING TESTING DATA

```
In [4]:
image_generator_1=ImageDataGenerator(vertical_flip=False,horizontal_flip=True,shear_range=0.1,zoom_range=0.1,rescale=1/255,b
X_test1=image_generator_1.flow_from_directory(target_size=(224,224),
                                    directory="C:\\Users\\ASUS\\Desktop\\AI COURSE\\Project\\validation1",
                                    class_mode="categorical",
                                   batch_size=10,
                                )
```

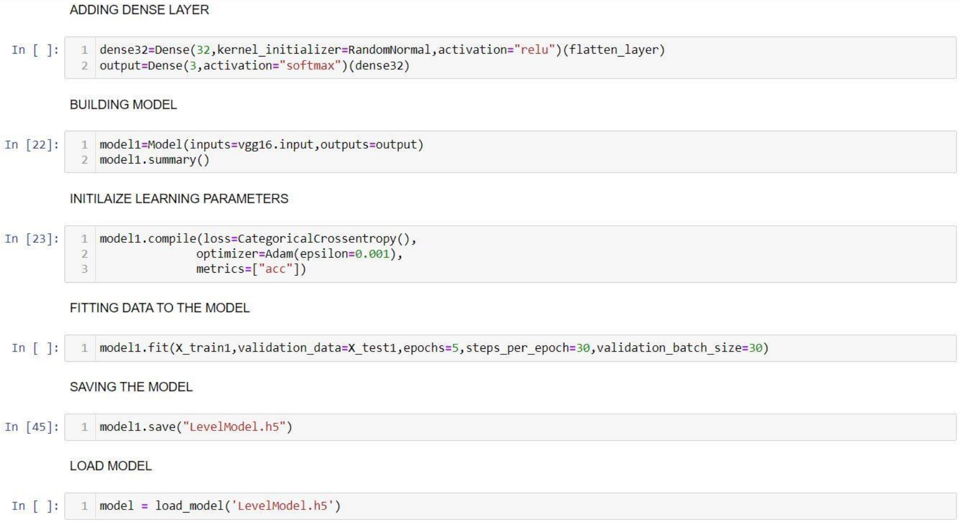
```
Found 171 images belonging to 3 classes.
```

INITIALIZING MODEL

```
In [6]:
vgg16=VGG16(include_top=False,input_shape=(224,224,3),weights='imagenet')
for i in vgg16.layers:
  i.trainable=False
```

ADD FLATTEN LAYER

```
In [ ]:
flatten_layer=Flatten()(vgg16.output)
```



ADDING DENSE LAYER

```
In [ ]:
dense32=Dense(32,kernel_initializer=RandomNormal,activation="relu")(flatten_layer)
output=Dense(3,activation="softmax")(dense32)
```

BUILDING MODEL

```
In [22]:
model1=Model(inputs=vgg16.input,outputs=output)
model1.summary()
```

INITILAIZE LEARNING PARAMETERS

```
In [23]:
model1.compile(loss=CategoricalCrossentropy(),
              optimizer=Adam(epsilon=0.001),
              metrics=["acc"])
```

FITTING DATA TO THE MODEL

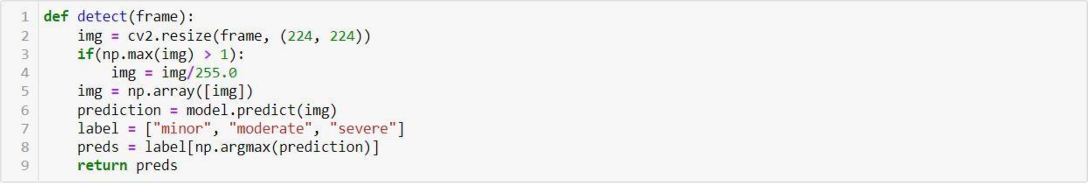
```
In [ ]:
model1.fit(X_train1,validation_data=X_test1,epochs=5,steps_per_epoch=30,validation_batch_size=30)
```

SAVING THE MODEL

```
In [45]:
model1.save("LevelModel.h5")
```

LOAD MODEL

```
In [ ]:
model = load_model('LevelModel.h5')
```

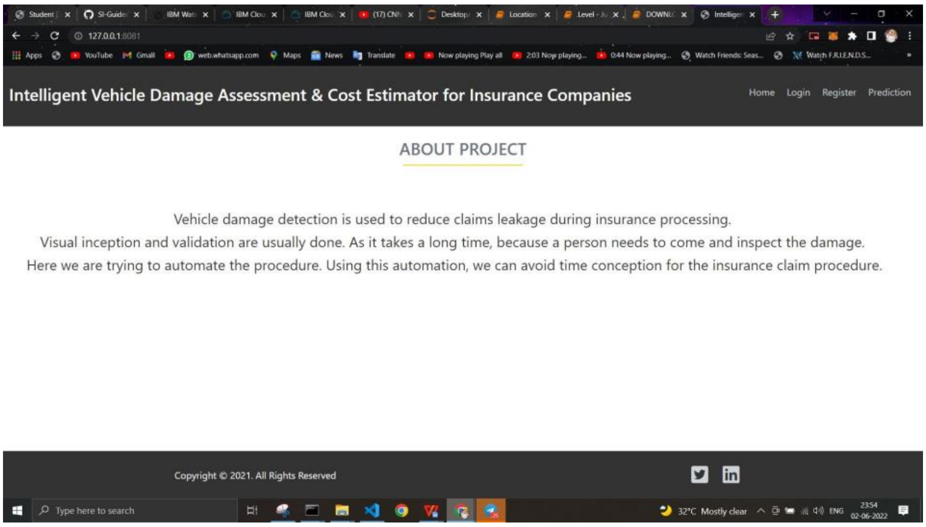


```
def detect(frame):
    img = cv2.resize(frame, (224, 224))
    if(np.max(img) > 1):
        img = img/255.0
    img = np.array([img])
    prediction = model.predict(img)
    label = ["minor", "moderate", "severe"]
    preds = label[np.argmax(prediction)]
    return preds
```

(For the second model we can use the same process but with different data set)

Output:

Flask application user interface



Intelligent Vehicle Damage Assessment & Cost Estimator for Insurance Companies

ABOUT PROJECT

Vehicle damage detection is used to reduce claims leakage during insurance processing.
Visual inception and validation are usually done. As it takes a long time, because a person needs to come and inspect the damage.
Here we are trying to automate the procedure. Using this automation, we can avoid time conception for the insurance claim procedure.

