INTELLIGENT VEHICLE DAMAGE ASSESSMENT AND COST ESTIMATOR FOR INSURANCE COMPANIES

TEAM ID:
PNT2022TMID27051

ABSTRACT:

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 scratch from and estimates the cost of damage. This model can also be used by lenders if they are underwriting a car loan, especially for a used car.

TABLE OF THE CONTENT

1. INTRODUCTION

In the simplest terms, AI which stands for artificial intelligence refers to systems or machines that mimic human intelligence to perform tasks and can iteratively improve themselves based on the information they collect. AI manifests in a number of forms.

1.1 PROJECT OVERVIEW

Intelligent damage determination system can be used to determine the appearance damage of vehicles in small cases. In Car Insurance industry, a lot of money is being wasted on Claims leakage. Claims leakage is the gap between the optimal and actual settlement of a claim. Visual inspection and validation are being used to reduce claims leakage. But doing inspection might take a long time and result in delaying of claims processing. An automated system for doing inspection and validation will be of great help in speeding up the process.

1.2 PURPOSE

The rapidly expanding automobile industry highly backs the equally fast-growing auto insurance market. Although until now this industry has been solely based on traditional ways to make repair claims. In case of an unfortunate accident, the claims for the car damage needs to be filed manually. An inspector is required to physically analyze the vehicles to assess the damage and obtain a cost estimate. In such situation, there is also the possibility of inaccurate settlements due to human errors. Automating such a process with the help of machine learning and remote usage would make the process a lot more convenient for both sides of the damage, increasing productivity of the insurance carrier and satisfaction of the customer.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEMSS

Digital Signal Processing is a unique branch of engineering, as it paves the way for unprecedented collaboration between Computer Science and Electronics engineering. Any signal can be labelled as a n-dimensional signal. An image is typically a 2 or 3 dimensional signal. Image processing is one of the most important application of 2-dimensional signal processing. With the development of a number of signal processing algorithms, machine learning techniques and the computational prowess to implement them, a variety of images can now be processed to the finest levels of granularity.

In this paper, Convolutional Neural Network (CNN) based methods for classification of car damage severity are implemented. Many techniques such as directly training a CNN and pre- training a CNN using transfer learning from large CNNs trained on ImageNet on top of the set of pre-trained classifiers were tested. It was observed that transfer learning combined withadditional layers provides the best results, that is building an ensemble classifier on the top of the set of pretrained classifiers. A method was devised to classify the extent of damage. Experimental results validate the effectiveness of our proposed solution, across a number of evaluation parameters. The main focus was on the influence of certain hyperparameters and on seeking theoretically founded ways to adapt them, all with the objective of progressing to satisfactory results as fast as possible.

Deep learning is an efficient method used for classification. Kalpesh Patil, et. al.**[1]** Have used the concept of deep learning in order to classify car damage. The model used is trained on CNN directly. The preprocessing includes the steps of domain-specific pre-training followed by fine-tuning. The paper has conducted a combined and separate study of Transfer Learning and Ensemble Learning. The research has a setback of unavailability of a proper dataset which has resulted in creation of dataset by annotating images. The use of Convolution Auto encoder based pre-training followed by supervised fine-tuning and transfer learning is a novelty factor of this research.

Deep learning methodology can also be used for detecting presence of damage and conducting further analysis. The researchers in **[2]** have

applied this in the field of automotives. In this paper, CNN is used for object recognition. The task of classification has been performed on Damaged Vehicle dataset. Mask RCNN is used for segmenting, decomposing and sub-dividing the various instances of Machine Learning. The scope of research is limited to a particular dataset. Extensive research on new data can be performed for testing the quality of the model. Yet the fact that it is an automated system that can classifythe damaged vehicle and predict how the damage has occurred remains a unique factor of this research.

The concept of faster R-CNN can be helpful for real-time object detection with Region Proposal Networks. This concept is implemented in **[3]** RPN (Region Proposal Network) is trained end-to-end to generate high-quality region proposals, which are used by Fast R-CNN for detection. RPN and Fast RCNN are merged into a single network by sharing their convolutional features using neural networks with attention mechanisms. The RPN component is essentially used for the unified network to focus on a particular object. The research does not include exploitation and preprocessing on the data. This process could have been used to improve results. The research has built a unified, deep learning based object detection system to run at near real-time frame rates.

Computer Vision Technology can be used for assessment of damage to an object. Xianglei Zhu, et. al. in **[4]** have developed an unified intelligent framework based on this concept. This paper uses RetinaNet algorithm to identify damaged parts. The accuracy with this algorithm is improved. Mask R-CNN is adopted for the identification of vehicle parts, the damaged parts are determined by the method of sampling, and the time complexity is greatlyreduced. The accuracy achieved in this research can be improved in order to get better results. A combination of characteristics of vehicle damage data and suitable data can further strengthen this system. The research has successfully reduced time complexity in damage detection and the use of RetinaNet gives good accuracy in damage detection.

The use of Improved Mask RCNN can be used for vehicle damage detection. In **[5]** this approach is followed using Segmentation algorithm. A deep learning approach is used to detect vehicle-damage for compensation problem in traffic accidents. The algorithm has achieved good detection results in different scenarios. Regardless of the strength of the light, the

damaged area of multiple cars, or a scene with an overly high exposure, the fitting effect is better and the robustness is strong. The limitation of this research lies in the mask instance segmentation. In many cases the obvious damage is not considered and segmented leading to inaccurate results. This research contributes to detection of damage of vehicles in a more efficient method through improved Mask algorithm.

Convolutional Neural Network (CNN) is a widely used algorithm for the purpose of classification problems. This method is used by Jeffrey de Deijn in

2.2 REFERENCES

[1] K. Patil, M. Kulkarni, A. Sriraman and S. Karande,"Deep Learning Based Car DamageClassification," 2017 16th IEEE International Conference on Machine Learning and Applications (ICMLA), 2017, pp. 50-54, doi: 10.1109/ICMLA.2017.0-179

[2] Rakshata P, Padma H V, Pooja M, Yashaswini H V, Karthik V,"Car Damage Detectionand Analysis Using Deep Learning Algorithm For Automotive", Vol 5, Issue 6, International Journal of Scientific Research Engineering Trends (IJSRET), Nov-Dec 2019,
ISSN (Online): 2395566X

[3] Ren, Shaoqing He, Kaiming Girshick, Ross Sun, Jian. (2015). Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks. IEEE Transactions on Pattern Analysis and Machine Intelligence. 39. 10.1109/TPAMI.2016.2577031.

[4] X. Zhu, S. Liu, P. Zhang and Y. Duan, "A Unified Framework of Intelligent Vehicle Damage Assessment based on Computer Vision Technology," 2019 IEEE 2nd InternationalConference on Automation, Electronics and Electrical Engineering (AUTEEE), 2019, pp. 124-128, doi: 10.1109/AUTEEE48671.2019.9033150.

[5] Q. Zhang, X. Chang and S. B. Bian, "Vehicle-Damage-Detection Segmentation Algorithm Based on Improved Mask RCNN," in IEEE Access, vol. 8, pp. 6997-7004,2020, doi: 10.1109/ACCESS.2020.2964055

[6] Jeffrey de Deijn,"Automatic Car Damage Recognition using Convolutional NeuralNetworks", 2018 Internship report MSc Business Analytics, 2018

2.3 PROBLEM STATEMENT DEFINITION

Need of an intelligent vehicle damage cost assessment system?

