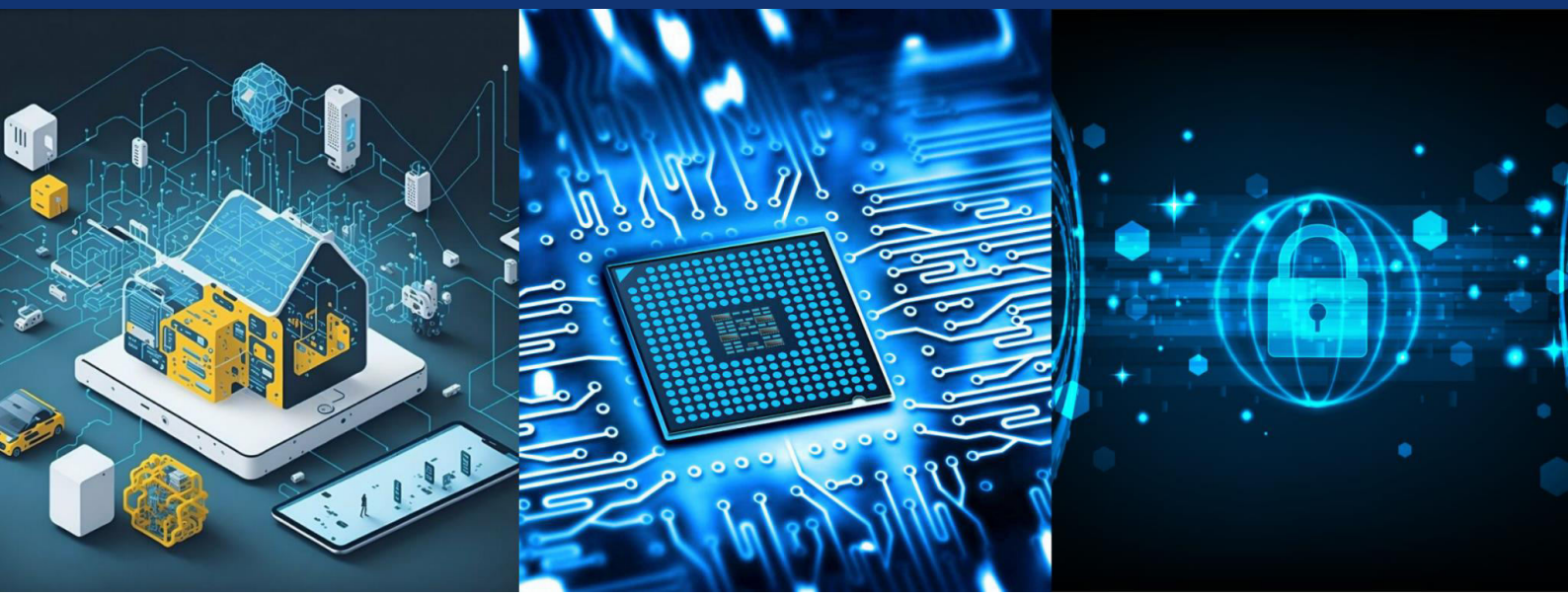
IJIRCCE

ISSN(O): 2320-9801

ISSN(P): 2320-9798



International Journal of Innovative Research in Computer and Communication Engineering

