Car-Scratch Detection with Deep Learning and OpenCV

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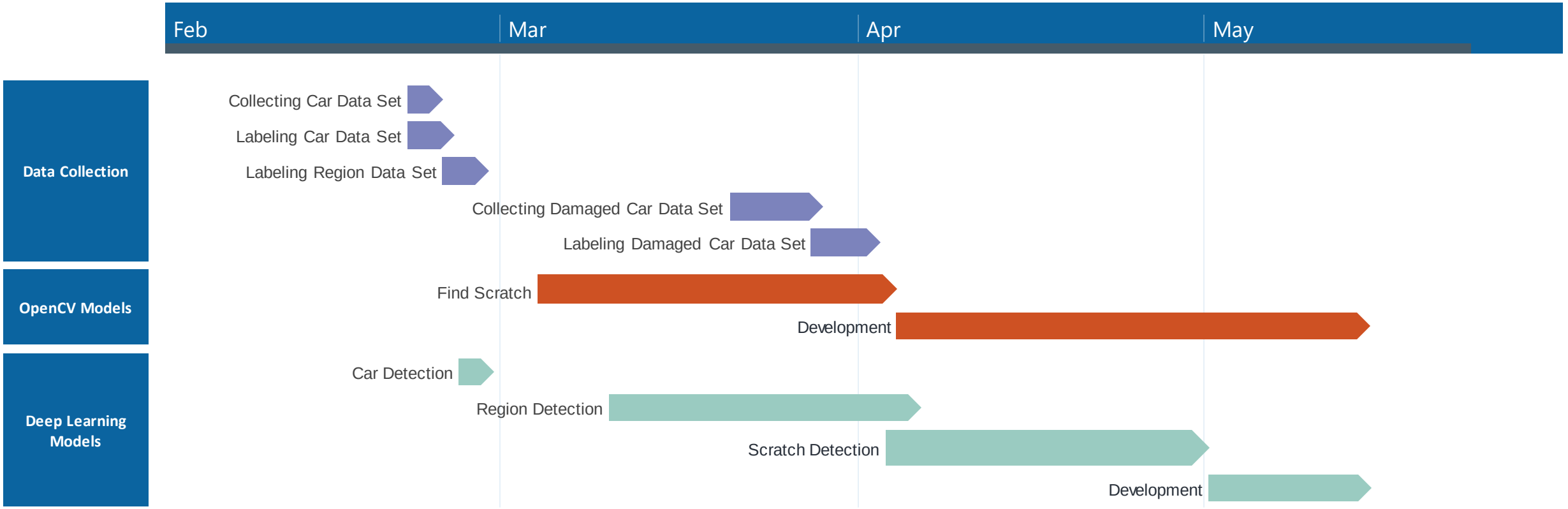
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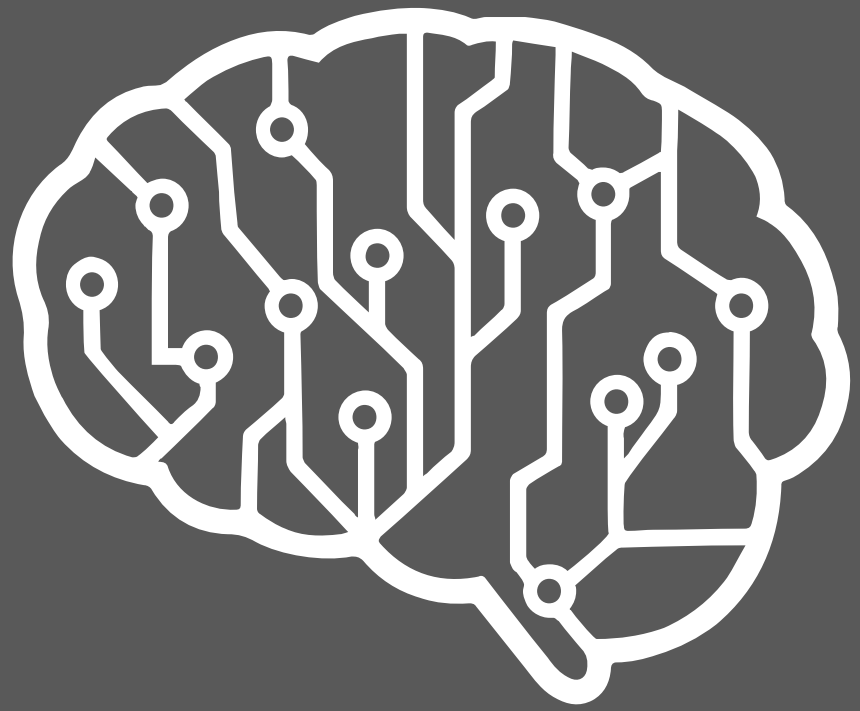