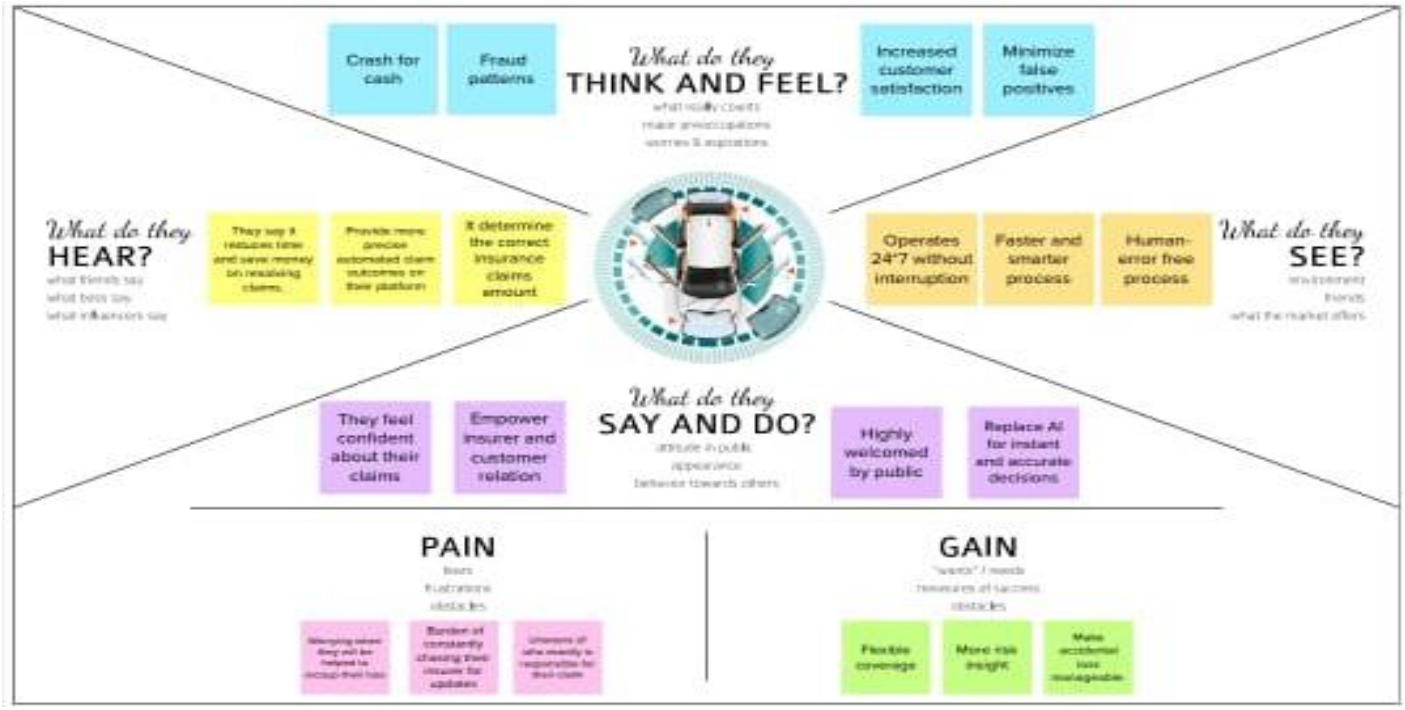
Nowadays, a lot of money is being wasted in the car insurance business due to leakage claims. Claims leakage Underwriting leakage is characterized as the discrepancy between the actual payment of claims made and the sum that should havebeen paid if all of the industry's leading practices were applied. Visual examination and testing have been used to may these results. However, they impose delays in the processing of claims. Here we can overcome these issues without any delay and efficiently.

Who does the problem affect?	Uneducated people or customers, Insurance Companies ,fraud agency and car manufacturers.
What are the boundaries of problem?	Insurance companies, Customers, Police department, Vehicle manufacturers.
What is the issue?	It is difficult to make out the severity level of damage of the car parts and efficientlyestimate the cost for the companies. In case of customers, it becomes for them to claim for insurance correctly.
When this issue occurs?	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.

Where is the issue occurring?	This issue occurs when the company starts investigating the damages done to the car to estimate the cost while the customer claims for an insurance.
Why is it important to fix the problem?	This system can effectively enhance the experience of automobile insurance companies, car owners. It can effectively control the cost expenditure of automobile insurance company, reduce the cost of automobile insurance company investigation, realize the first spot investigation, accurately fix the loss and effectively control the cost of compensation. It can also improve the owners' claim experience and shorten the time for the owners to settle claims.

3. IDEATION & PROPOSED SOLUTION

3.1 ***EMPATHY MAP***



3.2 IDEATION & BRAINSTORMING

3.3 PROPOSED SOLUTION

S.No.	Parameter	Description
1.	Problem Statement (Problem to be solved)	Develop an efficient application that can useful for Users/customers.New methods have to be proposed in order to make it faster and efficient.
2.	Idea / Solution description	* This helps to customers to claim the insurancewhen your car damaged. * When the car is stolen,a theft claim arises is easyand quick. * It helps the customer appear physically to claiminsurance. * It reduces the time of the customer,this modelwill predict the location of the damage as in front,side or rear.
3.	Novelty / Uniqueness	* Fastest insurance claim to customer. * Providing good customer support . * Avoid unauthorized user. * Used to fixed the problem and then working onVGG16 pre trained model to increases the efficiency.
4.	Social Impact / Customer Satisfaction	* Easy to operate and user friendly interface. * The optimization of all the insurance processesrelated to vehical damage. * It avoid fruadstres. * It provides knowledge to peoples about network. * Used to save time for calculating the area andlevel of damaged quickly.
5.	Business Model (Revenue Model)	* As the application usage can be understood byeveryone,it is easy for them to use it properly fortheir safety. * The application is advertised all over the platforms.it can helpful for customer to claim. * Can collaborate with insurance companies. * Can collaborate with car companies.
6.	Scalability of the Solution	Vehical damage insurance is the essential one forall persons.So everyone should pay a correct estimated insurance amount .so drive safely. AI guided application provides 24\7 services to allcustomer queries.

3.4 PROBLEM SOLUTION FIT

Project - Intelligent Vehicle Damage Assessment and Cost Estimator for Insurance Companies

4.REQUIREMENT ANALYSIS

4.1 FUNCTIONAL REQUIREMENTS

FR No.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
FR-1	User Registration	Registration through FormRegistration through Gmail Registration through LinkedIN
FR-2	User Confirmation	Confirmation via Email Confirmation via OTP
FR-3	User Interface	Login System,Dashboard,Uploading Image,Review andAnalyze the results.
FR-4	Collection of datasets	Information about the user and their vehicle.Information about Insurance plans.
FR-5	Results	The model must be structured with high accuracy. Theresults obtained from the model will be displayed for the user to understand easily.

4.2 NON FUNCTIONAL REQUIREMENTS

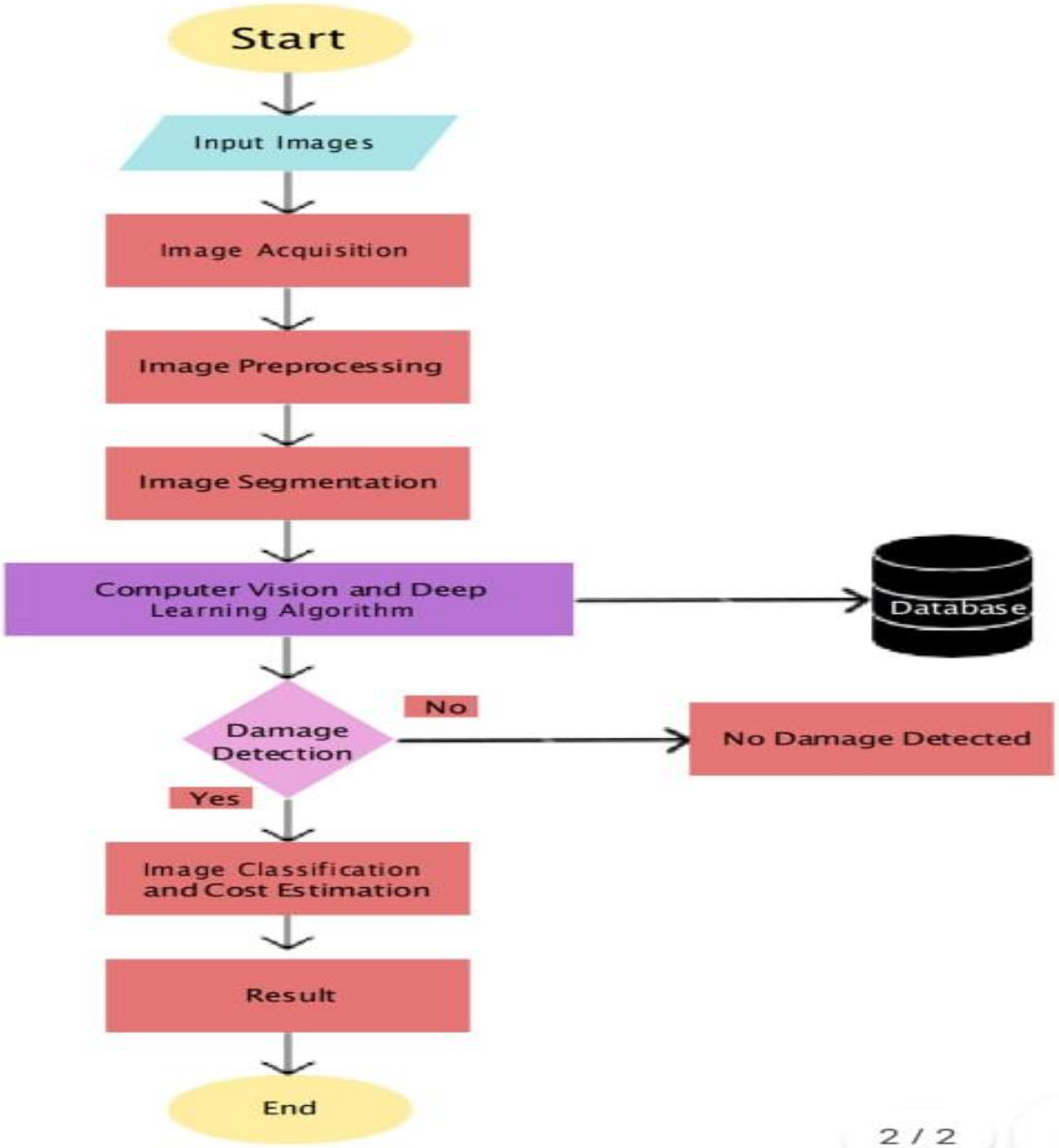
Following are the non-functional requirements of the proposed solution.