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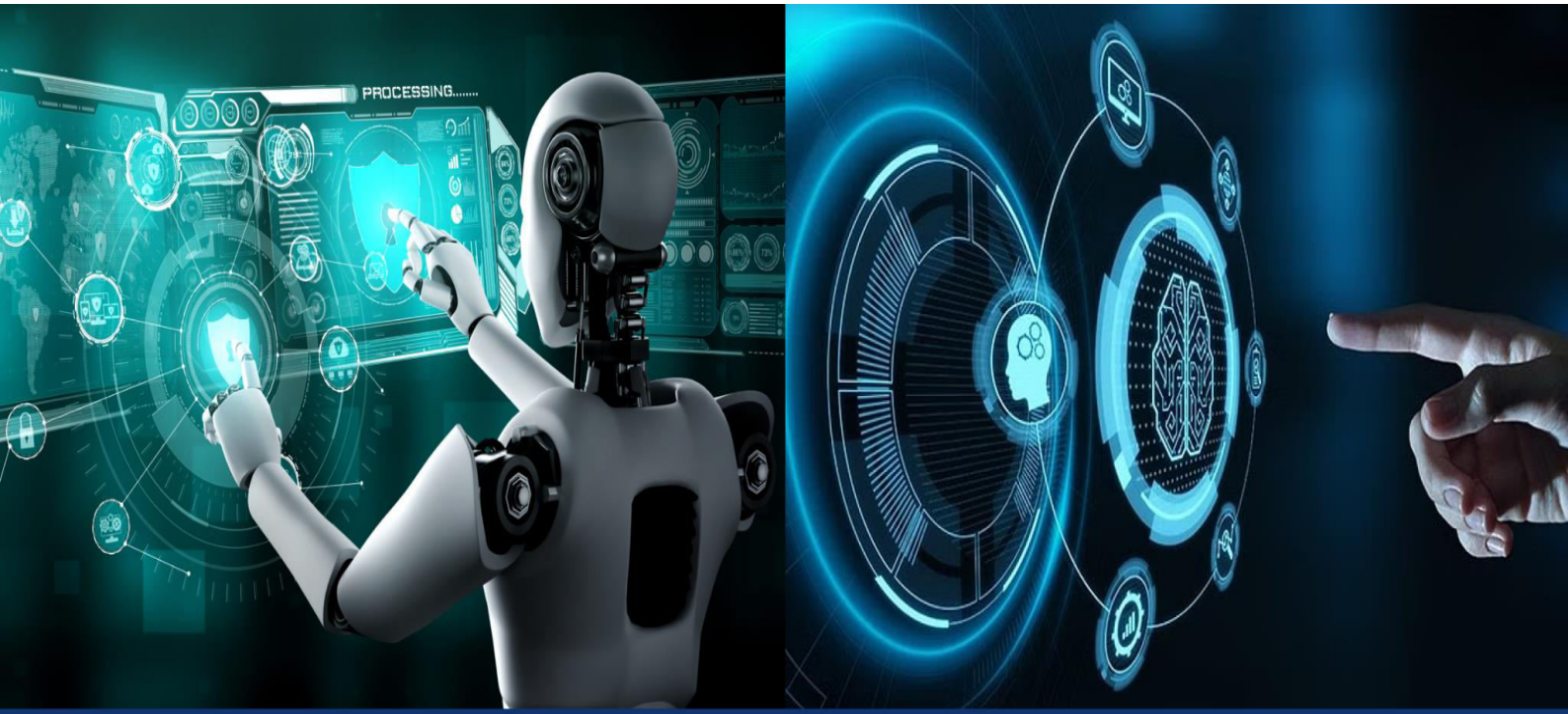

Impact Factor: 8.771

Volume 13, Issue 4, April 2025

© 2025 IJIRCCE | Volume 13, Issue 4, April 2025| DOI: 10.15680/IJIRCCE.2025.1304174

www.ijircce.com | e-ISSN: 2320-9801, p-ISSN: 2320-9798| Impact Factor: 8.771| ESTD Year: 2013|

International Journal of Innovative Research in Computer and Communication Engineering (IJIRCCE)

(A Monthly, Peer Reviewed, Refereed, Scholarly Indexed, Open Access Journal)

Exterior Car Damage Detection System Using Deep Learning

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ABSTRACT: Accurate and timely vehicle damage assessment is pivotal for determining form costs and insurance claims. This exploration presents an automated auto damage discovery system using deep literacy ways. The model employs VGG 16 for vehicle identification, damage position, and inflexibility assessment. Mask R- CNN and Detectron2 fabrics are integrated to identify damaged corridor and classify damage types directly. The system generates a detailed damage report to support diagnostics and claim processing. The frontend is erected with HTML, CSS, and JavaScript, while Flask handles backend operations, and MongoDB stores data. This automated result enhances effectiveness in insurance claims and form assessments by minimizing homemade trouble and perfecting delicacy.

