



DHANALAKSHMI SRINIVASAN

COLLEGE OF ENGINEERING AND TECHNOLOGY

ECR, MAMALLAPURAM, KANCHIPURAM DISTRICT.

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INTELLIGENT VEHICLE DAMAGE ASSESSMENT & COST ESTIMATOR FOR INSURANCE COMPANIES

IBM NAALAIYA THIRAN

(Team ID : PNT2022TMID26890)

PROJRCT REPORT

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BACHELOR OF ENGINEERING

IN

INFORMATION TECHNOLOGY

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BONAFIDE CERTIFICATE

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1.

INTRODUCTION

1.1 PROJECT OVERVIEW

A broad understanding of image data Know how to pre-process/clean the data using different data preprocessing techniques. Know how to Know fundamental concepts and techniques of VGG16. Gain build a web application using the Flask framework.

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.

AI in automotive insurance holds significant potential to quickly estimate vehicle damages. Soon with the advancement in AI algorithms, assessment done manually would be a thing of the past. Traditionally the damage assessment was carried out by multiple parties which were time-consuming, highly prone to human error, leading to inaccurate cost estimations.

1.1 PURPOSE

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 scratch from and estimates the cost of damage

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM

Car insurers need to perform many daily operations, including validation, inspection, data processing, management, and storing of huge volumes of data generated by different parties. Moreover, the variety of cars increases as well as the number of insurance claims, and car rental services have to adjust their calculations accordingly.

The insurance sector has to stick to strict regulations which sometimes cause delays in obtaining insurance for its customers. McKinsey estimates that AI investments could potentially cost insurers as much as \$1.3 trillion annually. However, the losses caused by fraud and inaccurate assessment overreach this sum considerably. The process of analysis of insurance claims is often delayed because the inspection involves human intervention. AI-powered technology allows for automatic car repair detection and auto-detection monitoring with the possibility of manual intervention.

2.2 PROBLEM STATEMENT DEFINITION

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.

2.3 REFERENCE

PAPER TITLE	AUTHOR - PUBLICATION	DRAWBACKS	PROPOSED METHODOLOGIES	OUTCOMES	FUTURE SCOPE
Image Based Automatic Vehicle Damage Detection	Srimal Jayawardena A thesis submitted for the degree of Doctor of Philosophy at The Australian National University	This thesis proposes a solution which uses 3D Computer Aided Design for the discernment of car damage from the picture, the system only detects damage at the edge portion only. Detection of car damage through CAD software requires some knowledge about the software.	Monocular 2D/3D pose estimation 3D model assisted segmentation Reflection detection Obtain reliable point correspondences across photographs with largely reflective and homogeneous regions	The project explores the problem of automatically detecting mild damage in vehicles using photographs taken at the scene of the accident.	Detecting damages to vehicle panels such as dents, deformations in panels and also estimating the degree of damage in terms of repair costs. Making use of the reflections and specular highlights in the process of recovering the 3D pose.
Car Damage Assessment Based on VGG Models	Phyu Mar Kyu and Kuntpong Woraratpanya - Institute of Electrical and Electronics Engineers (IEEE) Conference: JSCI8 RE, Yan Rui ten beek, S. Bhulai Machine Learning with Applications Volume 9, 15 September 2022, 100332	Observed that training with a small dataset is insufficient to get the best accuracy based on the deep learning approach. Persistence of overfitting problem in the model performance	Deep learning-based algorithms, VGG16 and VGG19, for car damage detection and assessment Pre-trained CNN models trained on ImageNet dataset YOLO object detection to train and detect damage region. Transfer learning in pre-trained VGG model	94%, 71% and 61% in damage detection, damage location and damage severity in VGG16 Comparison of VGG16 and VGG19 model Precision, Recall, and F1-score	Training model with larger number dataset with diverse image The results of using transfer learning and regularization can work better than those of fine-tuning.
Convolutional Neural Networks for vehicle damagedetection		Challenge in damage inspection is the robustness against different light conditions	A damage detection model is developed to locate vehicle damages and classify these into twelve categories. FSSD with Darknet-53 and YOLO v3 with Darknet-53 yield the best mAP on, respectively.	A deep learning model that is able to accurately detect and classify vehicle damages. The model is evaluated in a specially designed light street, indicating that strong reflections complicate the detection performance. The model outperforms in the classes Bend and Cover Damage	Cross-validation between annotators and studies of the effect of different annotation granularities can be carried out.

3.IDEATION & PROPOSED SOLUTION

3.1 EMPATHY MAP CANVAS

An empathy map is a collaborative tool teams can use to gain a deeper insight into their customers. Much like a user persona, an empathy map can represent a group of users, such as a customer segment. The empathy map was originally created by Dave Gray and has gained much popularity within the agile community.

The empathy map represents a principal user and helps teams better understand their motivations, concerns, and user experience. Empathy mapping is a simple yet effective workshop that can be conducted with a variety of different users in mind, anywhere from stakeholders, individual use cases, or entire teams of people.

The 4 Attributes of Empathy:

1. Perspective taking.
 2. Staying out of judgment.
 3. Recognizing emotion in another person.
- Communicating the understanding of another person's emotions

3.2 IDEATION & BRAINSTORMING

Brainstorming is a group problem-solving method that involves the spontaneous contribution of creative ideas and solutions. This technique requires intensive, freewheeling discussion in which every member of the group is encouraged to think aloud and suggest as many ideas as possible based on their diverse knowledge.

4 Types of Brainstorming:

1. Reverse Brainstorming. A creative problem-solving technique in which the problem is turned around and considered from a different point of view to spur new and different


solutions.

2. Stop-and-Go Brainstorming.
3. Phillips 66 Brainstorming.
4. Brainwriting.

Benefits of Brainstorming:


1. Provides a quick and easy class activity. Brainstorming sessions can be effectively used in the classroom.
2. Contributes to classroom collective power.
3. Creates a student-centered activity.
4. Supports learning in a relaxed environment.
5. Strengthens problem-based learning.
6. Encourages creative thought.


