King
Saud University
College of Computer and Information Sciences
Department of Information Technology

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Graduation Project Proposal

<CrashLens>

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1 Introduction

Road traffic accidents represent a continuing challenge for transportation systems and insurance operations in the Kingdom of Saudi Arabia, as they frequently result in material vehicle damages that require accurate assessment before repair or insurance claim settlement. According to a national study on traffic accident analysis in Saudi Arabia, a total of 285,547 traffic accidents were recorded in the Kingdom during the year 1439H, reflecting the substantial volume of incidents that lead to vehicle damage and associated financial losses. These figures highlight the growing burden placed on damage assessment processes and insurance services within the country [1] [i].

In Saudi Arabia, traffic accidents represent a major economic and administrative concern due to their impact on vehicle repair costs, insurance claims, and service efficiency. National studies emphasize that traffic accidents lead to significant material losses, including vehicle damage and infrastructure costs, which place pressure on insurance companies and official assessment authorities [2] [ii][3][iii]. As the number of vehicles continues to increase, traditional damage assessment methods—primarily based on manual inspections—are becoming increasingly time-consuming, resource-intensive, and prone to subjectivity [4][iv].

Recent advances in artificial intelligence, particularly in computer vision and deep learning, have demonstrated strong potential in automating vehicle damage detection and severity estimation from images. Research in this field shows that AI-based systems can analyze vehicle images to identify damaged parts, classify damage severity, and support insurance-related decision-making with higher consistency and efficiency compared to purely manual approaches. Such technologies enable faster preliminary assessments, reduce operational delays, and support scalable insurance services.

From a national perspective, the adoption of intelligent digital solutions aligns with the objectives of Saudi Vision 2030, which emphasizes digital transformation, efficiency improvement, and the use of advanced technologies to enhance service quality across sectors, including transportation and insurance [5][v]. Implementing AI-powered damage assessment solutions contributes to improving operational efficiency, supporting data-driven decision-

making, and reducing reliance on manual processes.

This graduation project proposes CrashLens, an AI-powered mobile application that allows vehicle owners to submit images of damaged vehicles and receive an initial estimation of damage severity and approximate repair cost. The system aims to support users by providing a convenient and consistent preliminary assessment while offering insurance-related stakeholders structured and verifiable assessment reports. This document presents the problem addressed by the project, the proposed solution, product vision, roadmap, objectives, scope, required tools, and the Scrum team structure.

2 The Problem

Vehicle damage assessment after road accidents is currently a slow and largely manual process. In many cases, vehicle owners are required to visit physical inspection centers and wait for human assessors to evaluate the damage. This dependency on in-person inspection makes the process time-consuming and inefficient, particularly during peak periods when assessment centers must handle a high volume of insurance claims [4][vi].

In addition to delays, manual vehicle damage assessment is inherently subjective. Different inspectors may provide varying evaluations for the same damage, resulting in inconsistent severity judgments and repair cost estimates. Such inconsistencies often lead to disputes between vehicle owners and insurance providers, reducing transparency and increasing the overall processing time of insurance claims.

For example, after a minor traffic accident, a vehicle owner may need to take time off work to visit an authorized inspection center, wait for an assessor to review the damage, and then wait again for an official cost estimate. In some cases, the assessment may differ from another evaluator’s judgment, leading to further delays, reassessments, or disputes with the insurance company.

Despite the widespread availability of digital images and advances in computing technologies, there is still limited adoption of intelligent systems capable of providing initial, data-driven damage assessments based on visual evidence. The absence of such systems represents a missed

opportunity to reduce processing time, improve assessment consistency, and enhance user experience. This project focuses specifically on addressing this gap by providing an automated, image-based approach for preliminary vehicle damage severity and cost estimation, supporting—but not replacing—official inspection procedures.

3 The Solution

To address the limitations of manual vehicle damage assessment, this project proposes **CrashLens**, an AI-powered mobile application that provides an initial vehicle damage evaluation using images uploaded by users. The system enables vehicle owners to capture and submit guided multi-angle photos (e.g., front, rear, side, and close-up shots of the damaged area), along with basic vehicle information such as model and year, through a user-friendly interface.

The application analyzes the submitted images using artificial intelligence to estimate damage severity and generate an approximate repair cost. At a high level, the system follows a structured machine learning pipeline that includes image preprocessing, automated severity estimation, and cost calculation based on vehicle-related inputs. This approach supports faster and more consistent assessments while reducing dependency on immediate physical inspection.

From a technical perspective, the solution leverages computer vision methods, where a convolutional neural network (CNN) is used to classify vehicle damage severity into predefined categories (minor, moderate, or severe). The predicted severity is then combined with vehicle information through a structured costing mechanism to produce an approximate repair cost estimate (e.g., cost ranges based on severity and vehicle attributes). Model refinement and performance optimization will be conducted iteratively throughout the project lifecycle.

Overall, the proposed solution aims to improve accessibility, reduce claim processing delays, and provide more consistent preliminary assessments compared to purely manual evaluations.