KEYWORDS: Auto Damage Discovery, Deep Learning, VGG , Mask R- CNN, Detectron2, Image Processing, Automated Assessment, Insurance Claims, Flask, MongoDB, Car Damage Analysis.

I. INTRODUCTION

With the increasing number of vehicles on the road, accidents have become more frequent, posing financial and logistical challenges for car owners, insurance companies, and repair services. Accurate and timely assessment of vehicle damage is crucial for determining compensation, estimating repair costs, and facilitating efficient insurance claim settlements. However, manual damage inspection is often time-consuming, subjective, and prone to errors. Traditional methods rely heavily on human expertise, which may result in inconsistencies and delays in claims processing. To overcome these limitations, automated car damage detection systems using deep learning techniques have emerged as a promising solution.

This exploration presents an automated surface auto damage discovery system that leverages advanced machine learning models to enhance delicacy and effectiveness. The system is designed to identify the vehicle, descry damaged areas, classify the type of damage, and assess its inflexibility. The proposed model employs VGG- 16 for vehicle identification, damage identification, and localization of affected regions. VGG- 16 is a robust convolutional neural network (CNN) known for its strong point birth capabilities, making it well suited for detecting complex damage patterns. also, Mask R- CNN and Detectron2 fabrics are integrated to identify damaged corridor and classify damage types, enabling precise segmentation and bettered assessment delicacy.

By combining these deep learning techniques, the system effectively identifies key damage indicators while minimizing human intervention. Once the damage is detected, the system generates a detailed damage report outlining affected areas, severity levels, and potential repair recommendations. This report provides valuable insights for insurance providers and repair services, supporting faster and more informed decision making.

The system is designed as a web-based platform, ensuring accessibility and ease of use. The frontend interface, developed using HTML, CSS, and JavaScript, offers a responsive and user-friendly experience. The intuitive interface allows users to upload vehicle images and receive comprehensive damage analysis results efficiently. Flask, a lightweight Python-based framework, is utilized as the backend to handle user requests, process uploaded images, and manage system logic. MongoDB serves as the database for secure and efficient storage of user data and damage-related information.

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By automating the damage assessment process, this system enhances effectiveness in claim processing and form diagnostics. It eliminates the need for homemade examination, reducing processing time and perfecting result delicacy. Insurance companies can expedite claim blessings, while form services can pierce precise information for better planning and cost estimation. also, auto possessors profit from clearer perceptivity into the needed repairs and associated charges.

This exploration contributes to the advancement of smart automotive results by integrating deep literacy and computer vision ways. The proposed system improves the post-accident evaluation process, enhancing the overall experience for stake holders in the insurance and form diligence. By addressing the challenges posed by traditional damage assessment styles, this automated approach ensures thickness, delicacy, and briskly issues, making it a precious addition to ultramodern vehicle damage assessment results.

II. RELATED WORK

The research paper by Mallios, Xiaofei, and McLaughlin introduces an innovative system for estimating vehicle damage inflexibility using images captured by mobile bias in real world conditions. The study addresses the need for accurate, effective, and automated damage assessment in the insurance assiduity by exercising convolutional neural network (CNN) models. By assaying stoner- submitted images, the system effectively assesses damage inflexibility without the need for homemade examination, perfecting the speed and delicacy of insurance claim process proposed system represents a significant advancement in vehicle damage inflexibility estimation, particularly in challenging conditions where lighting, angles, and image quality may vary. The experimenters influence deep literacy ways to develop a robust model able of detecting and assessing damage directly from mobile images. This automated result enhances insurance operations by stream lining assessments and reducing mortal error. The study also emphasizes the eventuality for unborn advancements, suggesting areas for enhancing model robustness, expanding dataset diversity, and refining vaticination delicacy. These recommendations punctuate the ongoing eventuality of deep literacy in perfecting real world damage assessment results. This exploration provides a precious donation to the insurance sector, offering a scalable and practical system that enhances effectiveness and trustability in vehicle damage evaluation processes [1].