FR No.	Non-Functional Requirement	Description
NFR-1	Usability	Intelligent model for damage assessment in vehicleand cost estimate provided by insurance company.
NFR-2	Security	The authenticity of the user and the confidentialityof the user's details relating tohis vehicle must be preserved.
NFR-3	Reliability	This project needs to achieve good accuracy in damage assessment as well as cost estimation so that users receive an accurate and unbiasedamountof insurance.
NFR-4	Performance	Abide images should be captured and uploaded to awebsite where the proposed model will perform a
		damage assessment and quote the appropriate insurance costs.
NFR-5	Availability	The webpage must be compatible with webbrowsers on mobile phones and computers.
NFR-6	Scalability	The proposed solution will be scalable in the future due to more efficient and faster analysis and accurate cost forecasting.

5. PROJECT DESIGN

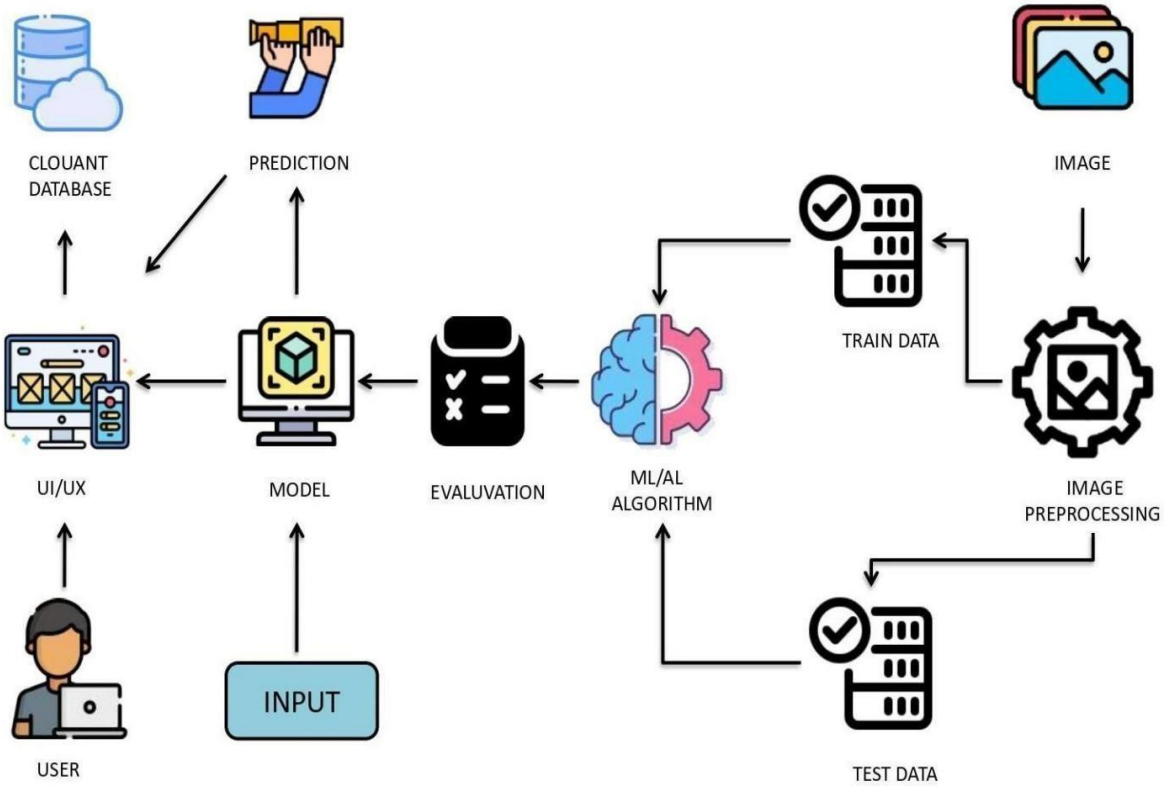
5.1Data Flow Diagrams

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a System. A neat and clear DFD can depict the right amount of the system requirement graphically. It shows How data enters and leaves the system, what changes the information, and where data is stored.