Microsoft® .NET

OpenCV

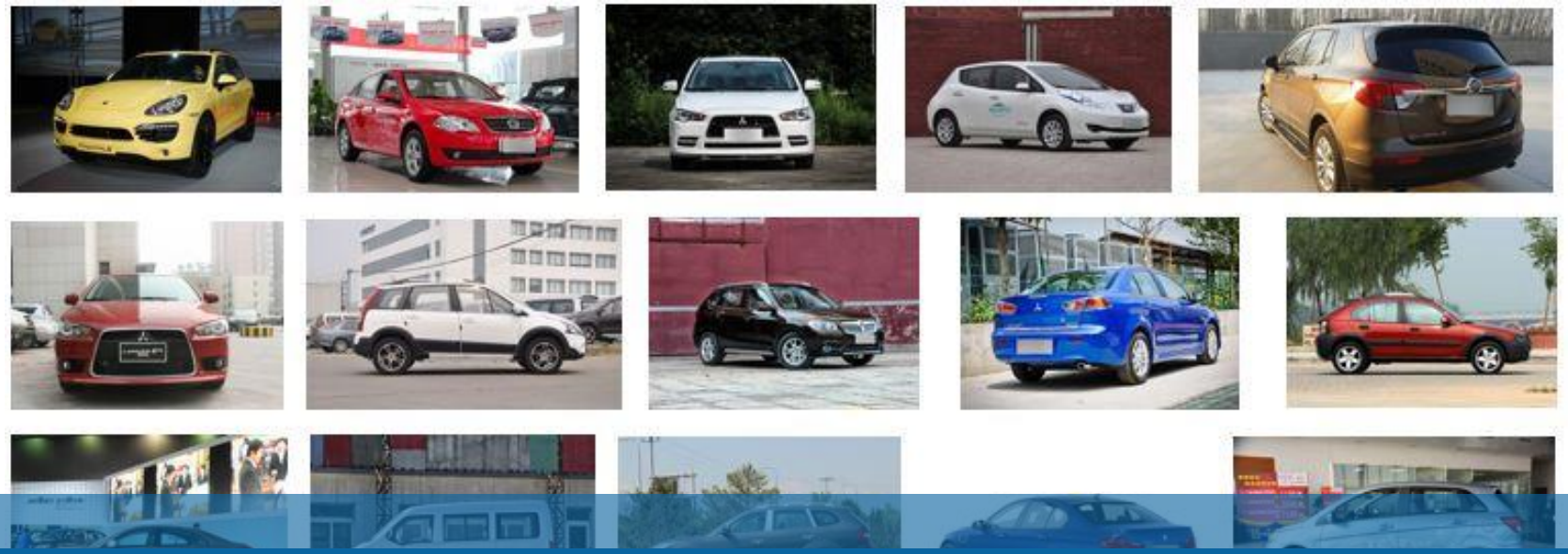
TensorFlow

Microsoft® SQL Server

NumPy

scikit - image
image processing in python

