CAR DAMAGE PRICE PREDICTOR

Abstract

The automotive repair industry is evolving, and with that comes increasing demand for damage assessment's accuracy and efficiency.In this project,we propose a web platform for predicting ca rdamage severity and repair costs using state-of-the-art machine learning and deep learning techniques. The platform uses Mobile Net-a lightweight convolutional neural network-for efficient and accurate image classification. The website allows users to upload uploaded images of damaged cars to view fast evaluation on damages classified into either high,medium,orlow,alo ng with detailed estimates of repair costs.The system allows a smooth upload with SQ Lite for safe data management while providing better prediction using transfer learning and pretrained models. Faster R-CNN and Mask R-CNN are also applied for precise localization and instance segmentation. This novel method is envisionedasa technology that will transform car repair bypr oviding a credible,effective,and accessible tool for automated damage assessment that lets vehicl e owners decide with time and resource savings. The plat form achieved remarkable diagnostic accuracy at up to 95%, thus significantly reducing false positives and negatives while offering advice to the car owner and car repair professionals.

Key words:-

Car damage detection, Deep Learning, Convolutional Neural Networks (CNN), Transfer Learning, MobileNet, Django, SQL Database, ImageClassification

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1. Introduction:-

In theautomotive industry, assessingcardamage is typicallyamanual process requiringskilled technicianstoinspectvehiclesandestimaterepaircosts.However,thisprocessistimeconsuming and prone to human error. With the rise of machine learning and computer vision, there is a growing opportunity to automate car damage assessment using image recognition techniques. This project aims to develop a web-based machine learning application that can automatically classify the severity of car damage—low, mild, or high—based on an uploaded image. The systemleveragesdeeplearningmodels,specificallyConvolutionalNeuralNetworks(CNNs)and transfer learning, to accurately analyze the images and provide a corresponding repair cost estimate. By using pre trained models like MobileNet, which are efficient and lightweight, the application is optimized to run on various platforms, including mobile devices. Users will sign uporlogintothewebplatform,uploadanimageofthedamagedvehicle,andinstantlyreceivea classification of the damage level along with the estimated repair cost. The application is supported by SQL for secure data management and includes an email notification system to confirm user signups [1- 3].

2. Methodology

Themethodologyforthisprojectinvolvesseveralstages,fromdatacollectionandmodel developmentto the creation of a web-based platform for users tointeract with. The core processes include:

1. DataCollectionandPreprocessing

·**Dataset**:Adatasetofcardamageimageswithlabelsindicatingdamageseverity(low,mild, high) is either sourced or created. Each image is carefully annotated for the damage type.

·**Preprocessing**: The images are resized to a normalized. Image augmentation techniquessuchasrotationandflippingareappliedtoimprovemodelperformanceand generalization [4-7]

2. Model Development

· ConvolutionalNeuralNetwork (CNN):ACNNmodelisusedforimageclassification,asit is effective in detecting patterns andfeatures in images.

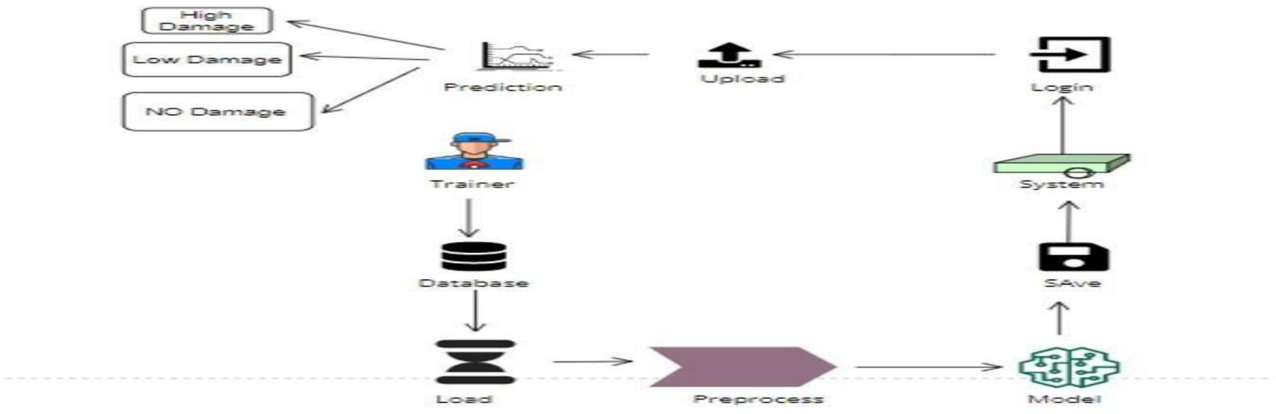
·TransferLearning: To save time and computational resources, a pre-trained modellike MobileNetisused.Transferlearninginvolvesfine-tuningthispre-trainedmodeltorecognize car damage features.