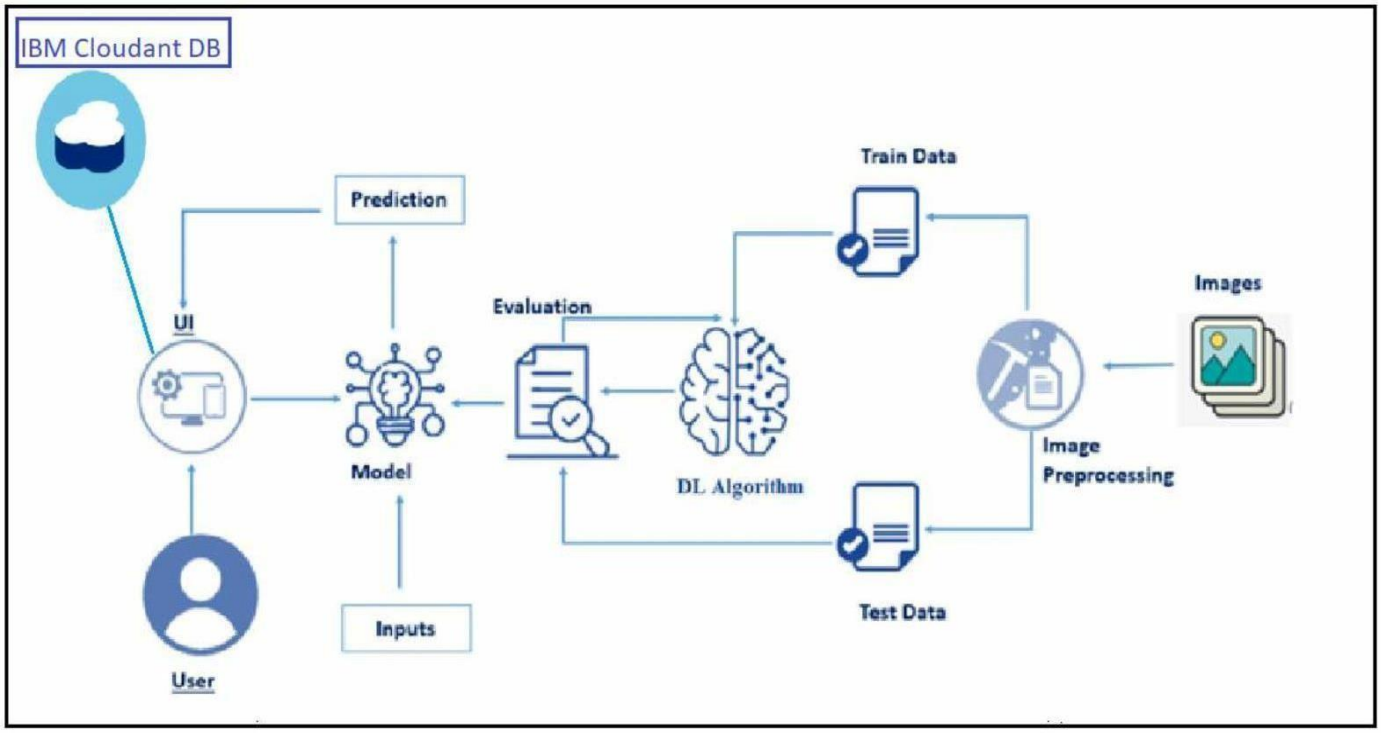


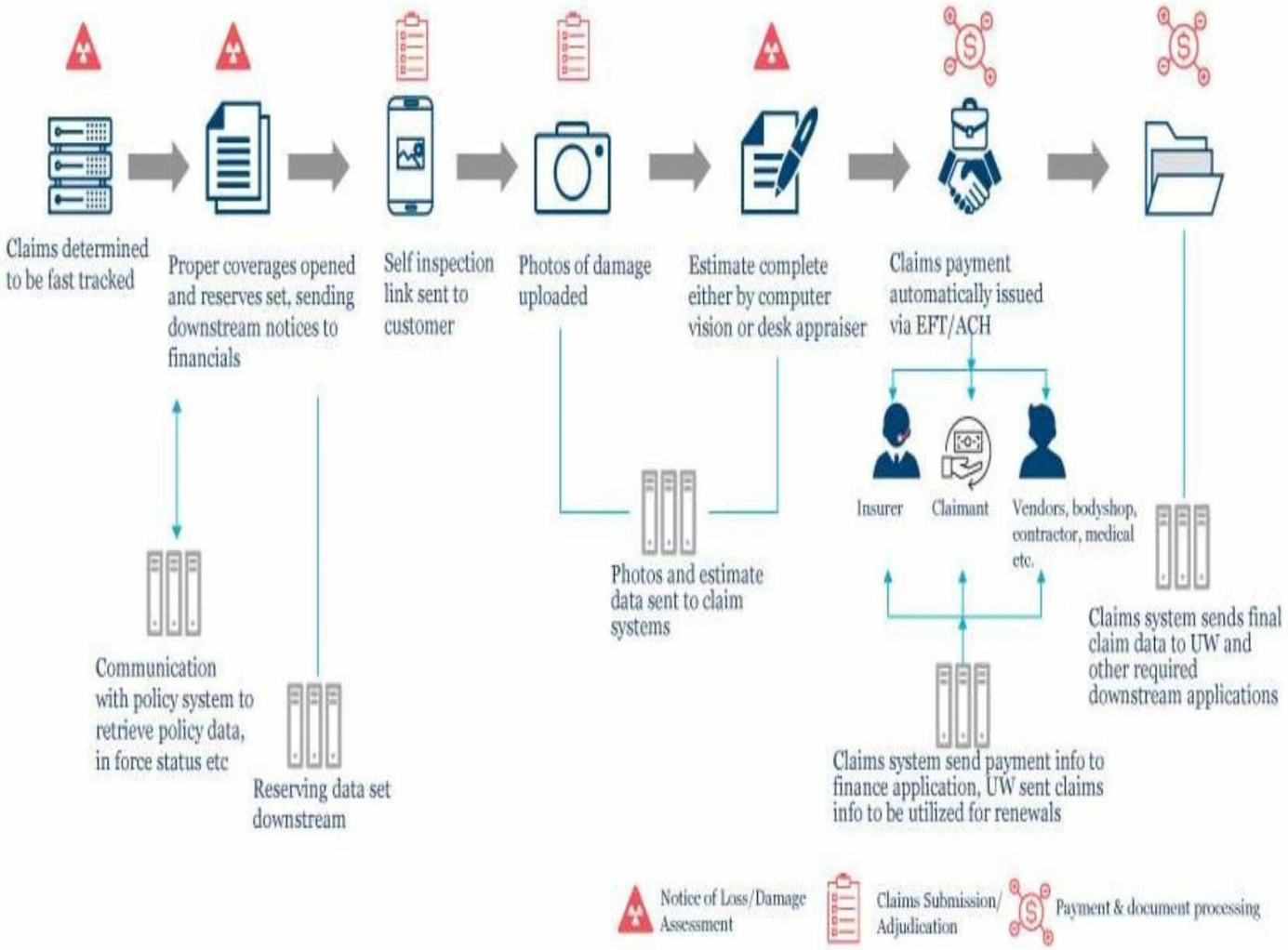
5.2 ***SOLUTION & TECHNICAL ARCHITECTURE*:**

***SOLUTION ARCHITECTURE*:**



TECHNICAL ARCHITECTURE:




Claims determined to be fast tracked
Proper coverages opened and reserves set, sending downstream notices to financials
Self inspection link sent to customer
Photos of damage uploaded
Estimate complete either by computer vision or desk appraiser
Claims payment automatically issued via EFT/ACH
Insurer
Claimant
Vendors, bodyshop, contractor, medical etc.
Claims system sends final claim data to UW and other required downstream applications
Communication with policy system to retrieve policy data, in force status etc
Reserving data set downstream
Photos and estimate data sent to claim systems
Claims system send payment info to finance application, UW sent claims info to be utilized for renewals
Notice of Loss/Damage Assessment
Claims Submission/ Adjudication
Payment & document processing

6 .PROJECT PLANING AND SCHEDULING

6.1 SPRINT PLANING AND 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 should be able to register in the application.	**3**	**Medium**	Ganesh A R, Harish D, Hemanth Raj S N, Ignesh Andrews S
Sprint-1	**Authentication**	**USN-2**	The registered user should be authenticated and verified and logged in.	**2**	**Low**	Ganesh A R, Harish D, Hemanth Raj S N, Ignesh Andrews S
Sprint-2	**Dataset upload and creating dashboards.**	**USN-3**	As a user I must capture images of my vehicle and upload it into the web portal	**2**	**Medium**	Ganesh A R, Harish D, Hemanth Raj S N, Ignesh Andrews S
Sprint-2		**USN-4**	I present the data using analytical tools and present the data using charts and graphs.	**3**	**Medium**	Ganesh A R, Harish D, Hemanth Raj S N, Ignesh Andrews S
Sprint-3	**Model creation and testing**	**USN-5**	As a user I must receive a detailed report of the damages present in the vehicle and the cost estimated	**5**	**High**	Ganesh A R, Harish D, Hemanth Raj S N, Ignesh Andrews S
Sprint-4	Details about estimated cost based on damage	USN-6	As a user, I need to get support from developers in case of queries and failure of service provided	5	High	Ganesh A R, Harish D, HemanthRaj S N, Ignesh Andrews S

6.2 PROJECT TRACKER,VELOCITY & BURNDOWN CHART

Project Tracker, Velocity & Burndown Chart: (4 Marks)

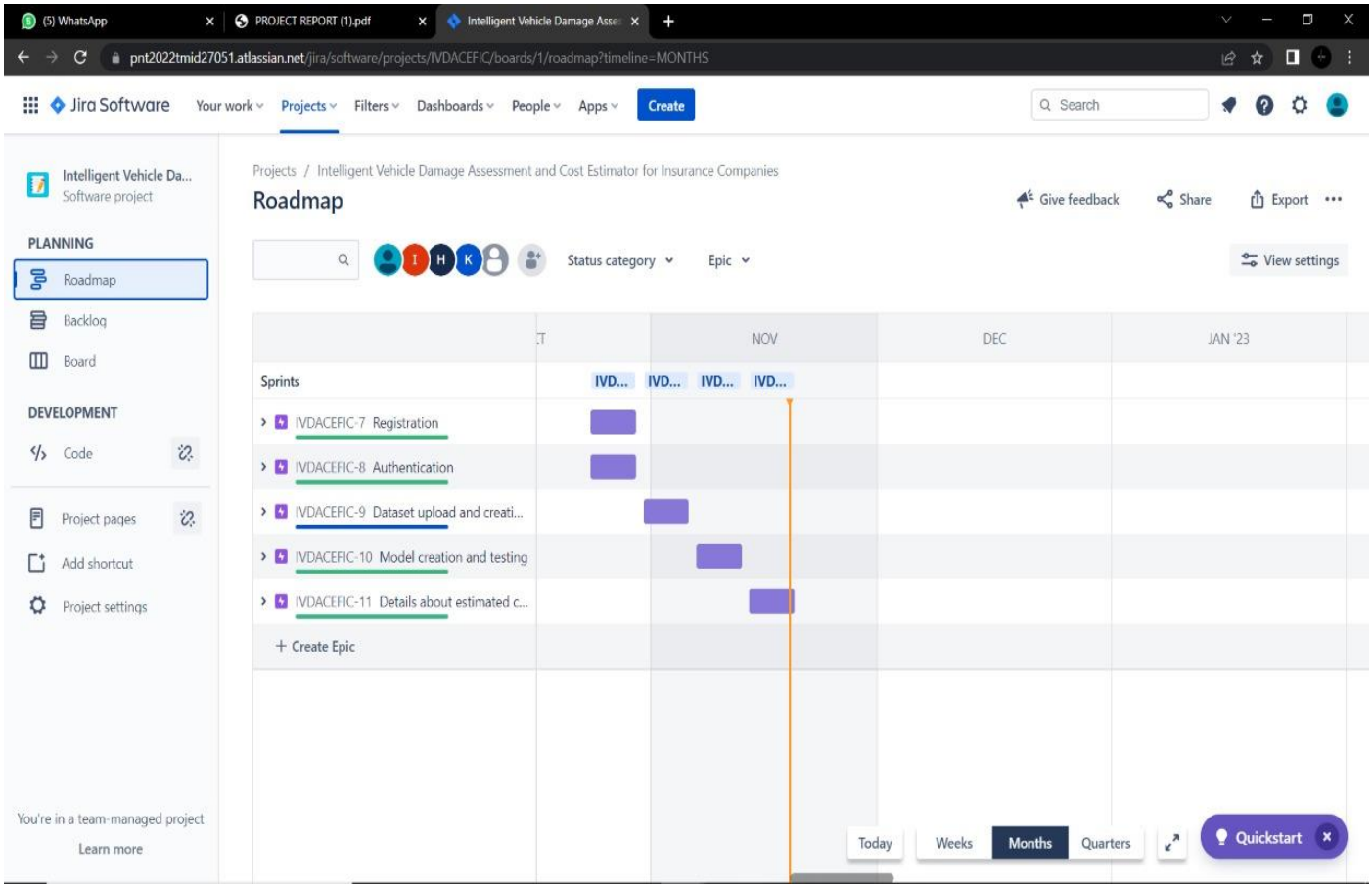
`Sprint	Total Story Points	Duration	Sprint Start Date	Sprint End Date (Planned)	Story Points Completed (as on Planned End Date)	Sprint Release Date (Actual)
Sprint-1	5	6 Days	24 Oct 2022	29 Oct 2022	5	29 Oct 2022
Sprint-2	5	6 Days	31 Oct 2022	05 Nov 2022	5	05 Nov 2022
Sprint-3	5	6 Days	07 Nov 2022	12 Nov 2022	5	12Nov2022
Sprint-4	5	6 Days	14 Nov 2022	19 Nov 2022	5	19Nov2022

