

Background

The Edison Cars AG is highly satisfied with your computer vision system and the rapid prototype development. Nevertheless, using the results for automated decision-making is crucial for improving the production of Edison Car AG. Therefore, Edison Cars AG expects you to think one step further and implement your object detection approach throughout the quality management process.

To achieve high automation in quality management, Edison Cars AG aims to introduce an automatic decision system that decides whether the scratched part of the car should be replaced or the scratch should be repaired. This decision should be based on financial and ecological costs.

Car parts

The backside of the Edison Cars AG cars is divided into three different areas based on different material components: top, middle, and bottom. The top part of the car is mainly constructed of glass and steel, the middle part is mainly steel, and the lower part is mainly plastic and steel. The following table shows the y-coordinates of the different car parts. Edison Cars AG emphasizes this segmentation since the material selection impacts the costs of exchanging and repairing car parts.

The labels of YOLOv8 follow this structure:

{object_class_id} {x_center} {y_center} {width} {height}

Car part	Y coordinate of the scratch
Top	0 to 0.49
Middle	0.50 to 0.59
Bottom	0.60 to 1

Costs

Edison Cars AG has different financial and ecological costs for replacing or repairing a car part with a scratch. The main materials influence the costs of correcting the scratch or replacing the car parts. For example, replacing the top part of the car causes higher economic costs than replacing the middle part since steel is less expensive than glass. Since the polymers used at the bottom are less costly, the exchange is cheaper than the correction. On the other hand, it has a higher CO₂-emission.

In the following table the costs are listed. Lower CO₂ points are preferred.

Car part of the scratch	Correction costs		Exchange costs	
	Material costs	CO ₂ points	Material costs	CO ₂ points
Top	130	3	150	2
Middle	80	5	70	6
Bottom	90	3	30	9

Tasks

Implement a function that determines whether the scratch is on the top, middle, or bottom of the car to the object detection algorithm you developed in week 1. Use the coordinates of the bounding box to determine the affected car part.

Based on the affected car part, implement a decision algorithm on whether the car part should be exchanged or not.

Finally, bring everything together to one approach, which accomplishes the following tasks:

1. Detection and localization of scratches

2. Assignment of scratch coordinates to car parts
3. Decision on dealing with scratch based on ecological and economic costs.

Input

For this task, you will be provided with the following input:

- Coordinates determining the car parts
- Financial and ecological costs for the replacement and corrections of car parts
- Production dataset for the testing of your final approach
- Further information for time implementation and machine learning: These are possible approaches that have different advantages and disadvantages. Of course, you can also use other approaches and resources:
 - Code quality: browserstack.com

Submission

The following documents must be emailed to s3g@fim-rc.de as one zip folder by 2:00 PM on 17.06.2024:

- Code file(s) to reproduce the results. This includes both the car part determination and the handling decision. Should the setting up of a special environment or packages be necessary, a step-by-step guide is also needed.
- Show exemplary results for different pictures in the dataset, including the detection, assignment to car parts and handling of scratches.
- A PowerPoint presentation explaining your approach to car part assignment and decision making. The reasoning behind the decision should be understandable and should include economic and environmental considerations.

Keep in mind

The content provided here serves only as a starting point. Feel free to use your own approaches and algorithms for the best possible prediction.

The following aspects are important for the assessment of your submission:

- Code Quality: The code must be executable, readable, commented, and adhere to the output format
- Assignment to car parts: Try to assign the output of your object detection model to the car parts, but do not try to over-engineer
- Decision on dealing with scratches: Try to decide not only based on numbers and integrate reasonable thinking
- Explanation of the approach should be understandable