INTELLIGENT VEHICLE DAMAGE ASSESSMENT AND COST ESTIMATOR FOR INSURANCE COMPANIES

ABSTRACT

1. INTRODUCTION

1.1 PROJECT OVERVIEW

Leakage claims cause the car insurance industry to lose a significant amount of money. Underwriting leakage is the difference between the amount actually paid for claims and the amount that would have been paid had all industry best practises been followed. Testing and visual evaluation have both been used to arrive at these conclusions. They do, however, cause a delay in the handling of claims. Improvements in the First Notice of Loss and the speed with which claims are assessed and analysed may be able to save a significant amount of money in the auto insurance claims process by reducing loss adjustment expenses. Using cutting-edge image analysis and pattern recognition technologies, car damage is automatically diagnosed and classed, with a method for automatically detecting the affected area by comparing images of the car taken before and after the collision. In this study, a CNN model that can identify a car's damage area is proposed. The model can assess damage (such as a dent or scratch from an object) and estimate the level of damage if users input photographs. As a result, insurance companies can manage claims more effectively. Lenders could take this model into account when approving a car loan, especially one for a secondhand automobile.

1.2 PURPOSE

In the modern world, the number of automobiles has significantly increased. Accidents occur more frequently because there are more cars on the road and more individuals are driving them fast. When an accident occurs, the parties involved file a claim with their auto insurance to get the money needed to fix the car since, based on fraudulent claims, the insurance provider behaves improperly and withholds payments.

2. LITERATURE REVIEW

2.1 EXISTING PROBLEM

2.1.1. TITLE: Convolutional Neural Networks for vehicle damage detection, 2021 AUTHOR NAME: R.E. Ruitenbeek

Vehicle damage is becoming a bigger issue for companies who offer shared transportation. The frequent driver changes call for the adoption of an efficient inspection system that can identify minor damage and classify it. In order to address this, a damage detection model that finds vehicle damages and divides them into twelve categories is developed. The effectiveness of various transfer learning and training procedures is assessed, and multiple deep learning algorithms are applied to increase detection performance. The final model can find minor flaws in a range of situations, including water and dirt. It was trained on more than 10,000 damage photographs. The model works similarly, according to a performance evaluation conducted with the help of domain experts. Additionally, the model is tested in a lit street that has been carefully built to show strong reflections complicate detection performance.

2.1.2. TITLE: Deep Learning Based Car Damage Detection, Classification and Severity AUTHOR NAME: Ritik Gandhi1, 2021

In the accident insurance industry, settling a claim takes time since it is a manual process, and there is a discrepancy between the ideal and actual payment. Deep learning models are being used to expedite the procedure as well as improve customer service and increase the profitability of insurance companies. In order to choose the best performing models for this study, we used a variety of pre-trained models, including VGG 16, VGG 19, Resnet50, and DENSENET. In order to establish whether or not the car is damaged, we first use the Resnet50 model. If it is, we then use the WPOD-net model to determine the licence plate. The impacted region is located using the YOLO model. The DENSENET model is then used to implement the damage severity. We discovered that transfer learning outperforms fine-tuning after applying multiple models. Furthermore, we present a framework that incorporates all of this into a single application, assisting in the automation of the insurance sector.

2.1.3. TITLE: Car Damage Assessment to Automate Insurance Claim, 2022

AUTHOR NAME: Siddhant Gole

The assessment of vehicle damage is a crucial step in authorizing claims, but the process is frequently delayed and inaccurate, leading to claim leakages. Our job is to develop a web application integrated with a deep learning model that takes user input in the form of pictures of damaged cars and evaluates the damage to provide a cost report the company can use to approve the initial reimbursement. The model uses the MASK R-CNN algorithm along with Faster RCNN to identify and localize the damaged regions. Additionally, the device has a security module that recognize and records information about the vehicle's liscence plate, body type, and logo for verification. Our objective is to create a system that uses photos to identify broken car parts and generate a cost analysis report that the company can use to sanction the insurance amount. The task would be to develop an end-to-end system for detecting and classifying types of damage via images, as well as to implement a car number plate, body type, and logo detection system to verify car details.