DATA SET



Car Dataset

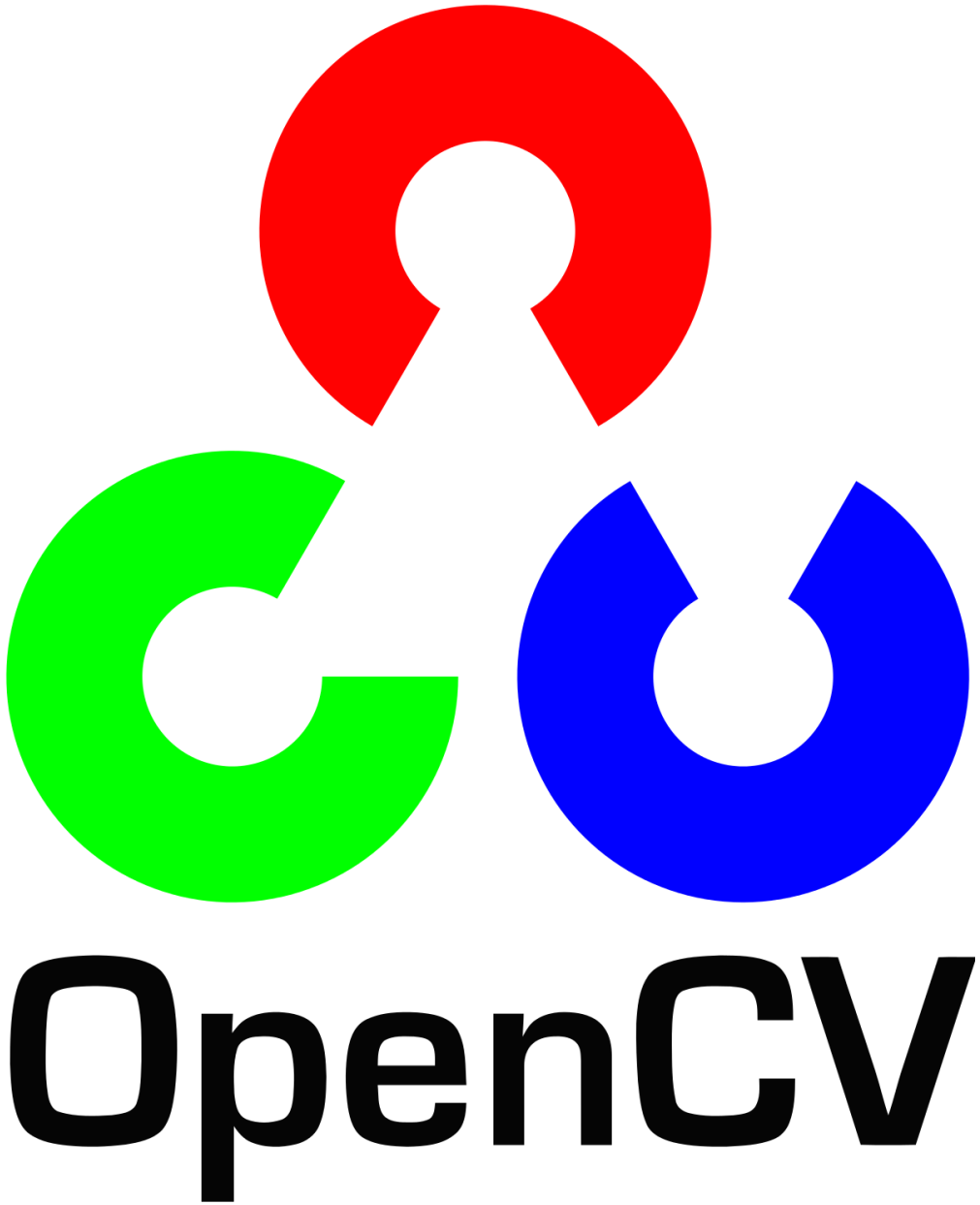
There are nearly 40,000 car photos in the car data set we collected.