Template





Brainstorm & idea prioritization

Use this template in your own brainstorming sessions so your team can unleash their imagination and start shaping concepts even if you're not sitting in the same room.

 10 minutes to prepare


 1 hour to collaborate

 2-8 people recommended



Before you collaborate

A little bit of preparation goes a long way with this session. Here's what you need to do to get going.

 10 minutes

A Team gathering
Define who should participate in the session and send an invite. Share relevant information or pre-work ahead.

B Set the goal
Think about the problem you'll be focusing on solving in the brainstorming session.

C Learn how to use the facilitation tools
Use the Facilitation Superpowers to run a happy and productive session.

[Open article](#) →

3.3 PROPOSED SOLUTION

Problem Statement (Problem to be solved): Nowadays 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. There is no easy way of accessing and knowing about the part of the vehicle getting damaged. Often the processing of such a damaged part of the vehicle carrying the area of damaged part is cumbersome. New methods have to be proposed in order to make it faster and efficient. Processing of Insurance for the cars needs to be assessed in a quicker way so that claims can be provided to the damaged parts.

Idea / Solution description: Automobile Industry is one of the major industry in a Country. This proposed system is Intelligent vehicle damage assessment and cost estimator for insurance companies using computer vision in artificial intelligence. The model will predict the location of the damage as in front, side or rear, and the severity of such a damage as in minor, moderate or severe and estimate the cost of damage of both car and bike.

Novelty / Uniqueness: Deep learning method used to fixed the problem and then Working on with VGG16 pretrained model by adding extra layers to increase the accuracy while implementing the project.

Social Impact / Customer Satisfaction: The model developed will be used to fix the damage caused to the Vehicle quickly so that the vehicle can be modified to the old look and also for faster processing of cost of the damage to claim insurance quickly. This project can be used to save time for calculating the area and level of the damage quickly such that the insurance claim can be made efficiently.

Business Model (Revenue Model): This can also be used to help car companies as well. Can collaborate with insurance companies. Can collaborate with car companies.

Scalability of the Solution: AI guided Application provides 24/7 service to clear all customer queries and guide them through all the processes. In future, it can be scaled as per the requirements of the insurance or car company to include answers to queries related to the cost based on the inputs provided

3.4 PROBLEM SOLUTION FIT

There is no systematic approach to receive a rapid answer from an insurance company. A week of waiting is required. The proposed solution should enable consumers to contact with the insurance provider and receive payments both online and offline. After uploading the damaged image and determining the extent of the damage, the user may obtain insurance only if the company approves the damaged image and the condition is more than 80%.

4.1 FUNCTIONAL REQUIREMENT

4.1.1 Framework Creation:

This approach provides a way for evaluating vehicle damage that insurance companies may utilize when processing claims. This module offered a framework for submitting a vehicle's damaged parts and requesting insurance from an organization. The dataset needed to train the Damage Detection and it has prepared by an admin. In order to make the images useful for training, they were manually annotated; damages were categorized into 7 distinct types such as Door Dent, Bumper Dent, Body Scratch, Broken Windshield, Broken Glass, Broken Lights and Smash By modifying its settings and loading the learned dataset, the model was set up to train on user data.

4.1.2 Object Detection:

Employ a specially trained CNN model utilizing transfer learning on to identify the object. This model takes different forms of damage into account validation sets such as Bumper Dent, Bumper Scratch, Door Dent, Door Scratch, Glass Shattered, Head Lamp, Tail Lamp, Undamaged, etc. The classification of car damage severity is as follows: Minor Damage which typically involves slight damage to the vehicle that does not impede the vehicle to cause severe injuries. It includes the headlight scratches, dents and digs in the hood or windshield, from gravel or debris, scratches in the paint. Moderate Damage which deals with any kind of damage that impairs the functionality of the vehicle in any way is moderate damage. It involves large dents in hood, fender or door of a car. 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.

4.1.3 Damage Detection:

To locate damaged areas in a picture and create a bounding box around each object found, object localization is used which combines object localisation and classification to

provide a bounding box and a class for each item for object detection. Use CNN to generate a convolutional features map from an image to forecast the class and bounding box of an item. If the car is undamaged then it simply detects it and if it's a damaged one, then there are further localizations made models. The model shows accuracy on the validation set. To automate such a system, the easiest method would be to build a Convolution Neural Network model capable of accepting images from the user and determining the location and severity 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.

4.1.4 Claim Insurance:

The procedure of claiming insurance is done by persons who are in need. For access to the company's insurance, the user must register and authenticate. After that, users may access their insurance information and submit an insurance claim request. The request for an insurance claim can be viewed and approved by the insurance company. Once the damaged image has been uploaded and the degree of the damage has been determined, the user may receive insurance only if the firm accepts the damaged image and the condition is greater than 80%.

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	<ul style="list-style-type: none"> • Registration through Form • Registration through Gmail • Registration through LinkedIn
FR-2	User Confirmation	<ul style="list-style-type: none"> • Confirmation via Email • Confirmation via OTP
FR-3	User Interface	<ul style="list-style-type: none"> • User friendly and simple website

FR-4	Collect the datasets	<ul style="list-style-type: none"> • Collect the data from the user side and their vehicle side information. • Collect the data from about Insurance companies plans.
FR-5	Final Results	<ul style="list-style-type: none"> • Model should be trained with high accuracy. • Results obtained from the model should be displayed to The user with easy interpretability.

4.2 NON-FUNCTIONAL REQUIREMENTS:

Non-functional Requirements (NFRs) define system attributes such as security, reliability, performance, maintainability, scalability, and usability. They serve as constraints or restrictions on the design of the system across the different backlogs.