2.1.4. TITLE: Using Machine Learning Models To Compare Various Resampling Methods In Predicting Insurance Fraud, 2021

AUTHOR NAME: Ruixing Ming

One of the most common types of fraud is insurance fraud. For property insurance firms in particular, the cost of car insurance fraud is substantial and has a long-term impact on pricing strategies used by the insurance industry. And in order to lower insurance costs, it is now necessary to detect car insurance fraud. There are few published studies on the use of machine learning algorithms to identify insurance fraud, most likely because there is a dearth of available data, despite the fact that predictive models for identifying insurance fraud are frequently employed in practice. Using real-world data, evaluate the 13 machine learning techniques presented in this study. Due to the inconsistent datasets in this field, predicting insurance fraud has become very challenging. Because "non-fraud claims" make up the majority of the claims in our statistics, while "fraud claims" make up a far smaller portion. In order to address the problem of unbalanced data, the current study aims to provide a strategy that enhances the performance of machine learning algorithms by using re-sampling approaches, such as Random over Sampler, Random under Sampler, and hybrid methods.

2.1.5. TITLE: Evaluation of deep learning algorithms for semantic segmentation of car parts, 2021

AUTHOR NAME: Kitsuchart Pasupa

The examination of accident-damaged automobiles is one of the most important processes in the auto insurance sector. Right now, each essential part needs to be manually checked. It is anticipated that a smart device will be able to perform this evaluation more successfully in the future. In this paper, we examined and contrasted five deep learning methods for semantic segmentation of vehicle components. While HTC, CBNet, PANet, and GCNet were the other methods, Mask R-CNN served as the baseline reference method. Runs of instance segmentation were performed using these five algorithms. The most effective segmentation method for different car categories, including sedans, pickups, and SUVs, was HTC's ResNet-50 algorithm. When different labels were used, it achieved a mean average accuracy of 55.2 on our initial data set. Additionally, the durability of the models from each technique was tested by applying them to images of component parts taken in a real-world environment in a variety of weather conditions, including snow, frost, fog, and various lighting levels. When left and right sides were given different labels, GCNet was able to obtain a mean performance under corruption (mPC) of 35.2 and a relative degradation of performance on corrupted data (rPC) of 64.4%. However, when left and right sides were treated as one portion, mPC was 38.1 and rPC was 69.6%.

2.2 REFERENCES

[1]. R.E. Ruitenbeek, Convolutional Neural Networks for vehicle damage detection, 2021

[2]. Ritik Gandhi1Deep Learning Based Car Damage Detection, Classification and Severity, 2021

[3]. Siddhant Gole, Car Damage Assessment to Automate Insurance Claim, 2022

[4]. Ruixing Ming, Using Machine Learning Models To Compare Various Resampling Methods In Predicting Insurance Fraud, 2021

[5]. Kitsuchart Pasupa, Evaluation of deep learning algorithms for semantic segmentation of car parts, 2021

2.3 PROBLEM STATEMENT DEFINITION

The process of filing an insurance claim for a car is cumbersome under the current system, and it takes time before the first payout is authorised. Owing to claim leakage, insurance companies lose millions of dollars annually. This is due to the growth of the automotive industry and the daily increase in accident rates. Claim leakage is the difference between the company's actual spending and what they should have truly spent. This could be due to inadequate claim processing, incorrect payments, human error, such as a lack of quality control or subpar customer service, or even claim fraud. The only approach to detect claim leaking is to audit closed claim files.

3. IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

3.2 IDEATION & BRAINSTORMING

3.3 PROPOSED SOLUTION

Because there are more cars on the road, accidents happen more frequently because individuals are driving them at high speeds. When an accident occurs, the people file a claim with their auto insurance for the necessary funds to repair the car, because to inaccurate claims, the corporation behaves improperly and doesn’t make payments now. Even if the car's damage is easily seen, the claim procedure will take longer than usual in accordance with company policy. Despite the company's best efforts, there is a delay in the claims procedure. Differentiate the suggested approach to perhaps speed up the process of assessing automotive damage.

3.4 PROBLEM SOLUTION FIT

There is no methodical way to get an immediate response from an insurance company. Consumers should be able to contact the insurance provider and make payments both online and offline thanks to the suggested method. The user may only acquire insurance if the company authorizes the damaged image and the condition is greater than 80% after uploading the damaged image and assessing the amount of thedamage.

4. REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENT

When processing claims, insurance firms may use this methodology to evaluate car damage. This module provided a structure for presenting a vehicle's damaged parts and asking a company for insurance. The admin has prepared the dataset needed to train the Damage Detection. The photographs were manually annotated to make them usable for training; damages were divided into 7 categories, such as Door Dent, Bumper Dent, Body Scratch, Broken Windshield, Broken Glass, Broken Lights, and Smash. The model was set up to train on user data Object Detection by altering its settings and loading the learned dataset.

FRAME WORK :

Use a CNN model that has been specially trained to recognise the object via transfer learning. This model includes validation sets for many types of damage, such as bumper dents, bumper scratches, door dents, door scratches, broken glass, headlamps, taillamps, and undamaged. Following is a classification of the severity of auto damage: Minor Damage is a term used to describe relatively minor vehicle damage that does not prevent the vehicle from causing serious injuries. It comprises headlamp scratches, dents and digs from gravel or other debris in the hood or windshield, as well as paint scratches. Moderate damage refers to any type of damage that interferes in any manner with the vehicle's functionality. Large dents in the hood, fender, or door are involved.

Even if the airbags are deployed during collision, then it comes under moderate damage. Severe Damage – Structural damages such as bent or twisted frames, broken/bent axels, and missing pieces of the vehicles and in some cases even the destruction of airbags. These types of damages are a big threat to the human life.

Damage Detection:

Object localization, which combines object localization with classification to generate a bounding box and a class for each item for thing detection, is used to locate damaged regions in a photograph and create a bounding box around each object detected. Create a convolutional features map from an image using CNN to predict an item's class and bounding box. If the car is unharmed, it is simply detected; if it is damaged, additional localizations are created for the models. The validation set demonstrates the model's correctness. The simplest way to automate such a system would be to create a Convolution Neural Network model that can take user-provided photos and determine the position and extent of the damage. The model is required to pass through multiple checks would first ensure that given image is that of a car and then to ensure that it is in fact damaged. These are the gate checks before the analysis begins. Once all the gate checks have been validated, the damage check will commence. The model will predict the location of the damage as in front, side or rear, and the severity of such damage as in minor, moderate or severe.

Claim Insurance

Those that are in need go through the insurance claim process. User registration and authentication are required in order to access the company's insurance. Following that, users can view their insurance details and request an insurance claim. The insurance company can review and approve the request for an insurance claim. The user may only receive insurance if the company accepts the damaged image and the condition is greater than 80% after the damaged image has been uploaded and the extent of the damage has been evaluated.

4.2 NON FUNCTIONAL REQUIREMENTS

Usability

The system shall allow the users to access the system with pc using web application. The system uses a web application as an interface. The system is user friendly which makes the system easy

Availability

The system is available 100% for the user and is used 24 hrs a day and 365 days a year. The system shall be operational 24 hours a day and 7 days a week.

Scalability

Scalability is the measure of a system's ability to increase or decrease in performance and cost in response to changes in application and system processing demands.

Security

A security requirement is a statement of needed security functionality that ensures one of many different security properties of software is being satisfied.