Region Dataset

We labeled 1500 of this car data set that we collected in 3 different categories for the purpose of determining the region. These categories are cowling, right door and left door. We applied Data Augmentation to increase our data set and increase diversity.

Scratch Car Dataset

We collected nearly 3200 damaged car photos to create a damaged car data set. We have labeled 1000 of them for scratch detection. We applied Data Augmentation to replicate our data set.



OpenCV Models

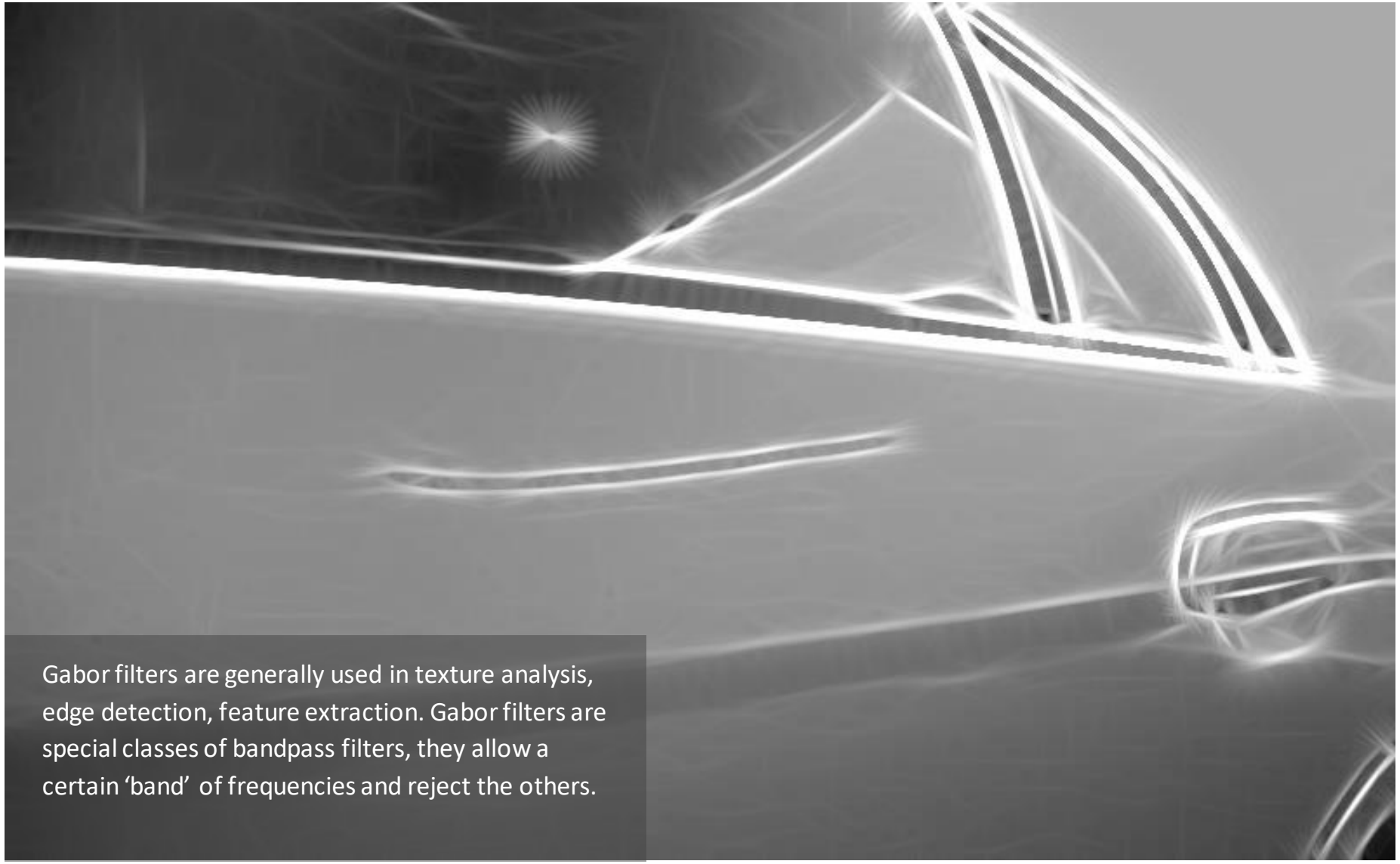
OpenCV model is the model where we obtain the exact coordinates of the scratch that we could not learn with the Deep Learning model.