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	<ul style="list-style-type: none"> • Intelligent model used to assessment the damage in the vehicle and estimate the cost to be provided by the insurance company.
NFR-2	Security	<ul style="list-style-type: none"> • The credibility of the user and the confidentiality of user details about their vehicle must be maintained.
NFR-3	Reliability	<ul style="list-style-type: none"> • This scheme can achieve good accuracy in damage

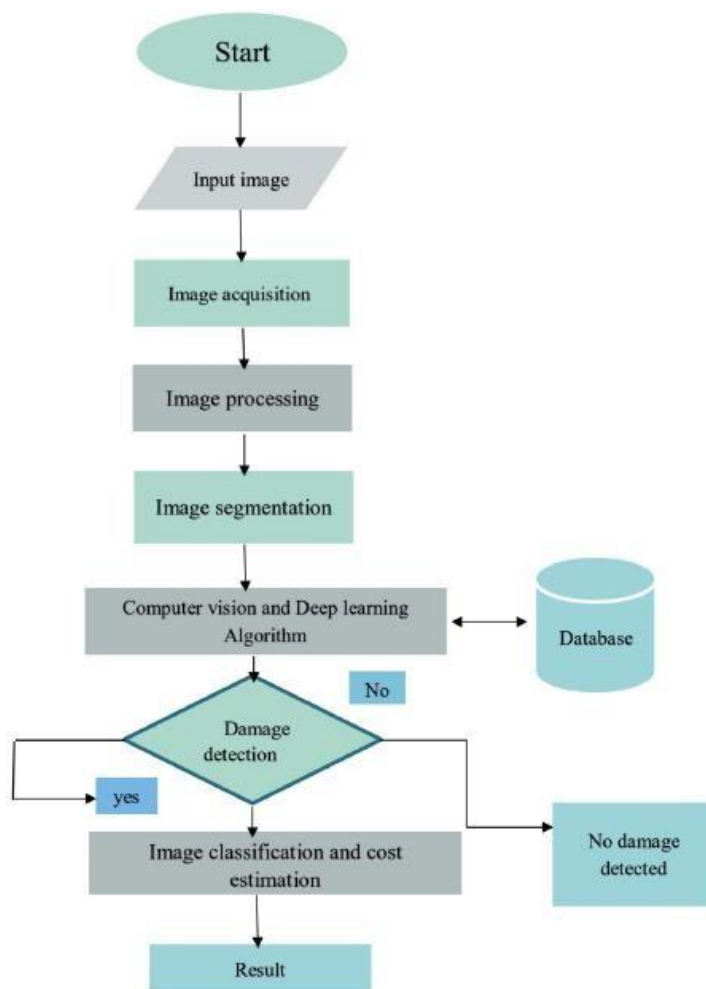
		estimation and cost estimation, thus providing accurate and unbiased insurance coverage to the user.
NFR-4	Performance	<ul style="list-style-type: none"> • Real-time images are to be captured and uploaded to the website, where the proposed model performs damage assessment and gives the insurance cost accordingly.
NFR-5	Availability	<ul style="list-style-type: none"> • The website should be compatible with web browsers on both mobile phones and computers.

5.

PROJECT DESIGN**5.1 DATA FLOW DIAGRAMS**

A data flow diagram (DFD) is a graphical or visual representation using a standardized set of symbols and notations to describe a business's operations through data movement. They are often elements of a formal methodology such as Structured Systems Analysis and Design Method (SSADM).

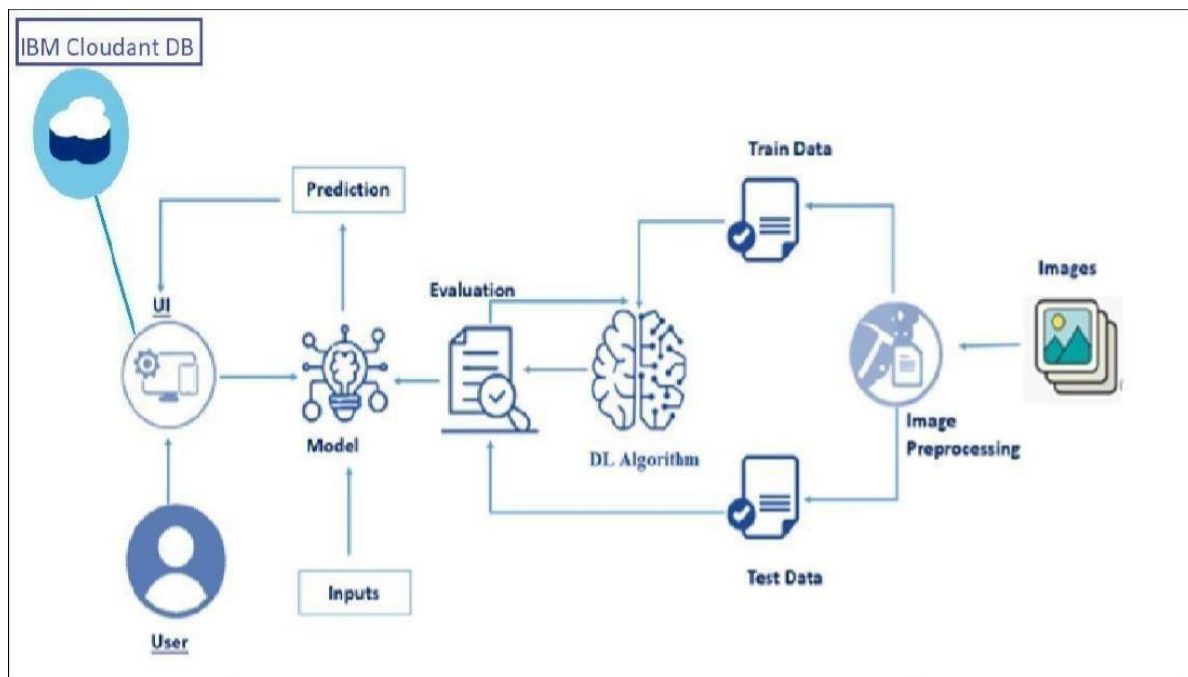
It helps us to understand the functioning and the limits of a system. It is a graphical representation which is very easy to understand as it helps visualize contents. Data Flow Diagram represent detailed and well explained diagram of system components