Performance

The information is refreshed depending upon whether some updates have occurred or not in the application. The system shall respond to the member in not less than two seconds from the time of the request submittal. The system shall be allowed to take more time when doing large processing jobs. Responses to view information shall take no longer than 5 seconds to appear on the screen.

Reliability

The system has to be 100% reliable due to the importance of data and the damages that can be caused by incorrect or incomplete data. The system will run 7 days a week. 24 hours a day.

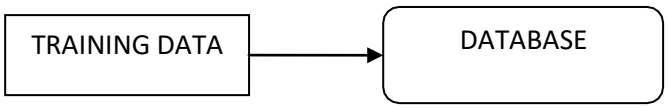
5. PROJECT DESIGN

5.1 DATA FLOW DIAGRAMS

How data is handled and moved within a system is depicted in a two-dimensional figure. Each data source is identified, along with how it interacts with other data sources to produce a common result, in the graphical representation. To create a data flow diagram, a person has to know what the external inputs and outputs are, how they link to one another, and how to visually depict these connections and the outcomes they produce. Teams involved in business development and design might use this type of graphic to identify or improve particular areas of the data processing process.

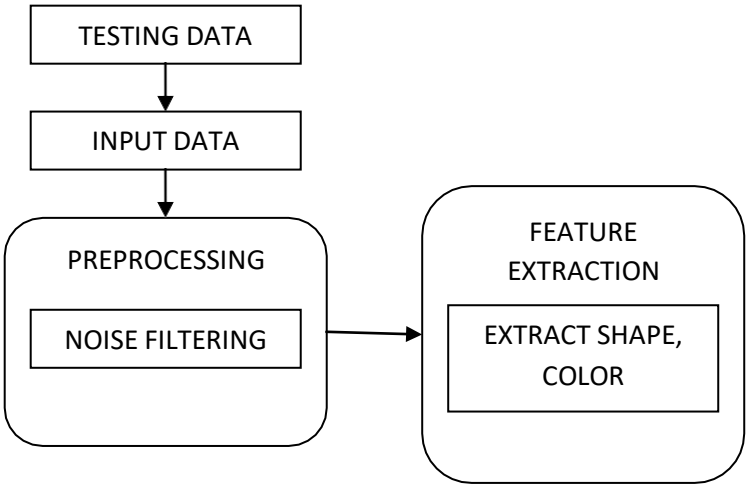
LEVEL 0

The Level 0 DFD demonstrates how the system is broken down into "sub-systems" (processes), each of which interacts with one or more data flows to or from an external agent and which, when combined, offer all of the system's functionality. Additionally, it illustrates the flow of data among the various system components and indicates internal data stores that are necessary for the system to function.



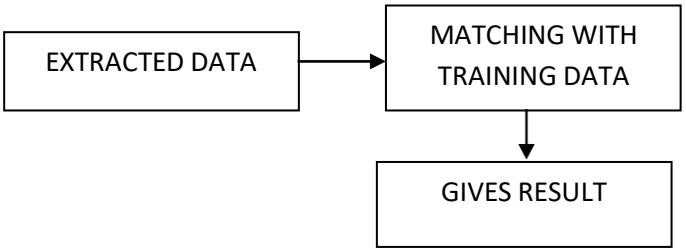
LEVEL 1

The Level 1 Data Flow Diagram is created next. This emphasises the primary tasks that the system does. Typically, between two and seven functions were used to define the system, with two representing a simple system and seven representing a complicated system. This makes the model manageable on paper or a screen.