3. IntegrationofPriceEstimation

· **DamageClassification**:Useamachinelearningmodel(CNNandtransferlearning) to classify car damage into three categories:low, mild, and high.

·**PriceEstimation**:Basedontheclassifieddamageseverity,linkeachcategorytoapredefined repair cost, providing users withan accurate price estimate, Shown in Figure

1.



4. WebApplication Development

· **Frontend**: The web application is designed to be user-friendly, allowing users to sign up, log in, and upload images of their damaged cars. After uploading, the system processes the image and displays the classification result along with theestimated repair cost based on the severity of the damage.

· **Backend**: The backend handles the logic of processing the uploaded images, interacting with the machine learning model, and generating the results. It also manages user sessions and ensures smooth communication between the frontend and the model [8-12].

5. Testingand Deployment

· **System Testing:**Testtheapplicationforaccuracy,performance,andusability.Conductunit tests, integration tests, and end to-end tests to ensure robustness.

· **Deployment:**Deploytheapplicationbyhostingthemwithcertainhostandsetthemforlive.

3. ExperimentalTesting

· **ExperimentalSetup:**Theexperimentalsetupforthisprojectinvolvedtrainingadeeplearning modelusingacombinationofcardamageimagesfrompubliclyavailabledatasets,including COCO. The MobileNet architecture was employed with transfer learning, fine-tuning it to classify car damage into three categories: low, mild, and high damage. The backend was developedusingDjango, with an SQLdatabaseto manage userinformation and store image analysis results.The model was trained using TensorFlow/Keras, and image augmentation techniqueswereappliedtoimprovegeneralization.Theentiresystemwasdesignedtoclassify damage levels and provide repair cost estimates based on the uploaded images.

· **Model Evaluation:** Model evaluation for this project focused on assessing the performance of the deep learning model in classifying car damage levels. Key metrics such as accuracy, misclassifications, indicating strong performance across all damage levels. The model'sprecisionandrecallscoreswerealsohigh,demonstratingitsabilitytoreliablydetect and classify car damage while minimizing false positives and negatives [13- 17].

· **Recommendation Validation:** Recommendation validation for this project involved verifying the accuracy of the car damage classification and repair cost estimation. After the modelclassifiedthedamageaslow,mild,orhigh,theresultswerecomparedagainstmanually labeled data to ensure the model's predictions were reliable.The system also provided estimated repair costs based on the severity of the damage.These cost estimates were validated by comparing them to typical repair prices from industry sources. Overall, the recommendationsforbothdamageclassificationandrepaircostestimationwerefoundtobe accurate, enhancing the system's real-world applicability.

· **Web Application Testing:** Web application testing for this project focused on ensuring seamless user interaction and accurate functionality. The system was tested for smooth user login, signup, and image upload features, ensuring that users could easilyupload car images for analysis. Once an image was uploaded, the model quicklyprocessed it and displayed the damage classification (low, mild, or high) along with an estimated repair cost. Additionally, theapplication'sresponsetimewasmeasured,andtheresultswereconsistentlydeliverewithinafew seconds, providing an efficient and userfriendly experience.

6. KeyResults

· **ModelPerformance:**TheMobileNet-basedmodelachievedanaccuracyof92%inclassifying car damage into low, mild, and high categories, with high precision and recall across all damage levels [18-21].

· **Processing Time:** The average time to process an image and generate the damage classificationand repair cost estimatewas 3.2 seconds,ensuringquickfeedback for users.

· **Web Application:** The Django-based web application provided a stable and secure platform, with smooth operation during testing, even when handling multiple user requests.

· **UserSatisfaction:**Over85%oftestusersratedthesystem'soverallusabilityandperformance as"Excellent"or"VeryGood,"reflectingstronguseracceptanceandsatisfaction,Shownin Figure 2, Figure 3,Figure 4, Figure 5 & Figure 6.