OpenCV Models

Convert to Gray

Gabor filter processes with a 2-dimensional array. That's why we convert the color picture into gray and make it 2D.

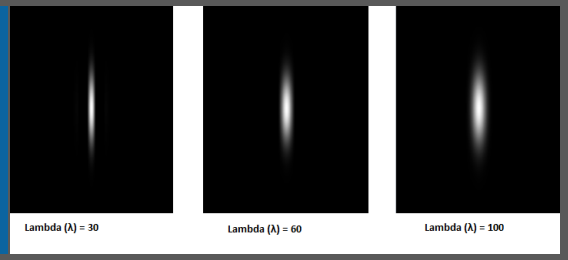
Gabor Filters



Gabor filters are generally used in texture analysis, edge detection, feature extraction. Gabor filters are special classes of bandpass filters, they allow a certain ‘band’ of frequencies and reject the others.

LAMBDA

The wavelength governs the width of the strips of Gabor function. Increasing the wavelength produces thicker stripes and decreasing the wavelength produces thinner stripes.

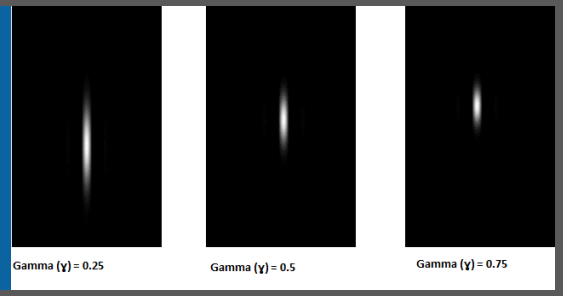


THETA

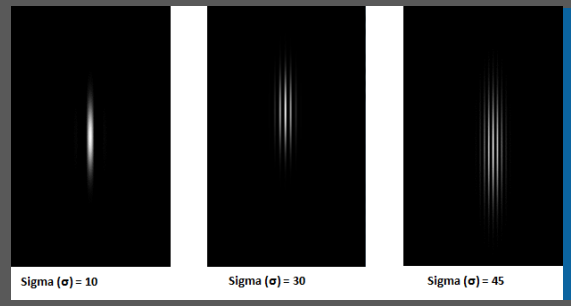
The theta controls the orientation of the Gabor function. The zero degree theta corresponds to the vertical position of the Gabor function.
We use 16 different theta parameter.

GAMMA

The aspect ratio or gamma controls the height of the Gabor function. For very high aspect ratio the height becomes very small and for very small gamma value the height becomes quite large.