Velocity:

We have an 6-day sprint duration, and the velocity of the team is 4 (points per sprint). To calculate the team's average velocity (AV) per iteration unit (story points per day)

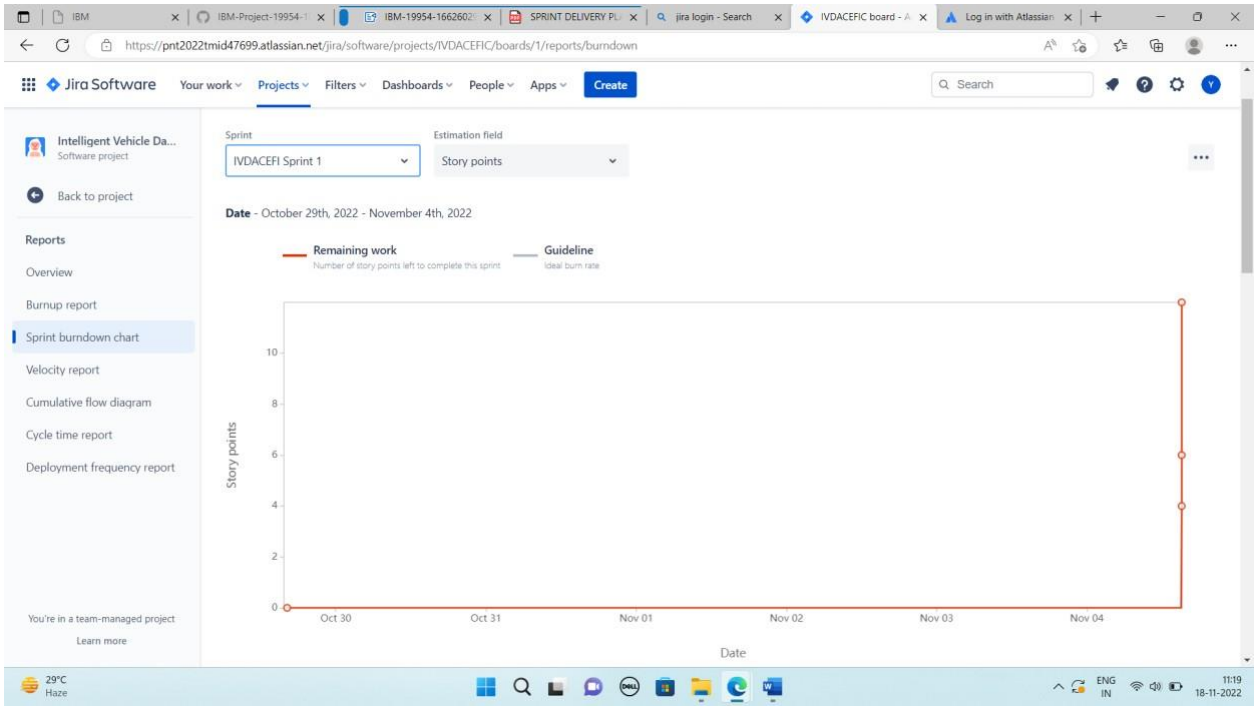
6.3 REPORT FROM JIRA

Jira Roadmap:

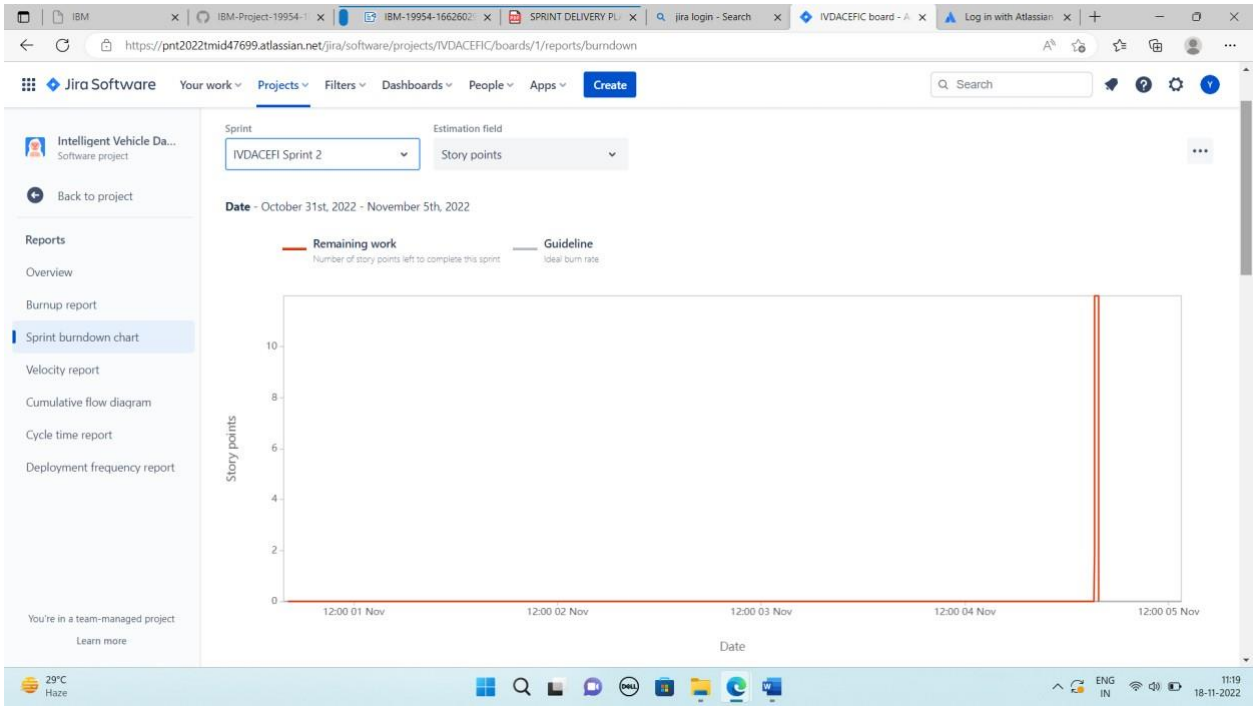


Burndown Chart

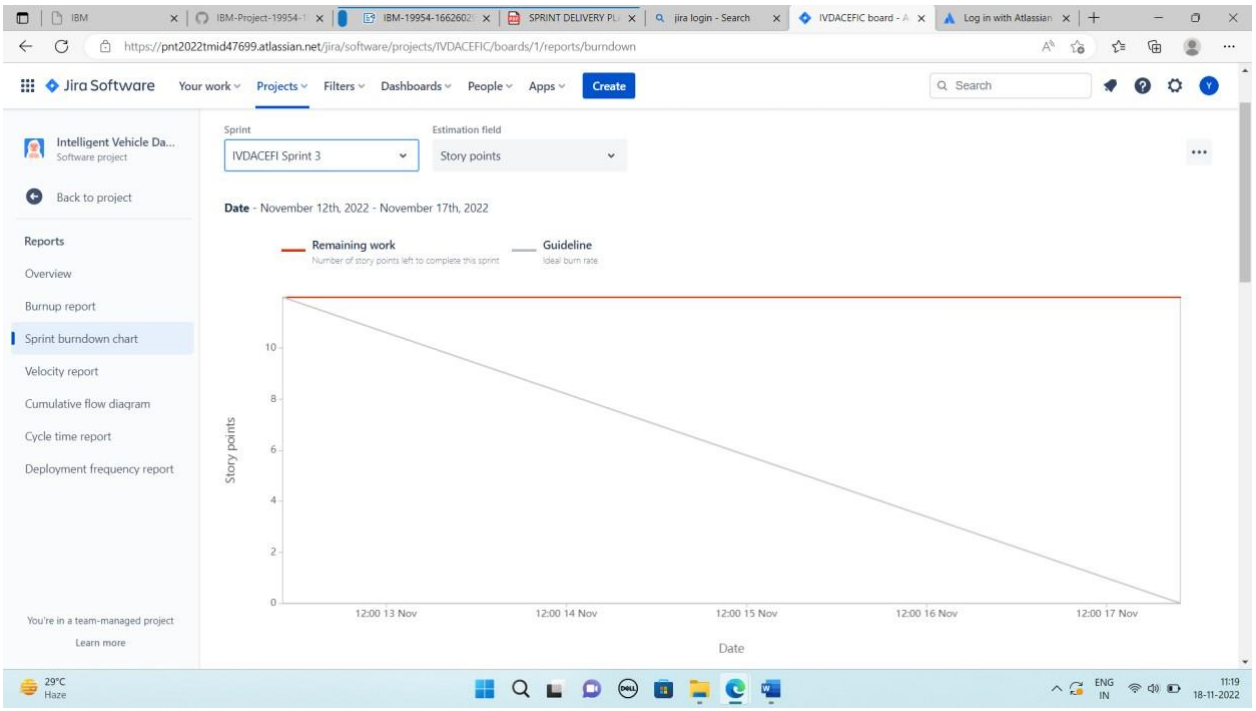
Sprint 1



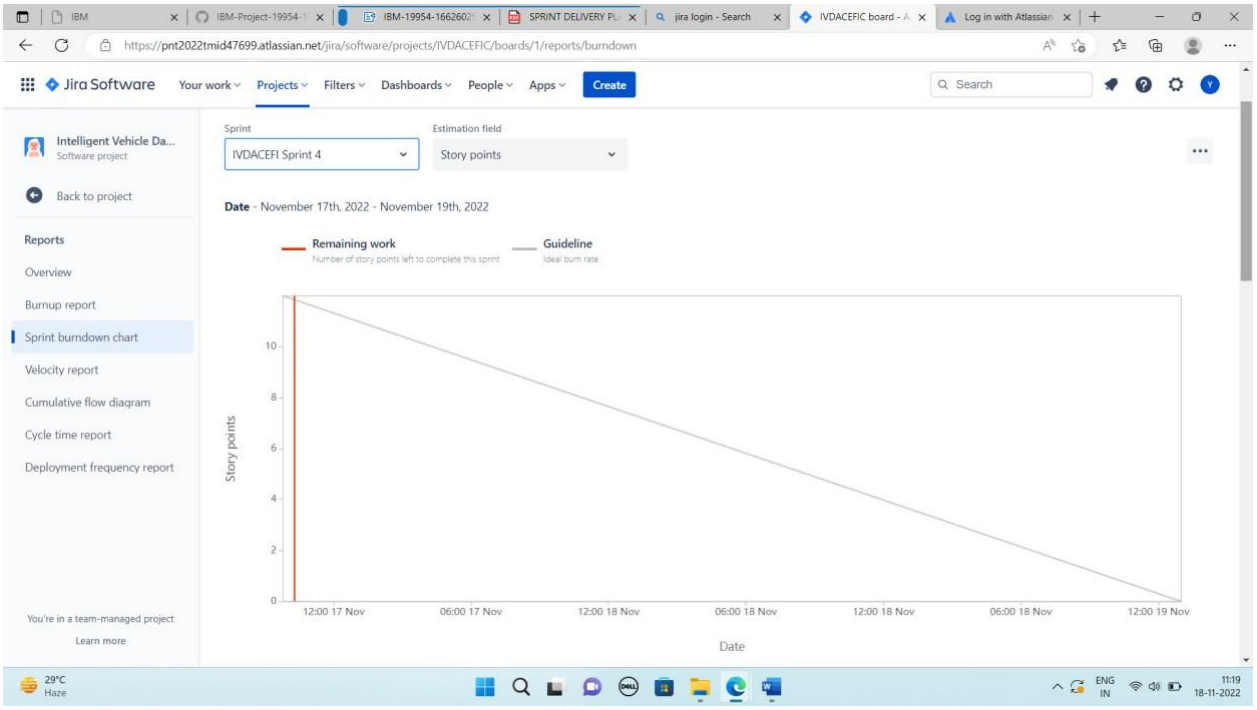
Sprint 2



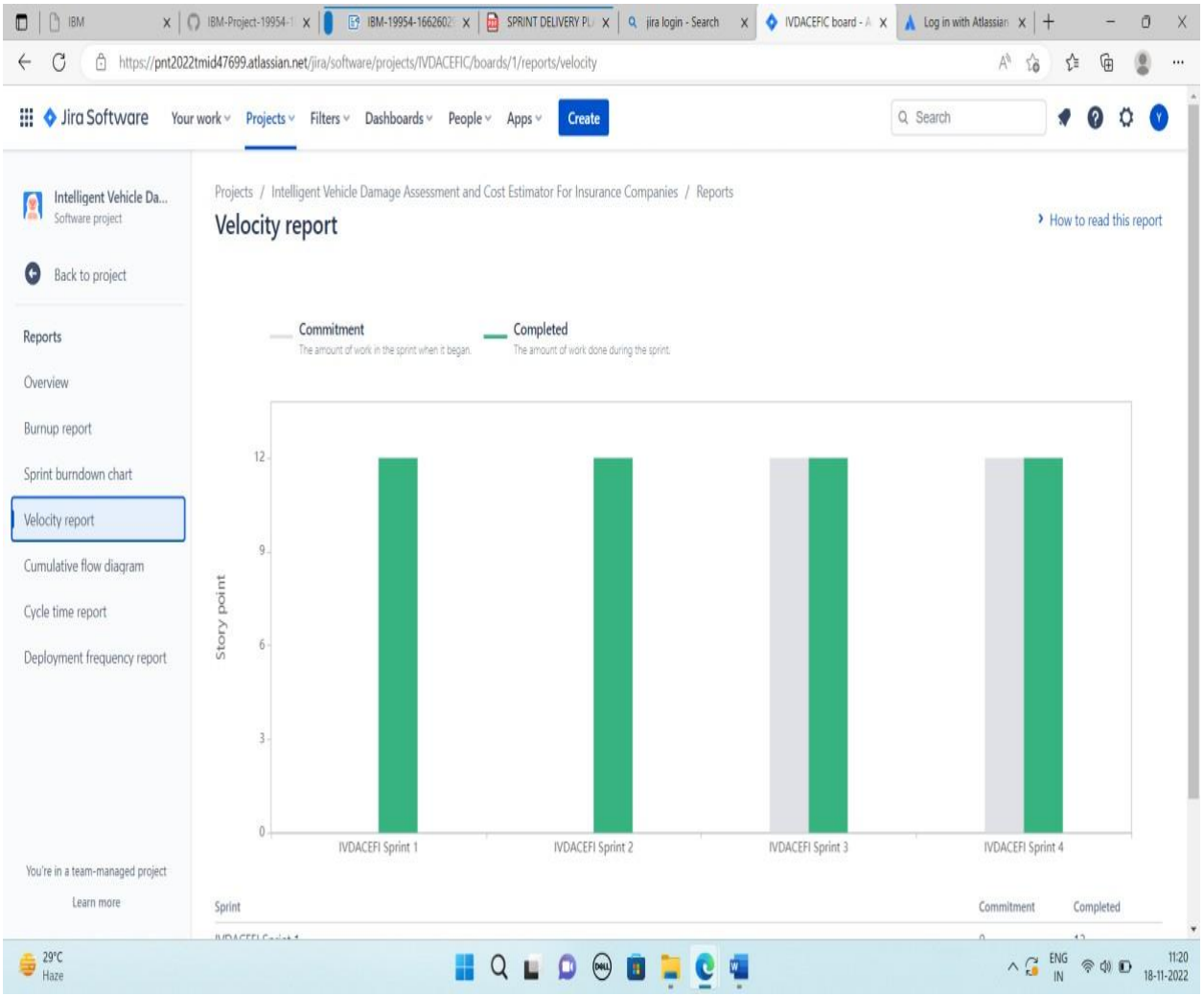
Sprint 3



Sprint 4



Velocity Report



7 .CODING AND SOLUTION FEATURES:

7.2 Features 1 : Upload the Image
7.3 Features 2: Predict the Image
7.4 Features 3: Display the Prediction

8 .TESTING

Test scenarios:

1. Verify python code is run without error
2. Verify the login the cloud Service
3.Verify the images are stored in the database
4.Verify to create a service credentials
5.To create web UI to interact with user
6.Get an predicted image in display