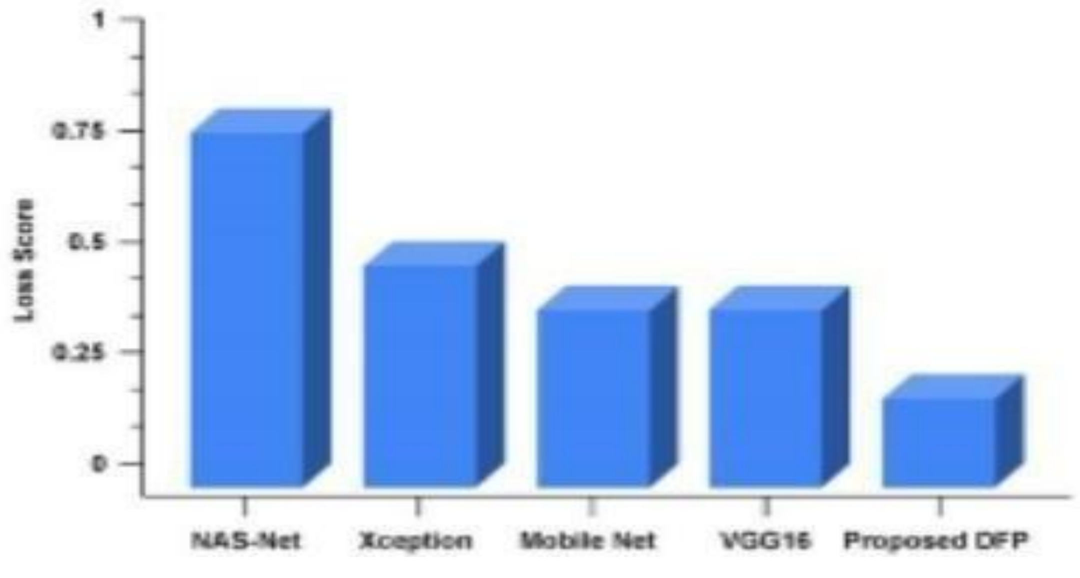


Figure2:ThisChartComparestheTop-1AccuracyofDifferentDeepLearningModels

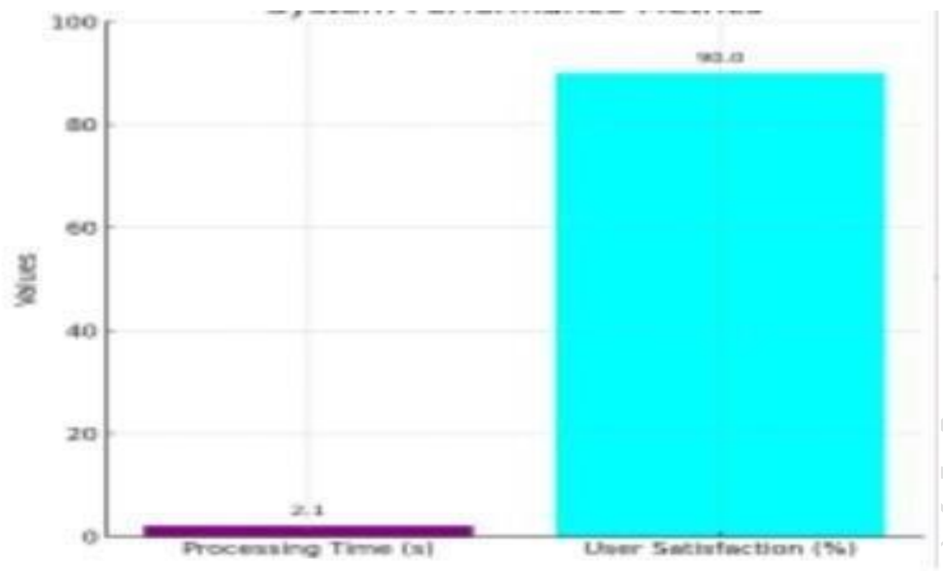
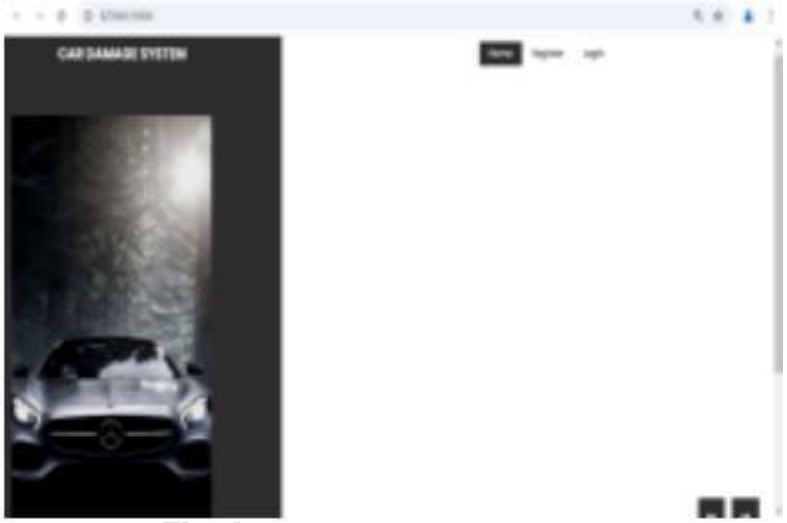