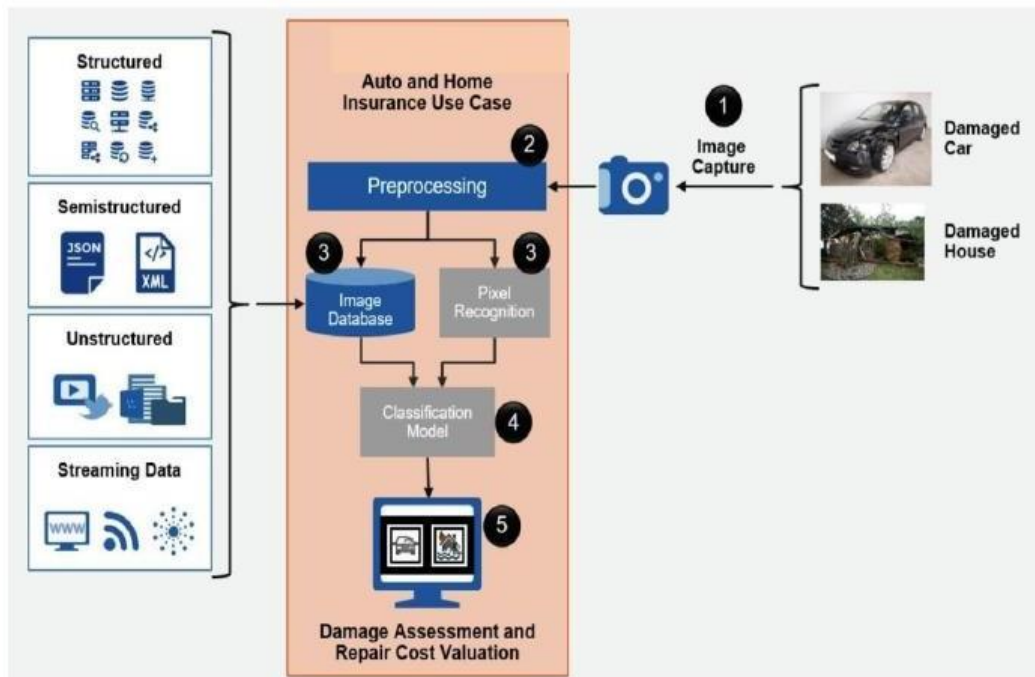
5.2 SOLUTION & TECHNICAL ARCHITECTURE

A system architecture or systems architecture is the conceptual model that defines the structure, behavior, and more views of a system. An architecture description is a formal description and representation of a system, organized in a way that supports reasoning about the structures and behaviors of the system. System architecture can comprise system components, the externally visible properties of those components, the relationships (e.g the behavior) between them. It can provide a plan from which products can be procured, and systems developed, that will work together to implement the overall system. There have been efforts to formalize languages to describe system architecture, collectively these are called architecture description languages (ADLs).

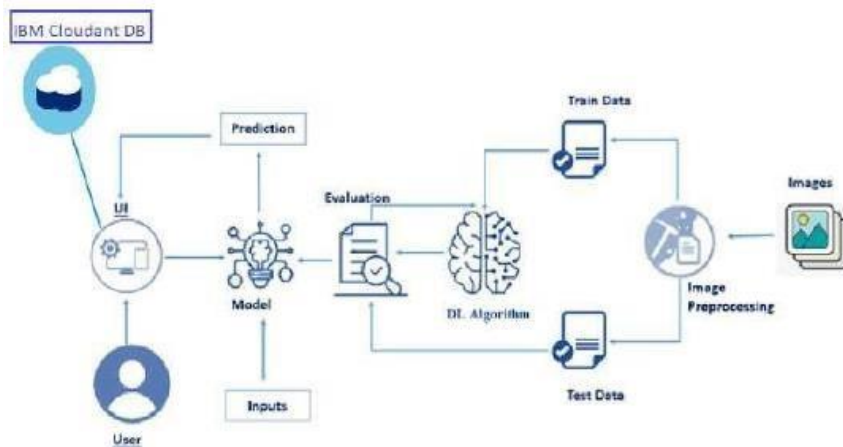
SOLUTION ARCHITECTURE :



OUTLINE ARCHITECTURE:



TECHNICAL ARCHITECTURE:



5.1 USER STORIES:



Customer experience journey map

Use this framework to better understand customer needs, motivations, and obstacles by illustrating a key scenario or process from start to finish. When possible, use this map to document and summarize interviews and observations with real people rather than relying on your hunches or assumptions.

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1

Intelligent Vehicle Damage Assessment and Cost Estimator for Insurance Companies

Narrow your focus to a specific scenario or process within an existing product or service. In the **Shape** row, document the step-by-step process someone typically experiences, then add detail to each of the other rows.

Tip
As you add steps to the experience, make each field "flexible" to make it easy to rearrange or to delete you are encouraged.