8.1 TEST CASES

					Maximum Marks	4 marks						
5	Test case ID	Feature Type	Component	Test Scenario	Pre-Requisite	Steps To Execute	Test Data	Expected Result	Actual Result	Status	TC for Automation(Y/N)	BUG ID	Execute
6	LoginPage_TC_001	Functional	Login page	Verify user is able to log into website with Valid credentials	Login first	1.Go to login page 2.Enter email ID and password 3.click to register	yogeshwaribcom@gmail.com	successfully log in to the website	Working as expected	Pass	YES	NIL	Yogeshv
7	homepage_TC_002	Functional	home page	verify the product available in the website and able to know the quantity & update the product	Home page	1.Login to home page 2.click an add product 3.enter name,price,quantity	update quantity of the product	Successfully updated the product	Working as expected	pass	YES	NIL	Akash Ar
8	pythoncode_TC_003	code	python3.11	verify python code run without error	software	1.download the python version 3.11 2.type the program and save it 3.verify its run continuously	type python code to create backend	successfully crested to the website	working as expected	pass	YES	NIL	Kamal
9	webUI_TC_004	Functional	Python flask	To create a web UI to interact with user	python IDE	1.Go to dashboard 2.open a web link 3.display the result	yogeshwaribcom@gmail.com	website should show the accurate quantity of the product	Working as expected	pass	YES	NIL	Sowmi
10	IBMcloud_TC_005	Functional	IBM Cloud service	verify login to the cloud service	IBM cloud service	1.log in to IBM.cloud.com 2.create your own account	yogeshwaribcom@gmail.com	successfully created an account	Working as expected	Pass	YES	NIL	Yogeshwa Sowmi
11	IBM DB2_TC_006	Functional	Dataset	Verify the database is created in the IBM cloud and get the service crendentials	IBM cloud service	1.Go to the catalog 2.to create the database , go to the cloudant 3.launch dashboard	create a database with click create button and store the quantity of the product	successfully created a database in DB2	Working as expected	Pass	YES	NIL	Akash Aravinth S & Kamalesh S
12													
13													
14													
15													
16													
17													
18													
19													
20													
21													
22													
23													
24													
25													
26													
27													

Shopenzer Testcases | Testsceamios

8.2 USER ACCEPTANCE TESTING

1.Purpose of Document

The purpose of this document is to briefly explain the test coverage and open issues of [product name]project time of the release to User Acceptance Testing(UAT).

2.Defect Analysis

This report shows the number of resolved or closed bugs at each severity level,and how they are resolved.

Resolution	Severity1	Severity2	Severity3	Severity4	Sub Total
By design	5	3	2	0	10
Duplicate	0	0	0	1	1
External	2	0	0	1	3
Fixed	6	2	0	0	8
Not Reproduced	0	1	1	0	2
Skipped	0	0	0	0	0
Won't Fix	0	0	0	0	0
Totals	13	6	3	2	24

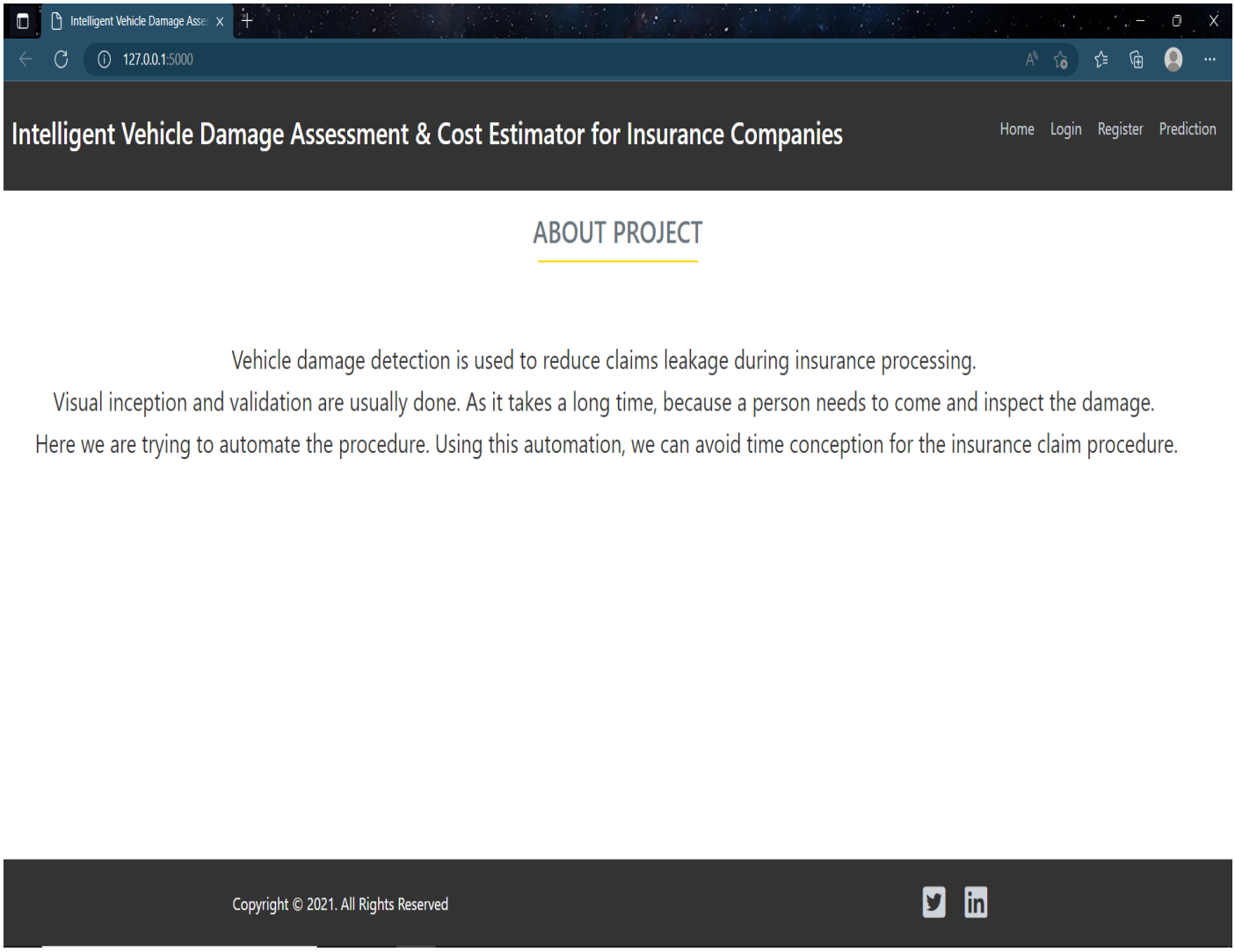
3.Test case Analysis

This report shows the number of test cases that have passed ,failed,and untested.

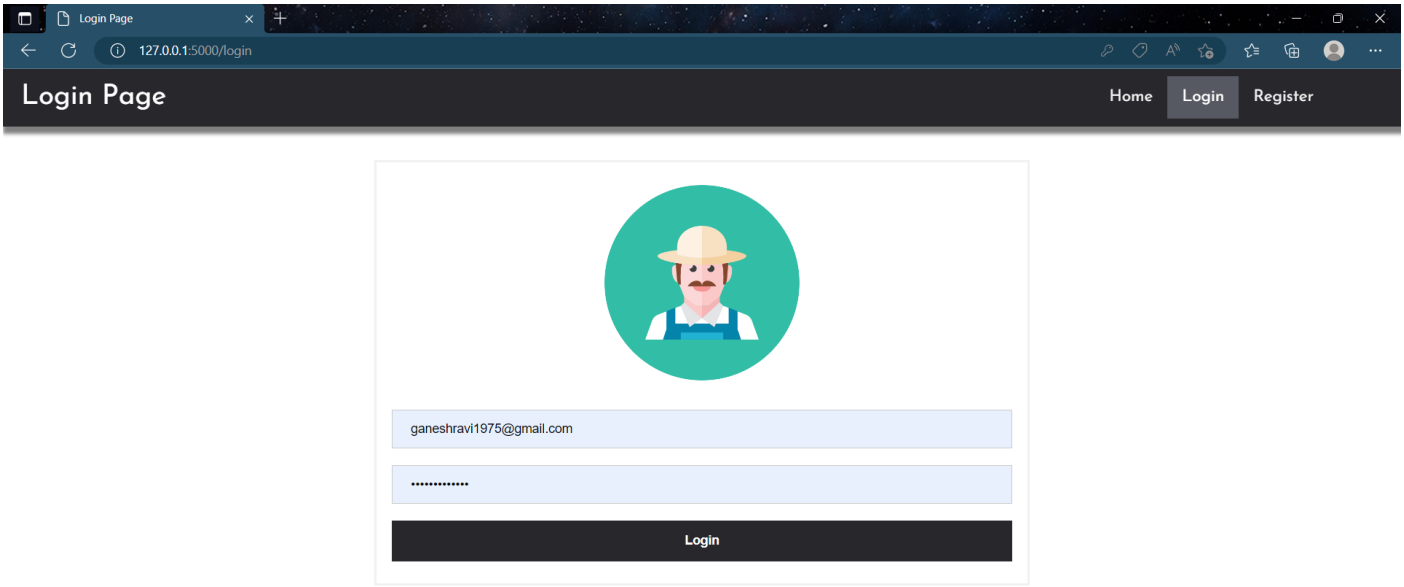
Section	Total cases	Not tested	Fail	Pass
Interface	1	0	0	1
Login	2	0	0	2
Logout	1	0	0	1
Limit	2	0	0	2