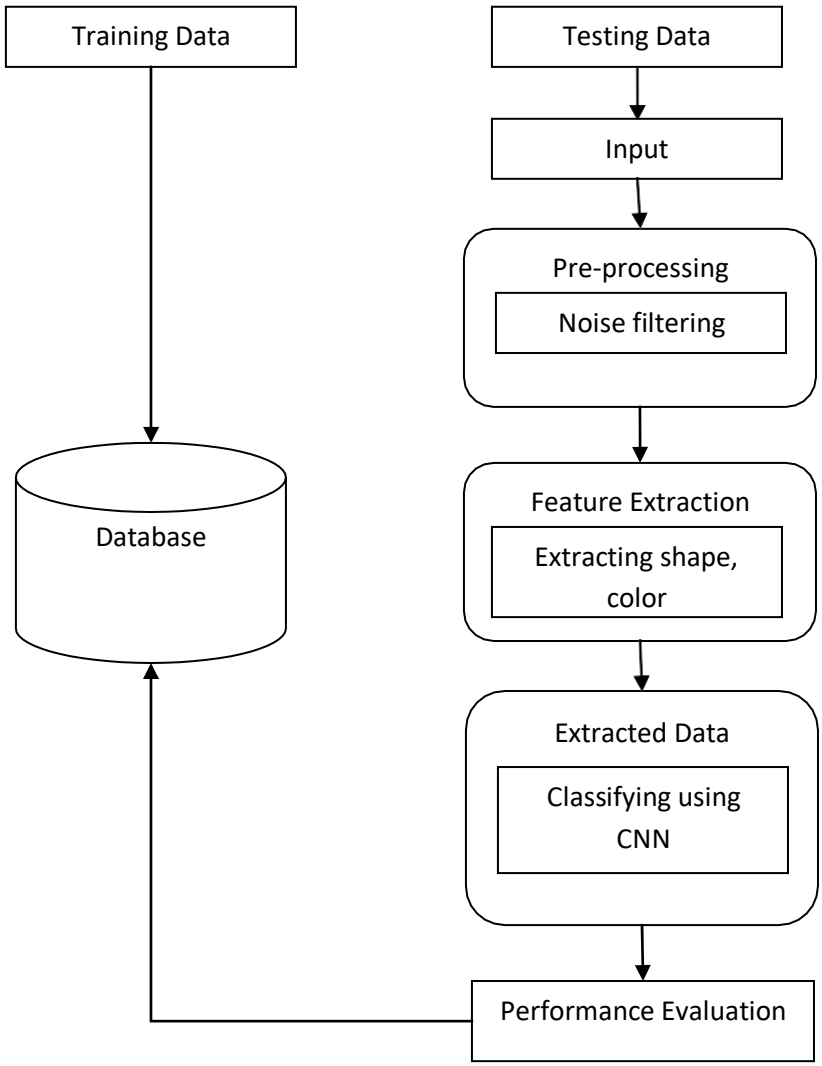
LEVEL 2

Within the business or system boundary under inquiry, a Data Flow Diagram (DFD) monitors processes and their data routes. Each domain boundary is specified in a DFD, which also shows how data is moved and transformed logically within each border. The graphic displays the types of input data that enter the domain, the types of logical operations that are performed on those data, and the types of output data that exit the domain. Essentially, a DFD is one of the earliest tools for process modelling.



5.2 SOLUTION & TECHNICAL ARCHITECTURE

A system architecture, sometimes known as a systems architecture, is a conceptual model that describes a system's behaviour, structure, and other aspects. A formal description and representation of a system that is set up to facilitate analysis of its structures and behaviours is called an architecture description. System architecture might include system elements, those elements' externally perceptible characteristics, and the connections (like behaviours) between them. It can offer a blueprint from which systems and products that will cooperate to implement the whole system can be developed. Languages that describe system architecture have been formalised in an effort; they are referred to as architecture description languages (ADLs).


Training Data
Testing Data
Input
Pre-processing
Noise filtering
Database
Feature Extraction
Extracting shape, color
Extracted Data
Classifying using CNN
Performance Evaluation

5.3 USER STORIES

6. PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

6.2 SPRINT DELIVERY SCHEDULE

6.3 REPORTS FROM JIRA

7. CODING & SOLUTIONING

7.1 FEATURE 1

7.2 FEATURE 2

7.3 DATABASE SCHEMA

8. TESTING

8.1 TEST CASES

- In order to ascertain whether a feature of an application is functioning properly, a test case has components that explain input, action, and an expected result. A test case is a series of instructions that, when followed, will indicate whether or not a specific test objective or target has been successfully validated.