Summary Browsing, buying, assessing, and settling a real-life issue	Entrice How does someone initially become aware of this process?	Enter What do people experience as they begin the process?	Engage In the core moments in the process, what happens?	Exit What do people typically experience as the process finishes?	Extend What happens after the experience is over?
Steps What steps does the person (or group) typically experience?	Understand the problem Search for a solution Research the problem Contact the provider Understand the process Understand the cost Understand the timeline	Research the problem Research the provider Research the cost Research the timeline Research the process Research the provider Research the cost Research the timeline	Understand the problem Understand the provider Understand the cost Understand the timeline Understand the process Understand the provider Understand the cost Understand the timeline	Understand the problem Understand the provider Understand the cost Understand the timeline Understand the process Understand the provider Understand the cost Understand the timeline	Understand the problem Understand the provider Understand the cost Understand the timeline Understand the process Understand the provider Understand the cost Understand the timeline
Interactions What interactions do they have at each step along the way? • People Who do they see or talk to? • Places Where are they? • Things What digital touchpoints or physical objects would they use?	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline
Goals & motivations At each step, what is a person's primary goal or motivation? (Help me, "or help me avoid...")	Understand the problem Understand the provider Understand the cost Understand the timeline	Understand the problem Understand the provider Understand the cost Understand the timeline	Understand the problem Understand the provider Understand the cost Understand the timeline	Understand the problem Understand the provider Understand the cost Understand the timeline	Understand the problem Understand the provider Understand the cost Understand the timeline
Positive moments What steps does a typical person find enjoyable, productive, fun, motivating, delightful, or exciting?	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline
Negative moments What steps does a typical person find frustrating, confusing, upsetting, costly, or time-consuming?	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline
Areas of opportunity How right or wrong was each step better? What ideas do we have? What have others suggested?	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline	The person who helps them understand the problem The person who helps them understand the provider The person who helps them understand the cost The person who helps them understand the timeline

6. PROJECT PLANNING & SCHEDULING

6.1 SPRINT PLANNING & ESTIMATION

Sprint	Functional Requirement (Epic)	User Story Number	User Story / Task	Story Points	Priority	Team Members
Sprint-1	Registration	USN - 1	As a user, I can register for the application by entering my details of name, email, cars etc. verifying my Gmail account and creating new account with password	7	HIGH	MOHAMMED NIZAM , THENMOZHI
Sprint-1	Login	USN -2	As a user,entering my email, and password, and confirming my password,I can login to my account.	7	HIGH	MOHAMMED NIZAM , SANTHOSH KUMAR
Sprint-1	Dashboard	USN-3	As a user, I can clearly see data, point, graphs, charts and trends of my previous activity and global activity related to my views	2	LOW	MOHAMMED NIZAM , SANTHOSH KUMAR
Sprint-2	Details about insurance company	USN-4	As a user, I can register for theApplication through Gmail and account id.	8	MEDIUM	SANTHOSH KUMAR, ARINA
Sprint-1	repeated logins and logout	USN-5	As a user,I can log in and view my dashboard at my demand on any time	4	HIGH	SANTHOSH KUMAR, MOHAMMED NIZAM
Sprint-2	Webpage	USN-6	As a user, I must enter all details of car, accident, capture images of my vehicle and upload it into the web portal.	12	HIGH	THENMOZHI , ARINA
Sprint 3	Details about estimated cost based on damage	USN-7	As a user I must receive a detailed report of the damages present in the vehicle and the Cost estimated.	20	HIGH	SANTHOSH KUMAR, ARINASS
Sprint 4	Provide friendly and efficient	USN-8	As a user, I need to get support from developers in case of	10	MEDIUM	MOHAMMED NIZAM, THENMOZHI , ARINA

	customer support and sort out the queries.		queries and failure of service Provided by chat-box,mail or call.			
Sprint 4	overview the entire process and act as a bridge between user and developer	USN-9	As a Team member, We need to satisfy thecustomer needs in an efficient way and make sure any sort of errors are fixed	10	HIGH	MOHAM MEDNIZAM, THENMO ZHI , ARINA

6.2 SPRINT DELIVERY SCHEDULE

Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	20	4 Days	5nov 2022	09nov 2022	20	10nov 2022
Sprint-2	20	4 Days	6nov 2022	10nov 2022	20	11nov 2022
Sprint-3	20	5 Days	7nov 2022	11nov 2022	20	12nov 2022
Sprint-4	20	9 Days	11nov 2022	18nov 2022	20	19nov 2022

7.CODING & SOLUTIONING

7.1 FEATURE 1

Index:

```
<!DOCTYPE html>

<html lang="en">

<head>

  <title>Home | IBM</title>

  <meta charset="utf-8">

  <meta name="viewport" content="width=device-width, initial-scale=1">

  <link rel="stylesheet"
href="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/css/bootstrap.min.css">

  <link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-
awesome/4.7.0/css/font-awesome.min.css">

  <script
src="https://ajax.googleapis.com/ajax/libs/jquery/3.6.0/jquery.min.js"></script>

  <script
src="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/js/bootstrap.min.js"></script>

<style>

.nav.navbar-nav{

  margin-left: 75px;

}

.navbar-brand{

  font-size: 22px;

}

.footer{

overflow: hidden;
```



```
background-color: #555;
position: fixed;
bottom: 0;
height: 65px;
width: 100%;
}
```

