Car Damage and Repair Cost Estimation Using Image Segmentation

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# What problem will be investigated, and why is it interesting?

This project aims to develop a system that detects and classifies vehicle damage based on images and estimate repair costs.

This is particularly interesting for insurance and automotive industries, where this process is often done with manual inspections which are time-consuming and prone to subjectivity. With this project we intend to improve the accuracy and efficiency of damage detection and cost prediction.

# What sources will be reviewed to provide context and background?

We will review previous academic papers on car damage detection (such as R.E. van Ruitenbeek, S. Bhulai, *Convolutional Neural Networks for vehicle damage detection*, <https://doi.org/10.1016/j.mlwa.2022.100332> ) This study develops a model to locate vehicle damages and classify them into twelve categories using multiple deep learning algorithms.

And car industry case study on how AI and image recognition technology can improve insurance claims estimation processes. [https://celebaltech.com/case-studies/leading-insurance-provider-leverages-ai-powered-vehicle-damage-detection](https://celebaltech.com/case-studies/leading-insurance-provider-leverages-ai-powered-vehicle-damage-detection?utm_source=chatgpt.com)

# What data will be used? If new data is collected, how will it be gathered?

We plan to use datasets available on platforms like *Kaggle*, as well as publicly available images from online sources, including insurance company reports. If needed, we may apply data augmentation techniques to address class imbalances and improve model generalization.

* <https://universe.roboflow.com/project/damaged-vehicle-images/dataset/3>
* <https://www.kaggle.com/datasets/iottech/electric-vehicle-data-1997-2024-update-version>

# What method or algorithm will be used? If existing implementations are available, will they be utilized, and how?

To segment and classify car damage, we will explore deep learning models, particularly:

* **CNN-based architecture**: Pre-trained networks (ResNet, EfficientNet) fine-tuned for damage classification.
* **Regression models**: Random Forest and Linear Regression for predicting repair costs based on extracted damage features.

# How will the results be evaluated? Qualitatively, what kinds of results are expected (e.g., plots or figures)? Quantitatively, what kind of analysis will be used to evaluate and/or compare the results (e.g., performance metrics or statistical tests)?

The model’s performance will be evaluated both qualitatively with the visualization of segmented damage and quantitatively by classifying the accuracy, IoU for segmentation and Mean Squared Error (MSE) for cost estimation.