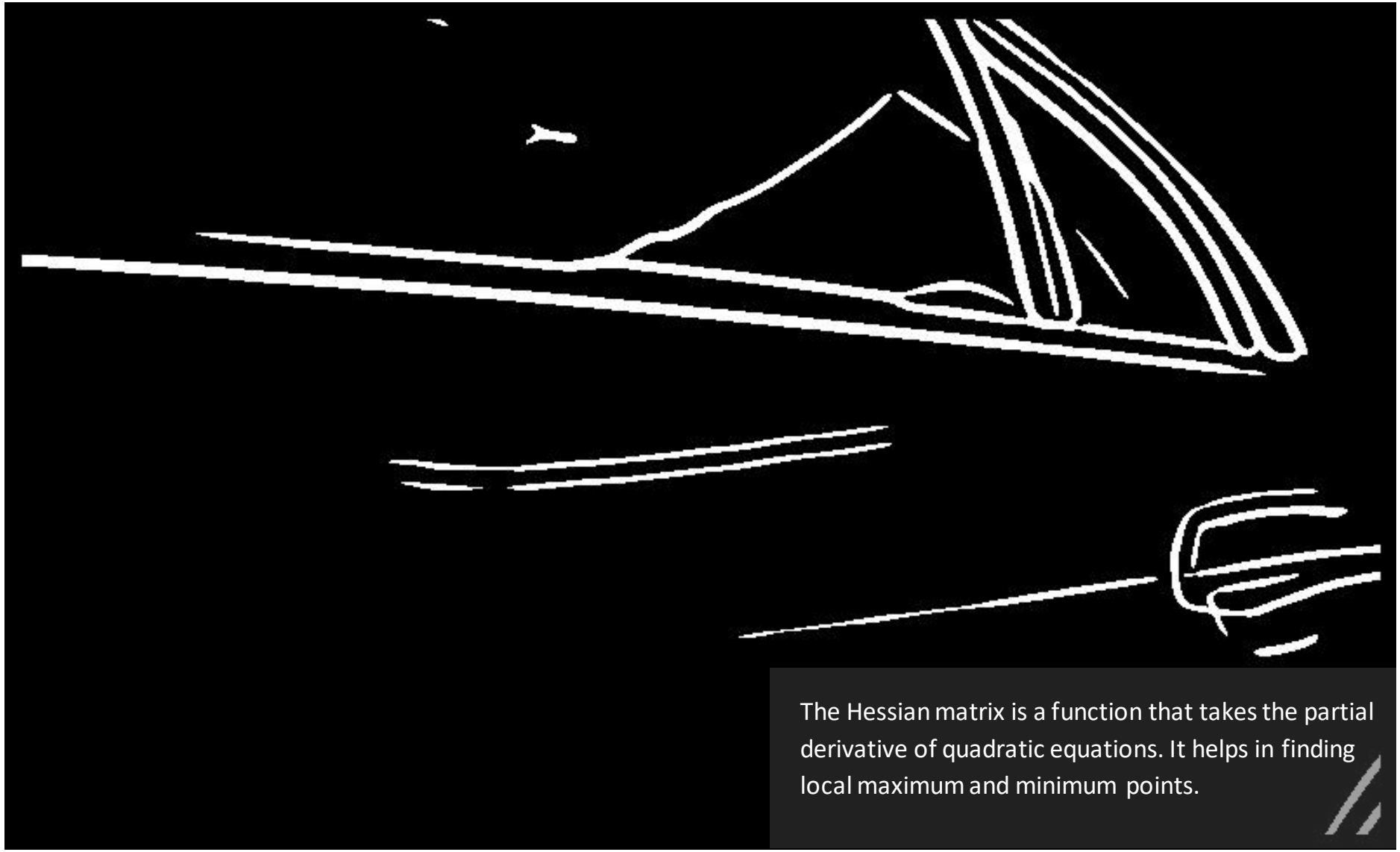


SİGMA



The bandwidth or sigma controls the overall size of the Gabor envelope. For larger bandwidth the envelope increase allowing more stripes and with small bandwidth the envelope tightens.