  Qualities of an effective test case:

- Accurate: Exacts the purpose.
- Economical: No unnecessary steps or words.
- Traceable: Capable of being traced to requirements.
- Repeatable: Can be used to perform the test over and over.
- Reusable: Can be reused if necessary.

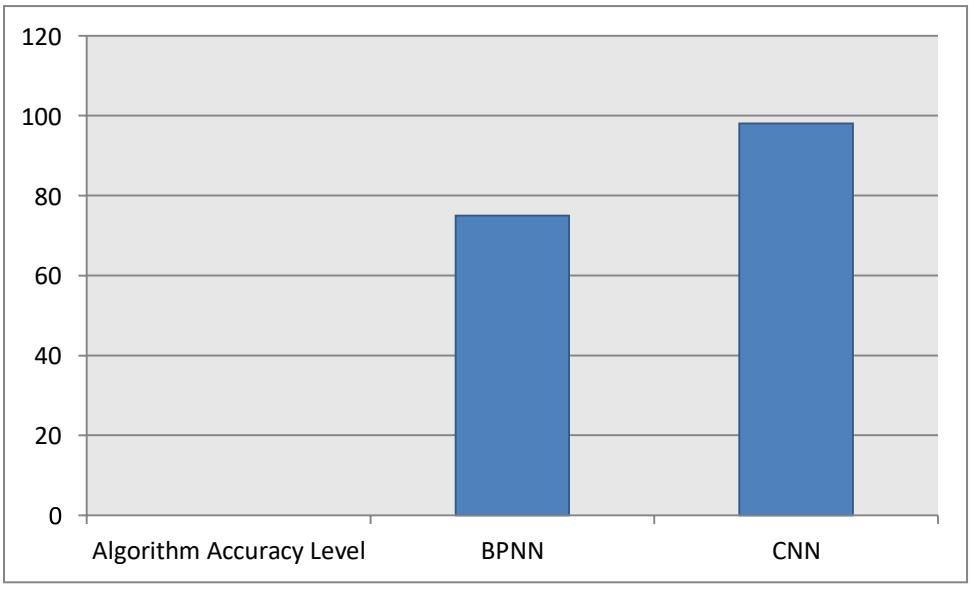
S.NO	**Scenario**	**Input**	**Excepted output**	**Actual output**
1	User login	User name and password	Login	Login success.
2	Upload Image	Upload damaged vehicle image as a input	Detecting object and analyze for claim insurance	Details are stored in a database.

8.2 USER ACCEPTANCE TESTING

Users, clients, or other authorised organisations conduct this type of testing to determine the specifications and operational practises of an application or piece of software. Acceptance testing is the most important testing phase since it establishes whether or not the customer will accept the application or software. It could involve the user interface, functionality, usability, and usefulness of the application. It is also known as operational acceptance testing, user acceptability testing, and end-user testing (UAT).

9. RESULTS

9.1 PERFORMANCE METRICS



10. ADVANTAGES & DISADVANTAGES

ADVANTAGE

- Digitalized claim process makes easy to use
- Give the accurate result of the damaged vehicle
- Helps the insurance company to analyze the damaged vehicle and also payment process.

DISADVANTAGE

- It will take more time to claim the insurance in manual process
- Because of incorrect claims, the company behaves badly and doesn’t make payments currently.
- Poor customer support

11. CONCLUSION

The concerns of car damage analysis and position and severity prediction will be dealt with in this research proposal using a neural network-based automobile detecting method. This project does a number of tasks in one go. The technique will undoubtedly help the insurance companies carry out much more complete and organised examinations of the vehicle damage. Simply providing a snapshot of the vehicle will allow the system to examine it, identify whether any damage is present, where it is located, and how bad it is.