Login:

```
<!DOCTYPE html>
<html lang="en">
<head>
  <title>Home | IBM</title>
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width, initial-scale=1">
  <link rel="stylesheet"
href="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/css/bootstrap.min.css">
  <link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-
awesome/4.7.0/css/font-awesome.min.css">
  <script
src="https://ajax.googleapis.com/ajax/libs/jquery/3.6.0/jquery.min.js"></script>
  <script
src="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/js/bootstrap.min.js"></script>
  <style>
.nav.navbar-nav{
  margin-left: 180px;
}
.navbar-brand{
  font-size: 22px;
}
```

```
.footer{
overflow: hidden;
background-color: #333;
position: fixed;
bottom: 0;
height: 65px;
width: 100%;
}

input[type=text], input[type=password] {
    width:500px;
    padding: 12px 20px;
    margin: 8px 0;
    display: inline-block;
    background-color: black;
    opacity: 65%;
    color: white;
    border: 1px solid #ccc;
    box-sizing: border-box;
    border-radius: 10px;
}

button {
    background-color: #04AA6D;
    color: white;
    padding: 14px 20px;
    margin: 8px 0;
    border: none;
    cursor: pointer;
```

```
width: 250px;
border-radius: 10px;
}
```

```
button:hover {
  opacity: 0.8;
}
.imgcontainer {
  text-align: center;
}
```

```
img.avatar {
  border-radius: 50%;
}
```

```
.ayya {
  padding: 16px;
}
label{
  margin-left:-400px;

}
```

```
</style>
```

```
</head>
```

```
<body style="background-image: linear-gradient(to right, #DECBA4, #3E5151);">
```

```

<nav class="navbar navbar-inverse">
  <div class="container-fluid">
    <div class="navbar-header">
      <a class="navbar-brand" href="#"><b>Login Page</b></a>
    </div>
    <ul class="nav navbar-nav">
      <li><a href="#">Home</a></li>
      <li class="active"><a href="login.html">Login</a></li>
      <li><a href="register.html">Register</a></li>
    </ul>
  </div>
</nav><br><br><br><br>

<div style="margin-top:-55px;" class="container">
  <form action="index.html" method="post">
    <div class="imgcontainer">
      
    </div>
    <center>
      <div class="ayya">
        <label for="uname"><b>USERNAME</b></label><br>
        <input type="text" placeholder="Enter Username" name="uname"
required><br>
        <label for="psw"><b>PASSWORD</b></label><br>
        <input type="password" placeholder="Enter Password" name="psw"
required><br><br>

```

```

        <button type="submit">LOGIN</button><br>
        <label>
            <input type="checkbox" checked="checked" name="remember"> Remember
me
        </label><br>
    </div>
</center>
</form>
</div>
<div class="footer">
    <p style="color:white;
        margin-top: 20px;
        text-align: center;"><b>
        COPYRIGHT @ 2022,ALL RIGHTS RESERVED</b>
    </p>

</div>

</body>
</html>

```

Logout:

```

<!DOCTYPE html>
<html lang="en">
<head>
    <title>Home | IBM</title>
    <meta charset="utf-8">

```

```

<meta name="viewport" content="width=device-width, initial-scale=1">

<link rel="stylesheet"
href="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/css/bootstrap.min.css">

<link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-
awesome/4.7.0/css/font-awesome.min.css">

<script
src="https://ajax.googleapis.com/ajax/libs/jquery/3.6.0/jquery.min.js"></script>

<script
src="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/js/bootstrap.min.js"></script>

<style>

.nav.navbar-nav{

margin-left: 180px;

}

.navbar-brand{

font-size: 22px;

}

.footer{

overflow: hidden;

background-color: #333;

position: fixed;

bottom: 0;

height: 65px;

width: 100%;

}

button{

background-color: black;

width: 150px;

border-radius: 10px;

}

```

```

</style>
</head>
<body style="background-image: linear-gradient(to right, #DECBA4, #3E5151);">
<nav class="navbar navbar-inverse">
  <div class="container-fluid">
    <div class="navbar-header">
      <a class="navbar-brand" href="#"><b>Intelligent Vehicle Damage Assessment
and Cost Estimator for Insurance Companies</b></a>
    </div>
    <ul class="nav navbar-nav">
      <li class="active"><a href="#">Home</a></li>
      <li><a href="login.html">Login</a></li>
      <li><a href="register.html">Register</a></li>
      <li><a href="prediction.html">Prediction</a></li>
    </ul>
  </div>
</nav><br><br>

<div style="margin-top: 80px;" class="container">
  <center>
    <h3 style="font-size: 42px;font-family: 'Franklin Gothic Medium', 'Arial Narrow',
Arial, sans-serif;">Successfully Logged Out !</h3><br>
    <b style="font-size:25px;">Login for More Information</b><br><br><br><br>
    <button><a style="color:white;" href="login.html">LOGIN</a></button>

  </center>
</div>
<div class="footer">

```

```

<p style="color:white;
    margin-top: 20px;
    text-align: center;"><b>
    COPYRIGHT @ 2022,ALL RIGHTS RESERVED</b>
</p>

```

```

</div>

```

```

</body>

```

```

</html>

```

Prediction:

```

<!DOCTYPE html>
<html lang="en">
<head>
  <title>Home | IBM</title>
  <meta charset="utf-8">
  <meta name="viewport" content="width=device-width, initial-scale=1">
  <link rel="stylesheet"
href="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/css/bootstrap.min.css">
  <link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-
awesome/4.7.0/css/font-awesome.min.css">
  <script
src="https://ajax.googleapis.com/ajax/libs/jquery/3.6.0/jquery.min.js"></script>
  <script
src="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/js/bootstrap.min.js"></script>
  <style>

```



```

.nav.navbar-nav{
margin-left: 280px;
}
.navbar-brand{
font-size: 22px;
}
.footer{
overflow: hidden;
background-color: #333;
position: fixed;
bottom: 0;
height: 65px;
width: 100%;
}
</style>
</head>
<body style="background-image: linear-gradient(to right, #DECBA4, #3E5151);">
<nav class="navbar navbar-inverse">
<div class="container-fluid">
<div class="navbar-header">
<a class="navbar-brand" href="#"><b>Intelligent Vehicle Damage Assessment
and Cost Estimator for Insurance Companies</b></a>
</div>
<ul class="nav navbar-nav">
<li><a href="#">Home</a></li>
<li><a href="login.html">Login</a></li>
<li><a href="register.html">Register</a></li>
<li class="active"><a href="prediction.html">Prediction</a></li>
</ul>