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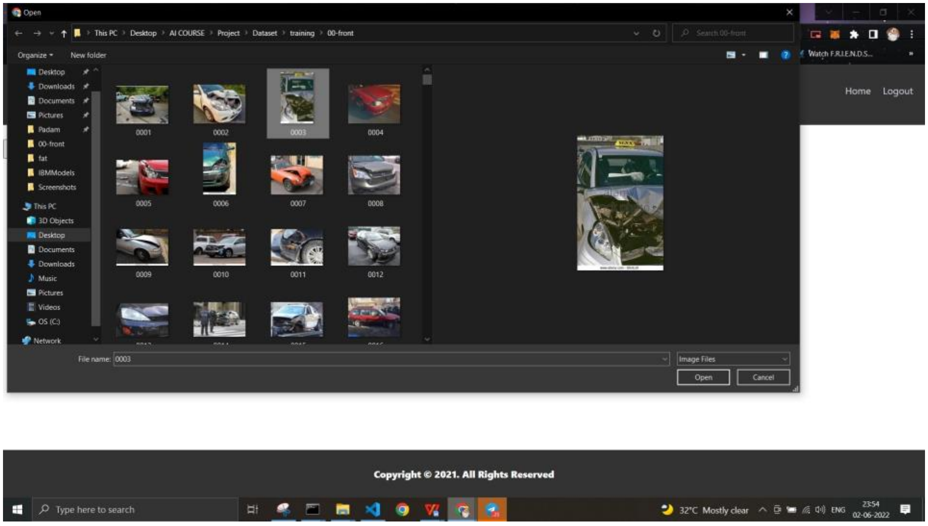
Image choosed



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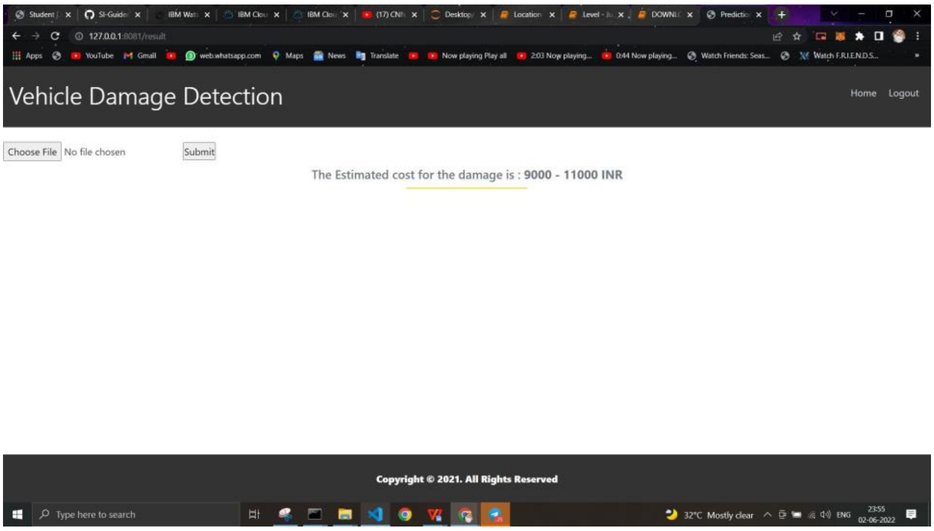
Predicted Estimate for Insurance amount



Vehicle Damage Detection

The Estimated cost for the damage is : 9000 - 11000 INR

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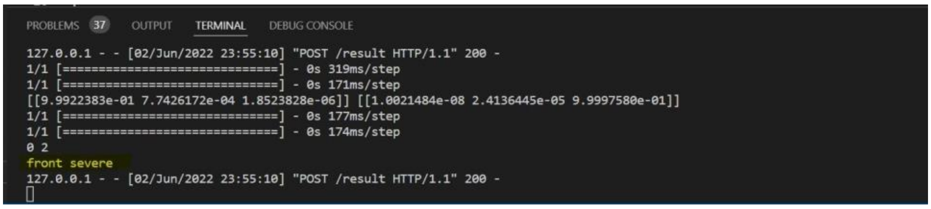
INPUT => Input given is Front and severely damaged vehicle

OUTPUT=> Output got is “front severe”.



```
127.0.0.1 - - [02/Jun/2022 23:55:10] "POST /result HTTP/1.1" 200 -
1/1 [==============================] - 0s 319ms/step
1/1 [==============================] - 0s 171ms/step
[[9.9922383e-01 7.7426172e-04 1.8523828e-06]] [[1.0021484e-08 2.4136445e-05 9.9997580e-01]]
1/1 [==============================] - 0s 177ms/step
1/1 [==============================] - 0s 174ms/step
0 2
front severe
127.0.0.1 - - [02/Jun/2022 23:55:10] "POST /result HTTP/1.1" 200 -
```

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