4 Product Vision

For vehicle owners **who** need a fast and consistent initial vehicle damage assessment after an accident, **CrashLens** is an AI-powered mobile application **that** analyzes uploaded vehicle images to estimate damage severity and approximate repair cost. **Unlike** manual inspection methods that are slow and subjective, **CrashLens** provides a standardized, data-driven preliminary evaluation that supports early claim and repair decisions.

5 Product Roadmap

The development of the CrashLens system will follow an incremental agile approach using the Scrum methodology. The project will be implemented over two academic semesters, resulting in two major releases. Each release consists of multiple sprints, and each sprint delivers a usable increment of the system.

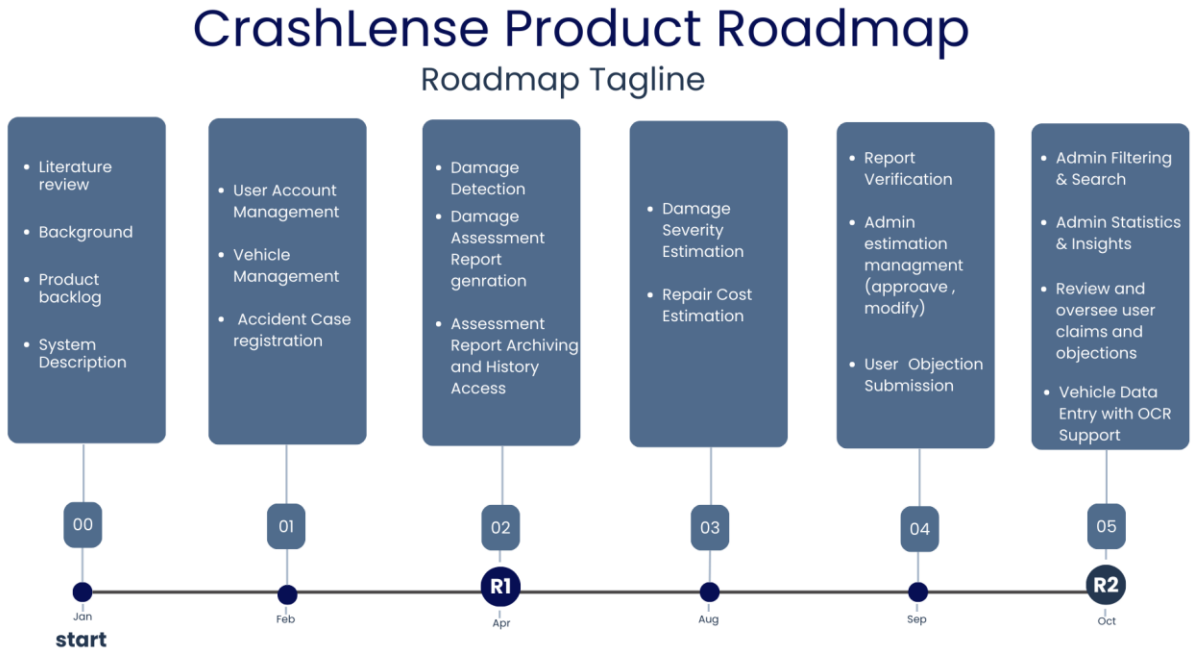

Figure 1CrashLense Roadmap

6 Objectives

The objectives of this graduation project are defined on three levels: **product**, **project**, and **learning**.

6.1 Product Objectives (Customer focus – value)

The product objectives describe the value that CrashLens provides to its intended users, including vehicle owners and insurance-related stakeholders. By the end of the project, CrashLens aims to:

1. Provide a digital platform for vehicle owners to register and manage their accounts and vehicles, enabling structured and consistent use of the system.
2. Enable users to register accident cases and submit vehicle damage information, including accident details and related vehicle images.
3. Provide automated damage assessment capabilities, including damage detection, damage severity estimation, and repair cost estimation, to support preliminary evaluation of vehicle damage.
4. Generate automated damage assessment reports that summarize accident details, detected damage, severity estimation, and repair cost estimation.
5. Support report verification functionality to allow third parties to confirm the authenticity and status of generated assessment reports.
6. Provide an administrative dashboard that allows authorized administrators to review accident cases and approve or modify damage assessments.
7. Enable management of user objections, allowing users to submit objections to assessment results and administrators to review and respond to them through the system.

6.2 Project Objectives (Solution focus – plan)

the project objectives describe the technical and developmental activities required to design, implement, and deliver the CrashLens system across two academic semesters.

1. Conduct a background study and literature review to understand vehicle damage assessment processes and existing AI-based approaches.
2. Analyze and prepare publicly available datasets for vehicle damage assessment, including data cleaning, organization, and splitting.
3. Design the overall system architecture, including frontend, backend, database, and model interaction.
4. Design the machine learning workflow for vehicle damage assessment, including data preparation strategies and model selection at a conceptual level.
5. Develop the backend infrastructure and database structure required to store user, vehicle, accident, and assessment data.
6. Develop and train machine learning models for damage detection, damage severity estimation, and repair cost estimation.
7. Evaluate and improve model performance through testing, experimentation, and refinement.
8. Integrate the trained models into the system.
9. Perform system testing and refinement to ensure correctness, reliability, and usability.
10. Prepare final documentation and project deliverables.