The research paper by Ritik Gandhi presents a comprehensive approach for vehicle damage assessment using mul-tiple pretrained deep learning models. The study aims to ameliorate delicacy and effectiveness in the insurance assiduity by automating crucial aspects of damage evaluation. The proposed system utilizes colourful models to perform distinct tasks in the assessment process. Initially, the system employs the ResNet50 model to determine whether the auto is damaged or not. However, the WPOD- net model is If linked as damaged. used to descry the vehicle's license plate for identification purposes. To pinpoint the damaged regions on the vehicle, the YOLO(You Only Look formerly) model is applied due to its exceptional object discovery capabilities. Eventually, the inflexibility of the damage is assessed using the DenseNet model, which effectively classifies damage intensity .Through trial, the study concludes that transfer literacy achieves superior results compared to fine- tuning ways. also, the experimenters propose a frame that consolidates these mod mono rails into a single operation. This intertwined system enhances robotization in the insurance assiduity by streamlining vehicle damage assessment, expediting claim processing, and reducing homemade examination sweats. The frame offers a practical and scalable result, perfecting both delicacy and effectiveness in post-accident evaluations [4].

The research paper by Chen, Yuan, and Dong presents an innovative approach to vehicle damage discovery using the Multi-Scale Damage Region- grounded Convolutional Neural Network (MD R- CNN). The proposed MD R- CNN model is specifically designed to ameliorate the discovery and originalization of vehicle damages by using multi-scale point birth ways. This system enhances the traditional Mask R- CNN armature, performing in bettered delicacy and superior segmentation quality .The MD R- CNN model effectively identifies vehicle damages across colourful scales, icing robust performance in real- world conditions where image quality, angles, and lighting may vary. By incorporating multi-scale point birth, the model excels in detecting small and large damage areas with enhanced perfection. This advancement makes the MD R- CNN model a precious tool for perfecting effectiveness in the insurance and automotive diligence, particularly in damage assessment and claim processing .The paper also addresses ongoing challenges in vehicle damage discovery, similar as perfecting model conception, expanding datasets for training, and refining vaticination delicacy. also, the authors suggest unborn exploration directions to further enhance

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the robustness and connection of damage discovery systems. The MD R- CNN model represents a significant step forward in vehicle damage assessment, offering a scalable and practical result for real- world automotive and insurance operations [5].

The research paper by Priti Warungse, Atharva Kasar, Apurva Kshirsagar, Geeta Hade, and Nishant Khandhar presents a comprehensive frame for auto damage discovery using deep literacy ways. The proposed system announcement dresses the growing need for precise, effective, and automated styles to estimate vehicle damage. This innovative result has significant eventuality in operations similar as insurance claims processing, vehicle conservation, and accident analysis. The design leverages a state- of- the- art convolutional neural network (CNN) armature, specifically ResNet , due to its remarkable point birth capabilities and high bracket performance. ResNet deep armature allows the system to directly identify and classify vehicle damage by rooting intricate visual features from images. The model is trained on a strictly curated dataset of vehicle images, each annotated with markers indicating the presence and inflexibility of damage. To ensure its effectiveness, the system undergoes expansive testing and confirmation, where crucial performance metrics similar as delicacy, perfection, recall, and F1- score are completely assessed. This evaluation process demonstrates the system's trustability in relating and assaying vehicle damage under colourful conditions. The proposed frame offers a robust result for enhancing effectiveness in insurance assessments, form diagnostics, and post-accident evaluations through automated and accurate damage discovery [6].

III. METHODOLOGY

The proposed automated exterior car damage detection system follows a structured methodology incorporating deep learning models, computer vision techniques, and web-based application development. The system is designed to identify cars, detect and classify damage, predict severity, and generate a descriptive damage report.

Methodology:

1.Data Collection and Preprocessing: Car Images are collected through various datasets. The car images undergo preprocessing steps, including resizing, normalization, and augmentation (rotation, flipping, and contrast adjustments) to enhance model performance.

2.Car and Damage Identification: The VGG-16 model, a pre-trained Convolutional Neural Network (CNN) model, is utilized to identify the car and detect damaged region. The model finds important features from input images and helps in damage classification.