12. FUTURE SCOPE

We will need to use a large dataset and a variety of regularisation techniques in our next work. If we have higher quality datasets that include the characteristics of a car (make, model, and year of production), location data, kind of damaged part, and repair cost, we can predict the cost of a broken automotive component more correctly and reliably. Together with a focus on the vehicle insurance sector, this study paves the way for future photo recognition efforts. By removing human bias, the study was able to accurately validate the existence of damage, its location, and its severity. By including the on-the-fly data augmentation methodologies, they can be further improved.

13. APPENDIX

SOURCE CODE

```
from flask import Flask, render_template, flash, request,session
from cloudant.client import  Cloudant
import cv2
client = Cloudant.iam("eb55a2b7-ae45-4df8-8d1c-69c5229ffdbe-
bluemix","YzG5FZg9Vs_HScOBZaWyVXm7PpNjbPrmPaPMfHx7w3X9",connect=
True)
my_database = client.create_database("database-dharan")
app = Flask(_name_)
app.config.from_object(_name_)
app.config['SECRET_KEY'] = '7d441f27d441f27567d441f2b6176a'
@app.route("/")
def homepage():
    return render_template('index.html')
@app.route("/userhome")
def userhome():
    return render_template('userhome.html')
@app.route("/addamount")
@app.route("/NewUser")
def NewUser():
    return render_template('NewUser.html')


@app.route("/user")
def user():


    return render_template('user.html')
@app.route("/newuse",methods=['GET','POST'])
def newuse():
    if request.method == 'POST':
        x = [x for x in request.form.values()]
        print(x)
        data = {
```

```
            '_id': x[1],
            'name': x[0],
            'psw': x[2]
        }
        print(data)
        query = {'_id': {'Seq': data['_id']}}
        docs = my_database.get_query_result(query)
        print(docs)
        print(len(docs.all()))
        if (len(docs.all()) == 0):
            url = my_database.create_document(data)
            return render_template('goback.html', data="Register, please login using your details")
        else:
            return render_template('goback.html', data="You are already a member, please login using your details")
@app.route("/userlog", methods=['GET', 'POST'])
def userlog():
        if request.method == 'POST':
            user = request.form['_id']
            passw = request.form['psw']
            print(user, passw)
            query = {'_id': {'$eq': user}}
            docs = my_database.get_query_result(query)
            print(docs)
            print(len(docs.all()))
            if (len(docs.all()) == 0):
                return render_template('goback.html', pred="The username is not found.")
            else:
                if ((user == docs[0][0]['_id'] and passw == docs[0][0]['psw'])):
                    return render_template("userhome.html")
                else:
                    return render_template('goback.html',data="user name and password incorrect")
```

```
@app.route("/predict", methods=['GET', 'POST'])
def predict():
    if request.method == 'POST':
        file = request.files['fileupload']
        file.save('static/Out/Test.jpg')
        import warnings
        warnings.filterwarnings('ignore')
        import tensorflow as tf
        classifierLoad = tf.keras.models.load_model('body.h5')
        import numpy as np
        from keras.preprocessing import image
        test_image = image.load_img('static/Out/Test.jpg', target_size=(200, 200))
        img1 = cv2.imread('static/Out/Test.jpg')
        # test_image = image.img_to_array(test_image)
        test_image = np.expand_dims(test_image, axis=0)
        result = classifierLoad.predict(test_image)
        result1 = ''
        if result[0][0] == 1:
            result1 = "front"
        elif result[0][1] == 1:
            result1 = "rear"
        elif result[0][2] == 1:
            result1 = "side"
        file = request.files['fileupload1']
        file.save('static/Out/Test1.jpg')
        import warnings
        warnings.filterwarnings('ignore')
        import tensorflow as tf
        classifierLoad = tf.keras.models.load_model('level.h5')
        import numpy as np
        from keras.preprocessing import image
        test_image = image.load_img('static/Out/Test1.jpg', target_size=(200, 200))
        img1 = cv2.imread('static/Out/Test1.jpg')
        # test_image = image.img_to_array(test_image)
```

```
            test_image = np.expand_dims(test_image, axis=0)
            result = classifierLoad.predict(test_image)
            result2 = ''
            if result[0][0] == 1:
                result2 = "minor"
            elif result[0][1] == 1:
                result2 = "moderate"
            elif result[0][2] == 1:
                result2 = "severe"
            if (result1 == "front" and result2 == "minor"):
                value = "3000 - 5000 INR"
            elif (result1 == "front" and result2 == "moderate"):
                value = "6000 8000 INR"
            elif (result1 == "front" and result2 == "severe"):
                value = "9000 11000 INR"
            elif (result1 == "rear" and result2 == "minor"):
                value = "4000 - 6000 INR"
            elif (result1 == "rear" and result2 == "moderate"):
                value = "7000 9000 INR"
            elif (result1 == "rear" and result2 == "severe"):
                value = "11000 - 13000 INR"
            elif (result1 == "side" and result2 == "minor"):
                value = "6000 - 8000 INR"
            elif (result1 == "side" and result2 == "moderate"):
                value = "9000 - 11000 INR"
            elif (result1 == "side" and result2 == "severe"):
                value = "12000 - 15000 INR"
            else:
                value = "16000 - 50000 INR"
            return render_template('userhome.html', prediction=value)
        if__name__== '_main_':
app.run(debug=True, use_reloader=True)
```