6.3 Learning Objectives (Student focus – skills gained)

The learning objectives describe the knowledge and skills the project team aims to acquire beyond the standard IT curriculum through the development of the CrashLens system. By completing this project, the team will:

1. Gain practical experience in applying computer vision techniques to real-world image-based vehicle damage assessment problems.
2. Learn how to design and implement multiple machine learning models for related tasks, including damage detection, damage severity estimation, and repair cost estimation.

3. Develop hands-on experience with the complete machine learning workflow, including data collection, data preparation, preprocessing, augmentation, training, evaluation, and model refinement.
4. Learn practical transfer learning and fine-tuning techniques using convolutional neural networks (CNNs) for image-based classification and detection tasks.
5. Strengthen skills in backend and system integration, including connecting machine learning models with application services, databases, and user-facing components.
6. Gain experience in building and managing a data-driven software system using Agile/Scrum practices, including sprint planning, backlog management, teamwork, and iterative delivery across multiple releases.

7 Scope

This project focuses on the development of an AI-powered mobile application that provides a preliminary, image-based assessment of vehicle damage after road accidents. The system is intended for vehicle owners aged 18 and above, as well as insurance-related stakeholders who benefit from consistent and verifiable preliminary assessment reports.

The application allows users to create accounts, register vehicles, and submit damage reports through guided multi-angle photo capture and image upload. Based on the uploaded images and basic vehicle information, the system produces an initial damage severity classification (minor, moderate, or severe) along with an approximate repair cost estimate. Where feasible and supported by the selected datasets, the system may additionally highlight damaged regions or parts as an enhancement to improve result clarity.

The scope of the project is limited to exterior visible vehicle damage captured through images. The project supports the mobile platform only and the English language. Direct integration with official insurance company systems, issuance of legally binding claim decisions, and internal or mechanical vehicle diagnostics are explicitly outside the scope of this project

8 Hardware/Software Tools and Cost

Hardware Tools	
Name and Description	Cost
Laptops for development	Already available
Mobile for Testing	Already available
Software Tools	
Name and Description	Cost
Flutter **(mobile application development framework)**	Free
Figma **(UI/UX Design tool)**	Free
Firebase **(authentication, database, and storage)**	Free
Google Colab **(model development and experimentation)**	Free
Visual Studio Code **(VS Code) – IDE**	Free
OpenCV **(image processing and computer vision)**	Free
Programming **languages like (Dart, Python)**	Free
TensorFlow or PyTorch **(deep learning framework)**	Free
Kaggle datasets **(training and evaluation data)**	Free
Jira **(Scrum project management)**	Free
GitHub **(version control and collaboration)**	Free

Table 1CrashLense Hardware/Software Tools and Cost Overvie

9 Scrum Team

9.1 Skill Set Requirements

Technical Skill Required	What is the current level of the team (*beginner-intermediate- advanced*) for each skill? How will the gap be bridged? *(if necessary*) Learning plan
Mobile App Development (Flutter/Dart)	The team's level is basic; the team has basic knowledge in developing cross-platform mobile applications using Flutter. To strengthen proficiency, team members will complete targeted Flutter tutorials and implement core application screens during the first development sprint.
Backend (Python +Flask)	The team's level is basic, the team has introductory experience in backend. This skill will be developed further by implementing simple backend functions early in the project and gradually extending backend functionality across later sprints.
Database (Firebase)	The team's level is basic, the team has basic familiarity with Firebase services for authentication, database management, and cloud storage. The team will enhance this knowledge through practical implementation, starting with user authentication and image storage.
Machine Learning: Computer Vision + CNN Fine-Tuning	The team has beginner-level experience in machine learning and computer vision. During early sprints the focus will be on understanding the selected dataset and conducting baseline experiments. Later on, the team will develop and fine-tune pretrained CNN models using transfer learning for vehicle damage assessment tasks.
Data Preparation & Preprocessing (resize, normalize, augmentation)	The team has intermediate experience in preparing image data. This skill will be strengthened by applying consistent preprocessing pipelines and experimenting to improve model robustness.

Software Engineering Tools (Git/GitHub, Jira, versioning)	The team has intermediate experience in collaborative software development tools such as GitHub and Jira. These tools will be used throughout the project to manage sprint tasks, maintain version control, and support Scrum-based teamwork.

Table 2e CrashLense Team Key Skill Requirements.

9.2 Roles and Responsibilities

Scrum Team	
Product Owner:	Dr. Luluah Alhusain
Developers:	Atheer Budie Aryam Almutairi Leen binmueqal Sarah Alruwayte
Scrum Master (SM):	Dr. Luluah Alhusain
Stakeholders:	Saudi drivers Insurance companies

Table 3CrashLense Team Roles And Responsibilities Overview

10 References

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