3.Damage Location and Type Classification: To achieve precise damage detection, VGG-16 model used for damage location and Mask R-CNN and Detectron2 frameworks are used for damage type identification. These models create pixel wise segmentations, affected regions and classifying damage types (e.g., dent, scratch, crack).

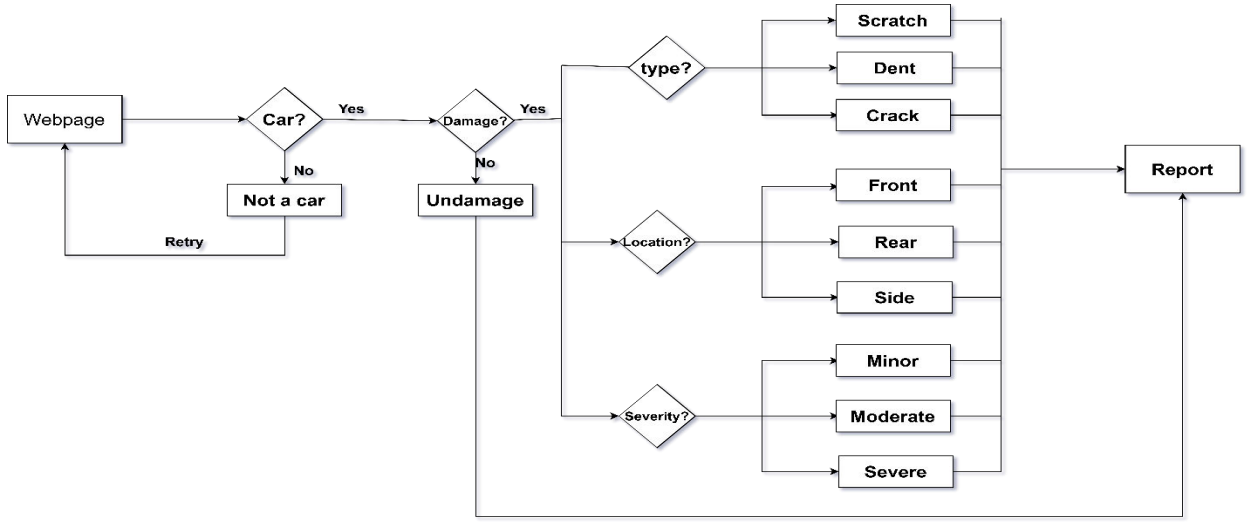

Fig 1. System Architecture

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4.Damage Severity Prediction: The VGG-16 model analyze location of damages and assigns severity levels (minor, moderate, severe) based on the extent of the affected region and predefined thresholds.

5.Web Application Development: A user-friendly web interface is developed using HTML, CSS, and JavaScript, while Flask serves as the backend framework. The MongoDB database stores user data, uploaded images, and damage analysis results. Users can upload car images, receive real-time damage analysis, and download a detailed damage report.

This methodology ensures an efficient, accurate, and automated car damage assessment system, improving insurance claim processing and repair diagnostics by eliminating manual inspections.

A. About Algorithm:

VGG-16:

1. Car and Damage Identification:

Purpose:

To check whether an image contains a car and whether that car is damaged or not.

How it works: VGG-16 is pre-trained on our dataset, to identify:

- Detect presence of a car
- Classify if damage is present.

Output:

The image is labelled as:

- Car Detected: Damaged
- Car Detected: Not Damaged

2. Feature Extraction for Damage Location and Severity:

Purpose:

To identify damage location and severity of the damage.

How it works:

VGG-16 is used as a backbone to provide a feature map of the input image. These feature maps are used to:

- Find location of damage
- Estimate severity of damage.

MASK R-CNN:

Mask R-CNN is an advanced deep learning model that performs:

- Object Detection.
- Instance Segmentation.
- Damage type classification

Detectron2:

Detectron2 is a high-level framework built by Facebook AI Research (FAIR) that provides implementations of state-of the-art models like Mask R-CNN.

In our project, Detectron2 helps to find type of damage:

- Dent
- Scratch
- Crack

Handling all the heavy operations (data loading, training loops, loss calculation, visualization).

Why use Detectron2?