Hessian Matrix



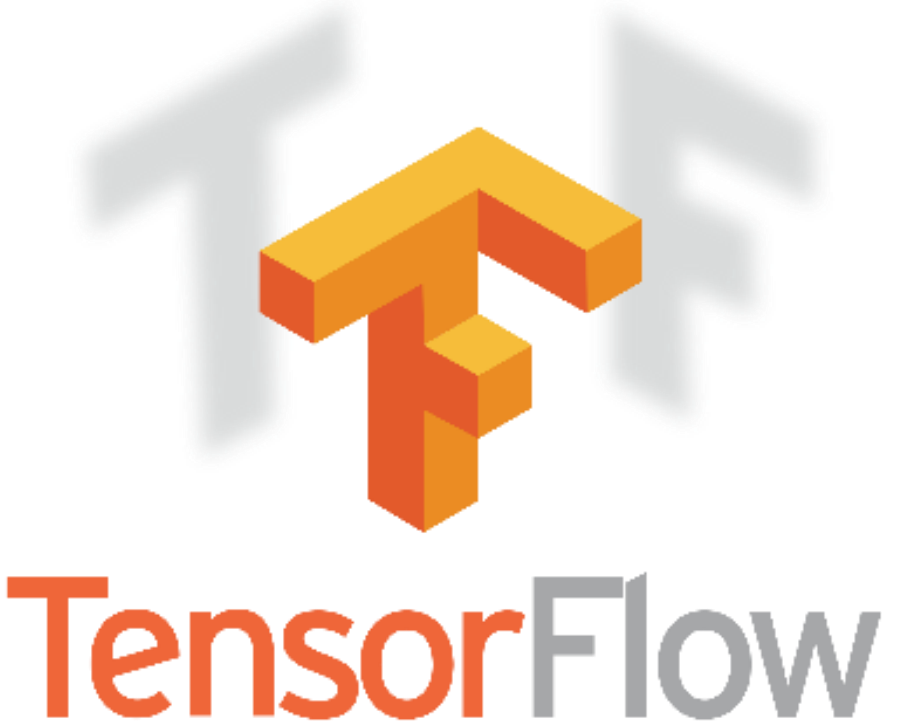
The Hessian matrix is a function that takes the partial derivative of quadratic equations. It helps in finding local maximum and minimum points.

Hough Line Probabilistic

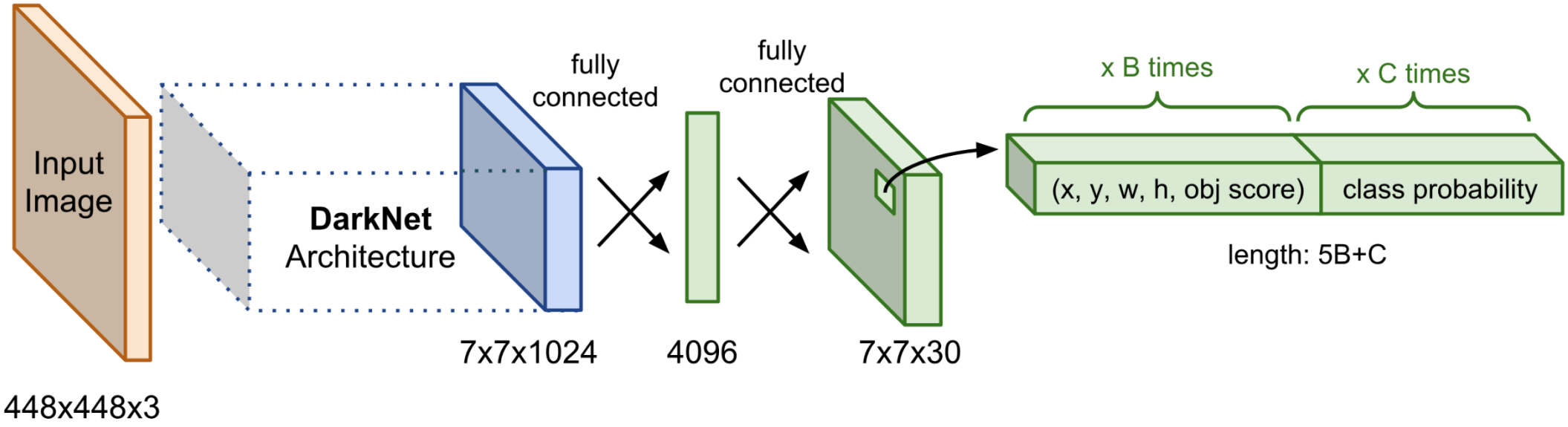
Hough Line Probabilistic uses the formula r = x.cosθ + y.sinθ to define lines. R is the perpendicular line drawn to the line, and θ is the angle of the perpendicular line drawn.