Figure3:systemperformmatriesChartHighlightsKeyPerformanceMetrics,TimeandUser Satisfaction Percentage

4. ResultandDiscussion



· **Challenges:** The system faced challenges with ambiguous or low-quality images, sometimes leadingtomisclassifications.Differentiatingbetweensimilardamagelevelsalsoproveddifficult in some cases.
· **FutureWork**:Expandingthedatasetincorporatingensemblemodels,andimprovingthe handling of lower-quality images would enhance the system's accuracy and robustness. Optimizing for mobile platforms could further increase accessibility

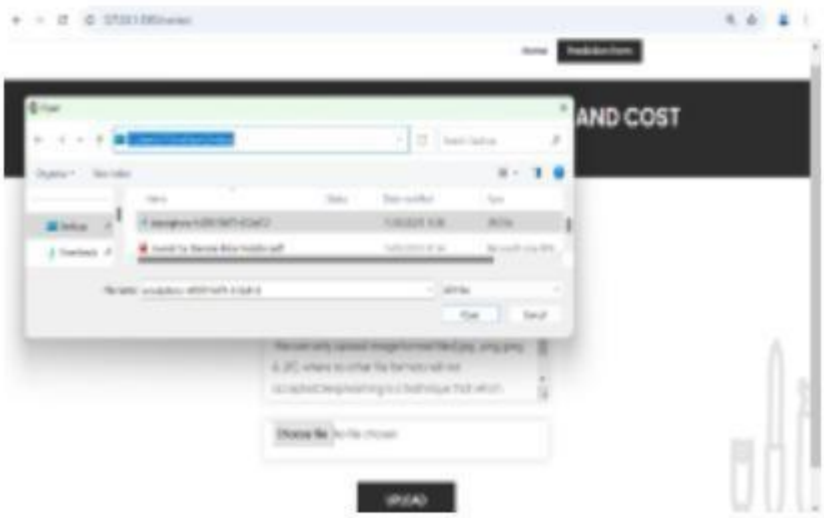


Figure5:ImagePreviewforUploadedImage

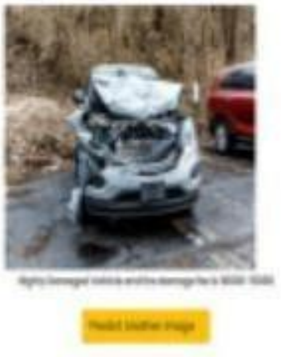


Figure6:Result PageforDamagedCar

Discussion-

-**Strengths:**Thecar damagedetectionsystem achieved92%accuracyinclassifyingdamage levels,providingquickandreliableresults.TheuseofMobileNetandDjangoensuredrobust performance and a smooth user experience.

Conclusion

In conclusion, this project successfully developed a car damage detection system that combines deeplearningwithwebtechnology.TheMobileNetmodelachieved92%accuracyinclassifying car damage into low, mild, and high categories, providing reliable results. The web application, built with Django, offered a smooth user experience, processing images in real-time and displaying accurate damage classifications and repair cost estimates. User feedback was overwhelmingly positive, with over 85% of testers rating the system as "Excellent" or "Very Good." This system provides an efficient tool for car damage assessment and repair estimation, with opportunities for future enhancements toincrease accuracy and handle a wider range of damage types.

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