- Plug-and-play Mask R-CNN
- High accuracy and fast performance
- Simple training on your own damage-annotated images
- Easy to integrate with Python/Flask backend

Summary flow:

- Data Collection from various sources.
- Preprocessing (Resize, Normalize, Augment)
- VGG-16 → Car and Damage Detection.
- VGG-16 → Damage Location

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- Mask R-CNN (Detectron2) → Type Classification
- VGG-16 → Severity Estimation
- Flask based Web Interface
  →Upload Image
  →View Results
  →Download Report

IV. SIMULATION RESULTS

Classification Report:Damage Detection Model

	precision	recall	f1-score	support
0	0.95	0.92	0.94	230
1	0.92	0.95	0.94	230
accuracy			0.94	460
macro avg	0.94	0.94	0.94	460
weighted avg	0.94	0.94	0.94	460

Fig 2. Damage Detection

	precision	recall	f1-score	support
Front	0.66	0.78	0.72	96
Rear	0.70	0.69	0.69	96
Side	0.81	0.69	0.75	96
accuracy			0.72	288
macro avg	0.73	0.72	0.72	288
weighted avg	0.73	0.72	0.72	288

Fig 3. Damage Location

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	precision	recall	f1-score	support
Minor	0.73	0.79	0.76	48
Moderate	0.57	0.44	0.49	55
Severe	0.73	0.82	0.77	68
accuracy			0.69	171
macro avg	0.68	0.68	0.68	171
weighted avg	0.68	0.69	0.68	171