```

```

</div>

</nav><br><br><br><br>

<div style="margin-top: -45px;" class="container">

    <center>

        <h2 style="font-family:'Franklin Gothic Medium', 'Arial Narrow', Arial, sans-serif;"><b>UPLOAD IMAGE TO PREDICT</b></h2><br>

        <form action="prediction.html">

            <input style="background-color:black;
                opacity: 78%;
                color: white;
                font-size: 18px;
                width: 250px;"
                type="file" id="myFile" name="filename">

            <br><br>

            <input style="background-color:black;
                opacity: 78%;
                color: white;
                font-size: 18px;
                border-radius: 18px;
                width: 150px;" type="submit">

        </form>

        <br>

        <h2 style="font-family:'Franklin Gothic Medium', 'Arial Narrow', Arial, sans-serif;" > <b> </b></h2>

    </center>

</div>

<div class="footer">

    <p style="color:white;

```

margin-top: 20px;

text-align: center;">

COPYRIGHT @ 2022,ALL RIGHTS RESERVED

</p>

</div>

</body>

</html>

Register:

<!DOCTYPE html>

<html lang="en">

<head>

<title>Home | IBM</title>

<meta charset="utf-8">

<meta name="viewport" content="width=device-width, initial-scale=1">

<link rel="stylesheet"
href="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/css/bootstrap.min.css">

<link rel="stylesheet" href="https://cdnjs.cloudflare.com/ajax/libs/font-awesome/4.7.0/css/font-awesome.min.css">

<script
src="https://ajax.googleapis.com/ajax/libs/jquery/3.6.0/jquery.min.js"></script>

<script
src="https://maxcdn.bootstrapcdn.com/bootstrap/3.4.1/js/bootstrap.min.js"></script>

<style>

.nav.navbar-nav{

```
margin-left: 180px;
}
.navbar-brand{
  font-size: 22px;
}
.footer{
overflow: hidden;
background-color: #333;
position: fixed;
bottom: 0;
height: 65px;
width: 100%;
}
input[type=text], input[type=password] {
  width:500px;
  padding: 12px 20px;
  margin: 8px 0;
  display: inline-block;
  background-color: black;
  opacity: 65%;
  color: white;
  border: 1px solid #ccc;
  box-sizing: border-box;
  border-radius: 10px;
}

button {
  background-color: #04AA6D;
```

```
color: white;
padding: 14px 20px;
margin: 8px 0;
border: none;
border-radius: 10px;
cursor: pointer;
width: 250px;
}
```

```
button:hover {
  opacity: 0.8;
}
.imgcontainer {
  text-align: center;
}
```

```
img.avatar {
  border-radius: 50%;
}
```

```
.ayya {
  padding: 16px;
}
label{
  margin-left:-400px;
}
```

```

</style>
</head>
<body style="background-image: linear-gradient(to right, #DECBA4, #3E5151);">
<nav class="navbar navbar-inverse">
  <div class="container-fluid">
    <div class="navbar-header">
      <a class="navbar-brand" href="#"><b>Vehicle Damage Detaction</b></a>
    </div>
    <ul class="nav navbar-nav">
      <li><a href="#">Home</a></li>
      <li><a href="login.html">Login</a></li>
      <li class="active"><a href="register.html">Register</a></li>
      <li><a href="prediction.html">Prediction</a></li>
    </ul>
  </div>
</nav><br><br><br><br>

<div style="margin-top:-55px;" class="container">
  <form action="index.html" method="post">
    <div class="imgcontainer">
      
    </div>
    <center>
      <div class="ayya">
        <label for="uname"><b>Name :</b></label><br>

```

```
<input type="text" placeholder="Enter Username" name="uname"
required><br>
```

```
<label for="psw"><b>Email id :</b></label><br>
```

```
<input type="text" placeholder="usermail@gmail.com" name="mail"
required><br>
```

```
<label for="psw"><b>Password :</b></label><br>
```

```
<input type="password" placeholder="Enter Password" name="psw"
required><br><br>
```

```
<button type="submit">REGISTER</button><br><br>
```

```
</div>
```

```
</center>
```

```
</form>
```

```
</div>
```

```
<div class="footer">
```

```
<p style="color:white;
margin-top: 20px;
text-align: center;"><b>
```

```
COPYRIGHT @ 2022,ALL RIGHTS RESERVED</b>
```

```
</p>
```

```
</div>
```

```
</body>
```

```
</html>
```

8. TESTING

8.1 TEST CASES

A test case has components that describe input, action and an expected response, in order to determine if a feature of an application is working correctly. A test case is a set of instructions on “HOW” to validate a particular test objective/target, which when followed will tell us if the expected behavior of the system is satisfied or not.

Characteristics of a good test case:

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

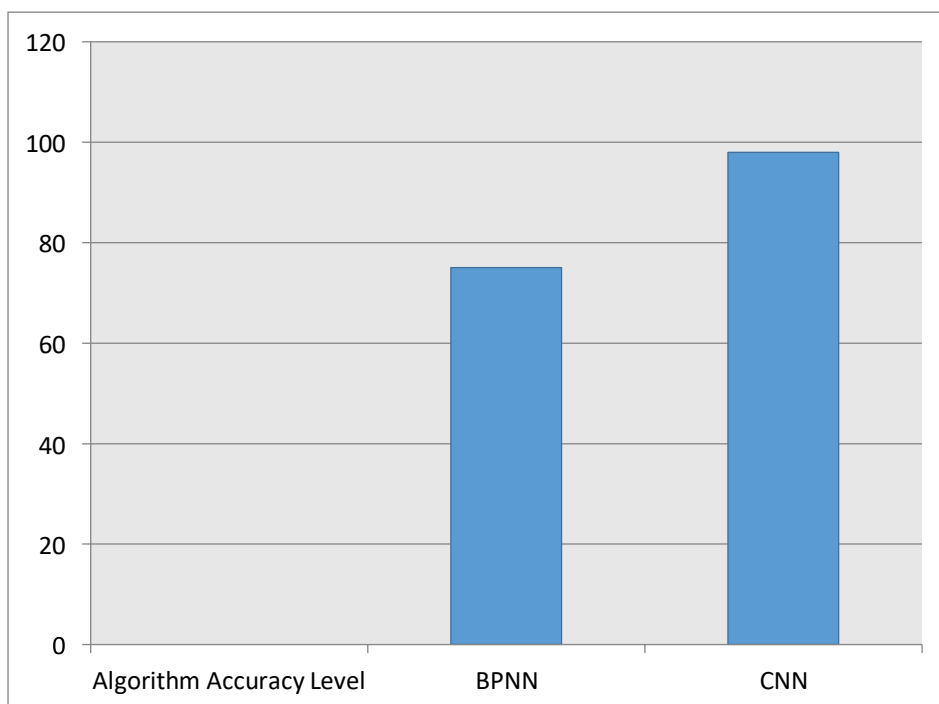
S.NO	Scenario	Input	Excepted output	Actual output
1	User login	User name and password	Login	Login success
2	Login success	Upload damaged vehicle image as a input	Detecting object and analyze for claim insurance	Details are stored in a database.