9.RESULT

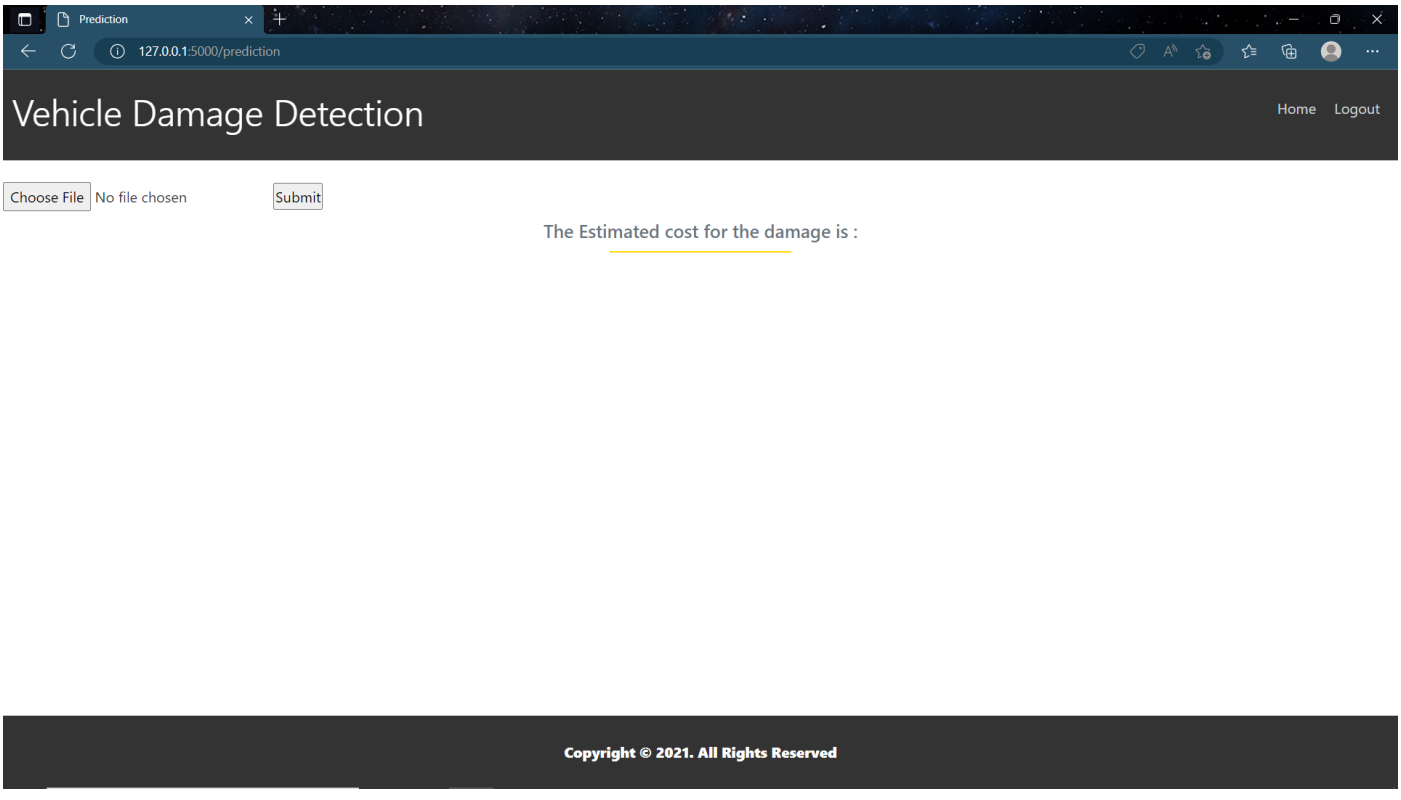
Home Page:



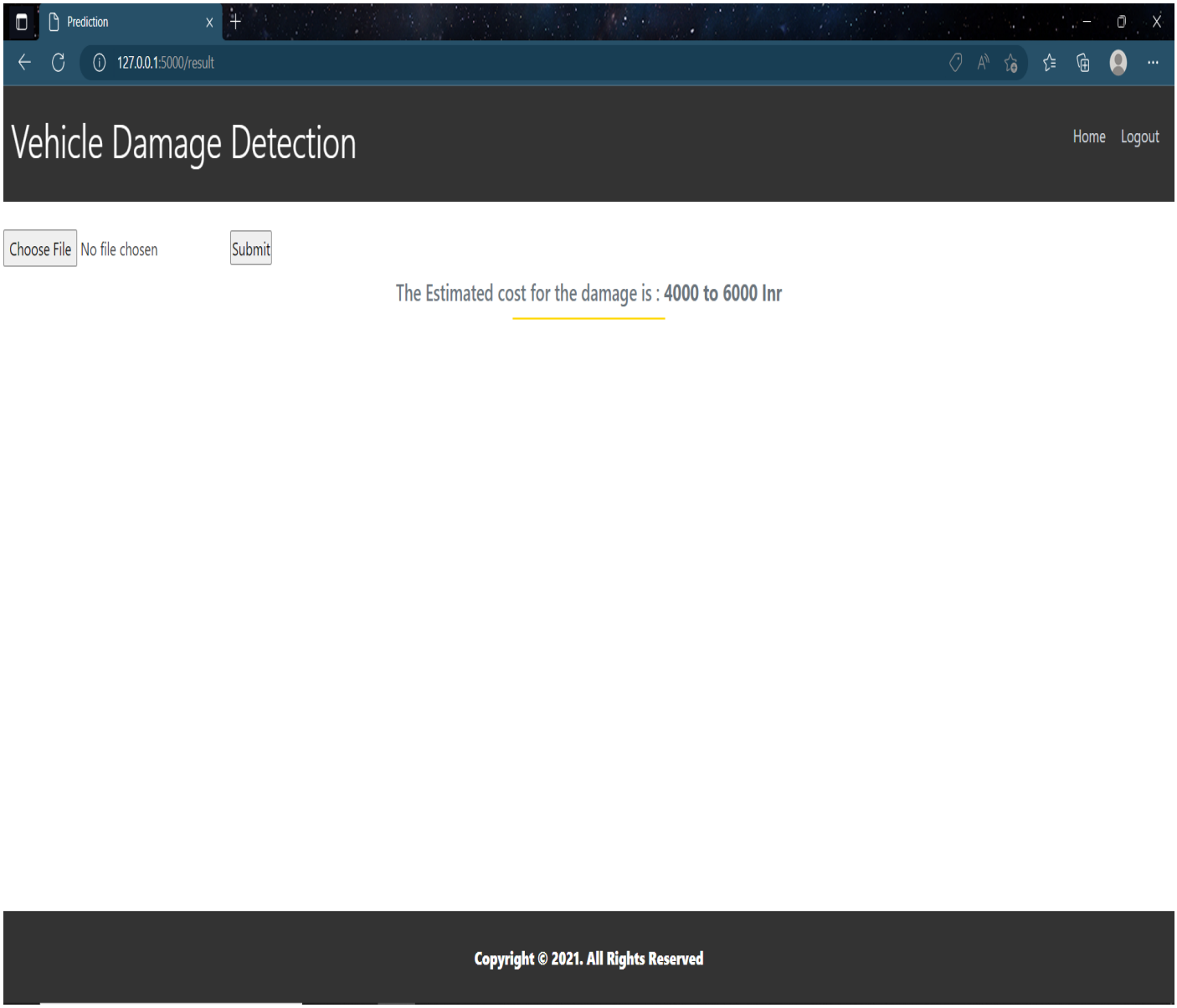
Login Page:



Upload page:



Prediction Page:



10. CONCLUSION

This Project has generally discussed the design and implementation of damage assessment for car insurance by developing deep learning car damage classification model on website development platform where user will upload image or images of damaged car with help of phone's camera. then according to damage calculation, the total cost of car will be displayed in a report format. This system is tested over a wide range of images yielding high accuracy rate.

10.1 ADVANTAGES & DISADVANTAGES

ADVANTAGE

- Estimating damages with over 90% accuracy of model for vehicle damage detection.
- The process is speed up the claim to the customer for their needs.
- AI has ability to analyze big data sets - pulling together customer insights and leading to predictive analysis.

DISADVANTAGE

- This may result in avoidable prediction inaccuracies as a result of human error.
- Prediction of damages difficult due to strong similarities between many images.
- AI may bring considerable threats of privacy problem, ethical concerns and prediction error.

11.LINKS

11.1 Github:

https://github.com/IBM-EPBL/IBM-Project-1281-1658382878

11.2 Demo:

https://drive.google.com/file/d/1QEySjXi1Y4fDDpM5MgNjwZ4B91rgANFL/view?usp=drivesdk