Fig 4. Damage Severity

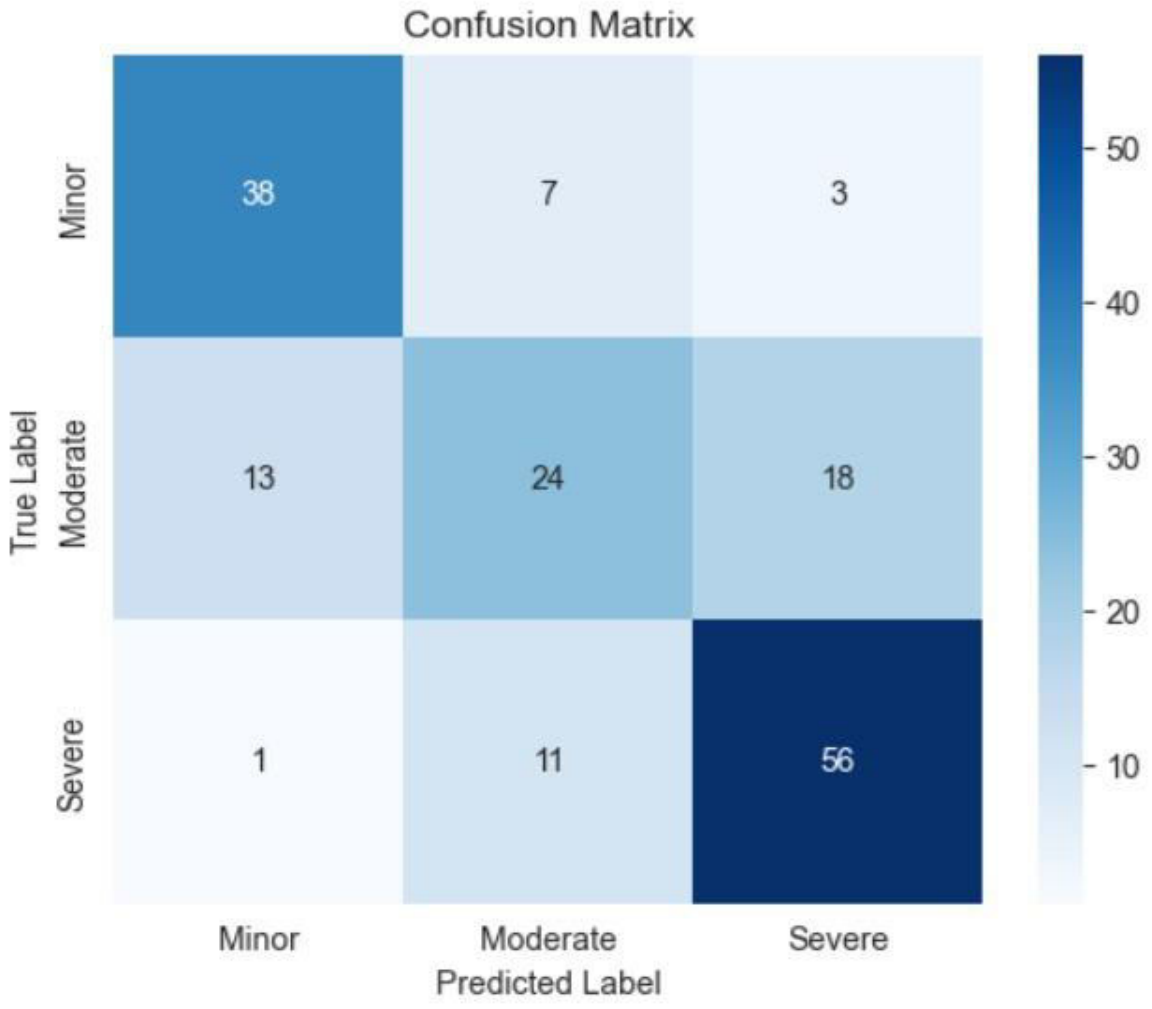

Fig 5. Confusion Matrix

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V. CONCLUSION AND FUTURE WORK

The external auto damage discovery system employs deep literacy ways to ameliorate the delicacy and effectiveness of damage assessment. The system utilizes VGG- 16 for vehicle identification, using its strong point birth capabilities. For precise damage localization and bracket, the system integrates Mask R- CNN and Detectron2, icing comprehensive damage discovery and accurate inflexibility pre platform is designed as a web- grounded operation, developed using Beaker for the backend and MongoDB for data storehouse. This stoner friendly interface enables real- time analysis and generates de tailed damage reports for enhanced diagnostics and decision timber. By automating the assessment process, the system significantly reduces homemade examination sweats, accelerates insurance claim processing, and improves form evaluations. This innovative result streamlines post-accident assessment procedures, offering an effective, dependable, and automated system for assessing vehicle damage with lesser delicacy and speed.

This system provides an efficient solution for car dam age detection; however, there is scope for further enhance - ments. Future work includes improving model accuracy by incorporating larger and more diverse datasets, ensuring better generalization across different car models, colours, and lighting conditions. Additionally, integrating real-time video analysis for moving cars can further enhance damage detection capabilities. Another advancement is the implementation of 3D damage assessment using LiDAR or depth-sensing cameras to give a more accurate evaluation of damage severity. Moreover, integrating blockchain technology for secure and tamper-proof insurance claim processing can enhance system credibility. Lastly, deploying the system as a mobile application will increase accessibility and usability for car owners and insurance providers.

REFERENCES

1. Dimitrios Mallios, Li Xiaofei, Niall Mclaughlin, “Vehicle Damage Severity Estimation for Insurance Operations Using In-The-Wild Mobile Images,” IEEE 2022.
2. Shreyansh Doshi, Amarjit Gupta, Jay Gupta, “Vehicle Damage Analysis Using Computer Vision: Survey”, ResearchGate 2023.
3. Qinghui Zhang, Xianing Chang , “Vehicle-Damage-Detection Segmentation Algorithm Based on Improved Mask RCNN”, IEEE 2020.
4. Ritik Gandhi “Deep Learning Based Car Damage Detection, Classification and Severity”, IJATCSE 2021.
5. Yuxin Chen, Hua Yuan, Shoubin Dong, “Vehicle Damage Detection based on MD R-CNN”, IEEE 2023.
6. Priti Warungse , Atharva Kasar, Apurva Kshirsagar, Geeta Hade, Nishant Khandhar, “Car Damage Detection Using Computer Vision”, JETIR 2023.
7. Chen Chen , Senior Member, Chenyu Wang , Bin Liu, Ci He, Li Cong, “Edge Intelligence Empowered Vehicle Detection and Image Segmentation for Autonomous Vehicles”, IEEE 2022.

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