8.2 USER ACCEPTANCE TESTING

This sort of testing is carried out by users, clients, or other authorised bodies to identify the requirements and operational procedures of an application or piece of software. The most crucial stage of testing is acceptance testing since it determines whether or not the customer will accept the application or programme. It could entail the application's U.I., performance, usability, and usefulness. It is also referred to as end-user testing, operational acceptance testing, and user acceptance testing (UAT).

9RESULTS

9.1 PERFORMANCE METRICS



10.ADVANTAGES & DISADVANTAGES

ADVANTAGE

1. Digitalized claim process makes easy to use
2. Give the accurate result of the damaged vehicle
3. Helps the insurance company to analyze the damaged vehicle and also paymentprocess.

DISADVANTAGE

1. It will take more time to claim the insurance in manual process
2. Because of incorrect claims, the company behaves badly and doesn't make paymentscurrently.
3. Poor customer support.

11. CONCLUSION

In this research proposal, a neural network-based solution for automobile detection will be used to address the issues of automotive damage analysis and position and severity prediction. This project does several tasks in one bundle. The method will unquestionably assist the insurance firms in conducting far more thorough and systematic analyses of the vehicle damage. Simply sending the system a photograph of the vehicle, it will evaluate it and determine whether there is damage of any type, where it is located, and how severe it is.

12. FUTURE SCOPE

In future work, need to use several regularization methods with a big dataset in our nextwork. Anticipate the cost of a car damaged component more accurately and reliably if we have higher quality datasets that include the attributes of a car (make, model, and year of production), location data, kind of damaged part, and repair cost. This study makes it possible to work together on picture recognition projects in the future, with a focus on the auto insurance industry. The study was able to accurately validate the presence of damage, its location, and its degree while eliminating human bias. These can be further enhanced by adding the in the fly data augmentation approaches.

13. APPENDIX

SOURCE CODE:

```
import re
import numpy as np
import os
from flask import Flask, app, request, render_template
from keras import models
from keras.models import load_model
from keras.preprocessing import image
from tensorflow.python.ops.gen_array_ops import concat
from keras.applications.inception_v3 import preprocess_input
import requests
from flask import Flask, request, render_template, redirect, url_for
from cloudant.client import Cloudant

client = Cloudant.iam('5ece5257-e0a3-455a-85cb-bae7e5b9af61-bluemix', 'pU-
Fdv1N3p-9FKVtJanxAyl-3jivVCf8WjLElGDpxNgR',
                    connect=True)
my_database = client.create_database('my_database')

model1 = load_model('Model/level.h5')
model2 = load_model('Model/body.h5')

app = Flask(__name__)
```

```

@app.route('/')
def index():
    return render_template('index.html')

@app.route('/index.html')
def home():
    return render_template('index.html')

@app.route('/register.html')
def register():
    return render_template('register.html')

@app.route('/afterreg', methods=['POST'])
def afterreg():
    x = [x for x in request.form.values()]
    print(x)
    data = {
        '_id': x[1],
        'name': x[0],
        'psw': x[2]
    }
    print(data)

    query = {'_id': {'$eq': 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)
        response = request.get(url)
        return render_template('login.html', pred="Registration Successful, Please
login using your details")
    else:
        return render_template('register.html', pred="You are already a member,

```

Please login using your details")

```

@app.route('/login.html')
def login():
    return render_template('login.html')

@app.route('/afterlogin', methods=['POST'])
def afterlogin():
    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('login.html', pred="The Username is not found")
    else:
        if ((user == docs[0][0]['_id'] and passw == docs[0][0]['psw'])):
            return redirect(url_for('prediction'))
        else:
            print('Invalid User')

@app.route('/logout.html')
def logout():
    return render_template('logout.html')

@app.route('/prediction.html')
def prediction():
    return render_template('prediction.html')

@app.route('/result')
def res():

```

```

if request.method == "POST":
    f = request.files['image']
    basepath = os.path.dirname(__file__)
    filepath = os.path.join(basepath, 'uploads', f.filename)
    f.save(filepath)

    img = image.load_img(filepath, target_size=(256, 256))
    x = image.img_to_array(img)
    x = np.expand_dims(x, axis=0)

    img_data = preprocess_input(x)
    prediction1 = np.argmax(model1.predict(img_data))
    prediction2 = np.argmax(model2.predict(img_data))

    index1 = ['front', 'rear', 'side']
    index2 = ['minor', 'moderate', 'severe']

    result1 = index1[prediction1]
    result2 = index2[prediction2]
    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('/prediction.html', prediction=value)

```

```
if __name__ == "__main__":  
    app.run(debug=False, port=8080)
```

GITHUB LINK :

<https://github.com/IBM-EPBL/IBM-Project-28583-1660113980.git>