Welcome Vehicle Damage Assessment

insurance companies for faster processing of claims if users can upload pics and the model can assess damage(be it

New User

Name _____

Email id

Password

Vehicle Damage Assessment

Cost Estimator

Home UserLogin NewUser

New User

Name san

Email id sangeeth5535@gmail.com

Password

Vehicle Damage Assessment

Cost Estimator

Home UserLogin NewUser

UserLogin

EmailId sangeeth5535@gmail.com

Password

m fi

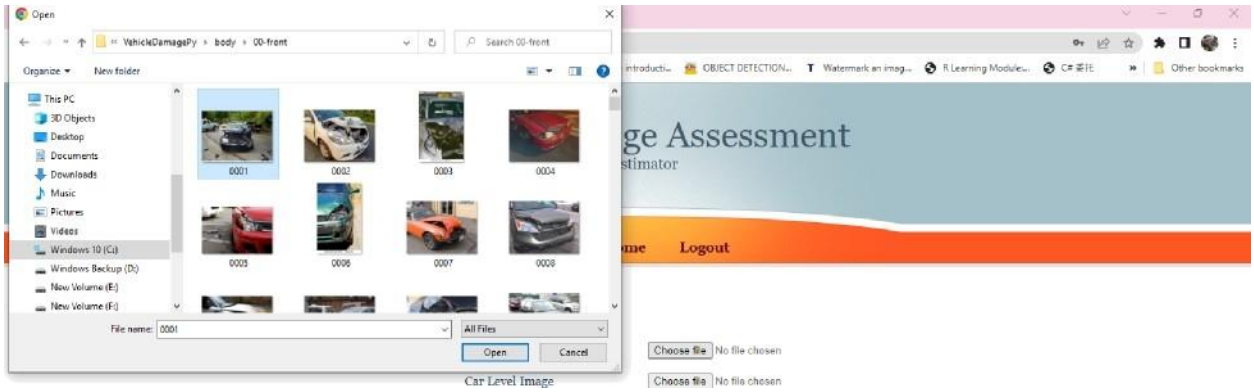
Vehicle Damage Assessment

Upload Image

CarBodfImage Choose file No file choser

Car Image Choose file No file choser

EsumaeCox



Car Level Image

EsumaeCox

Vehicle Damage Assessment

.' Cost Estimator

Upload Image

Bo Image Choose file No file chosen

Car Image Choose file No file chosen

Estimate 9000 11000 INR