Deep Learning Models

It's the model that finds the car, the regions of the car and the coordinates of the scratch on the regions.

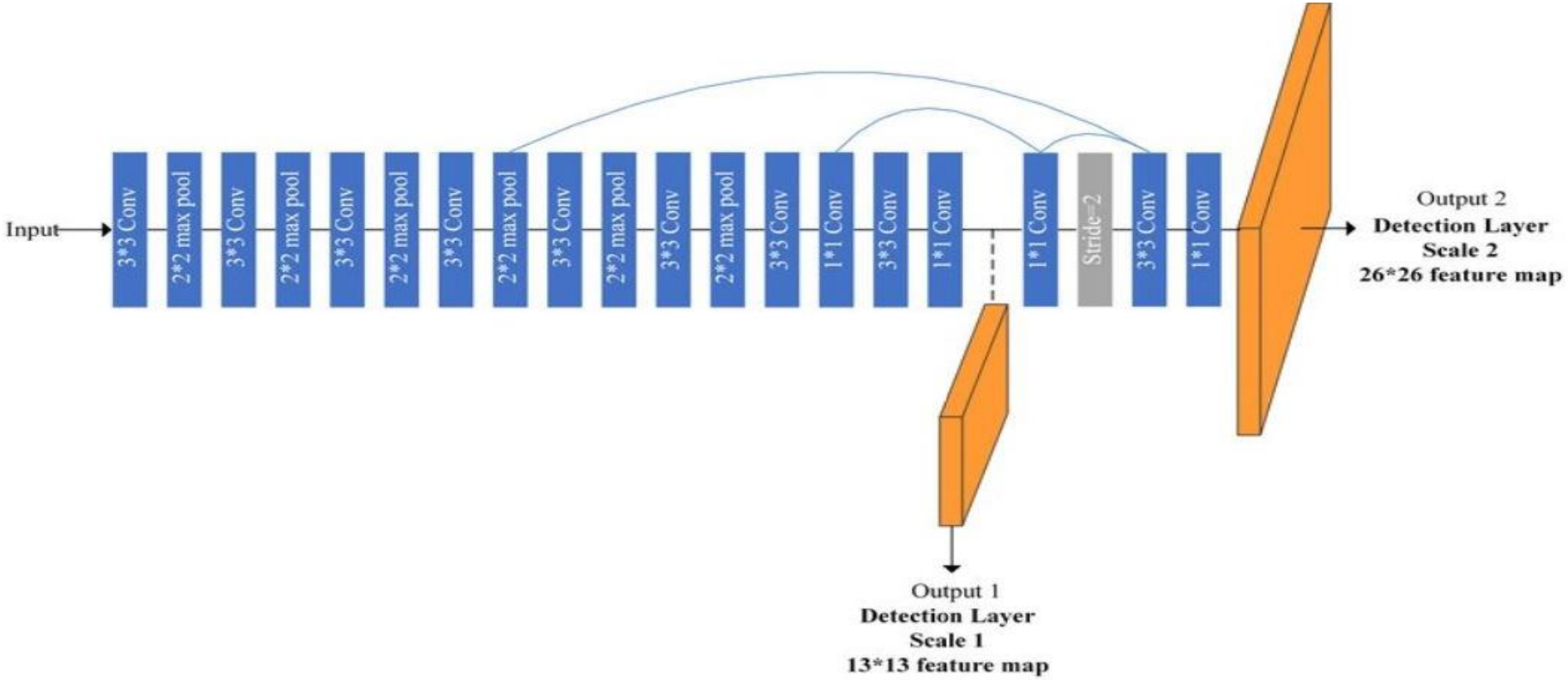


Car Detection



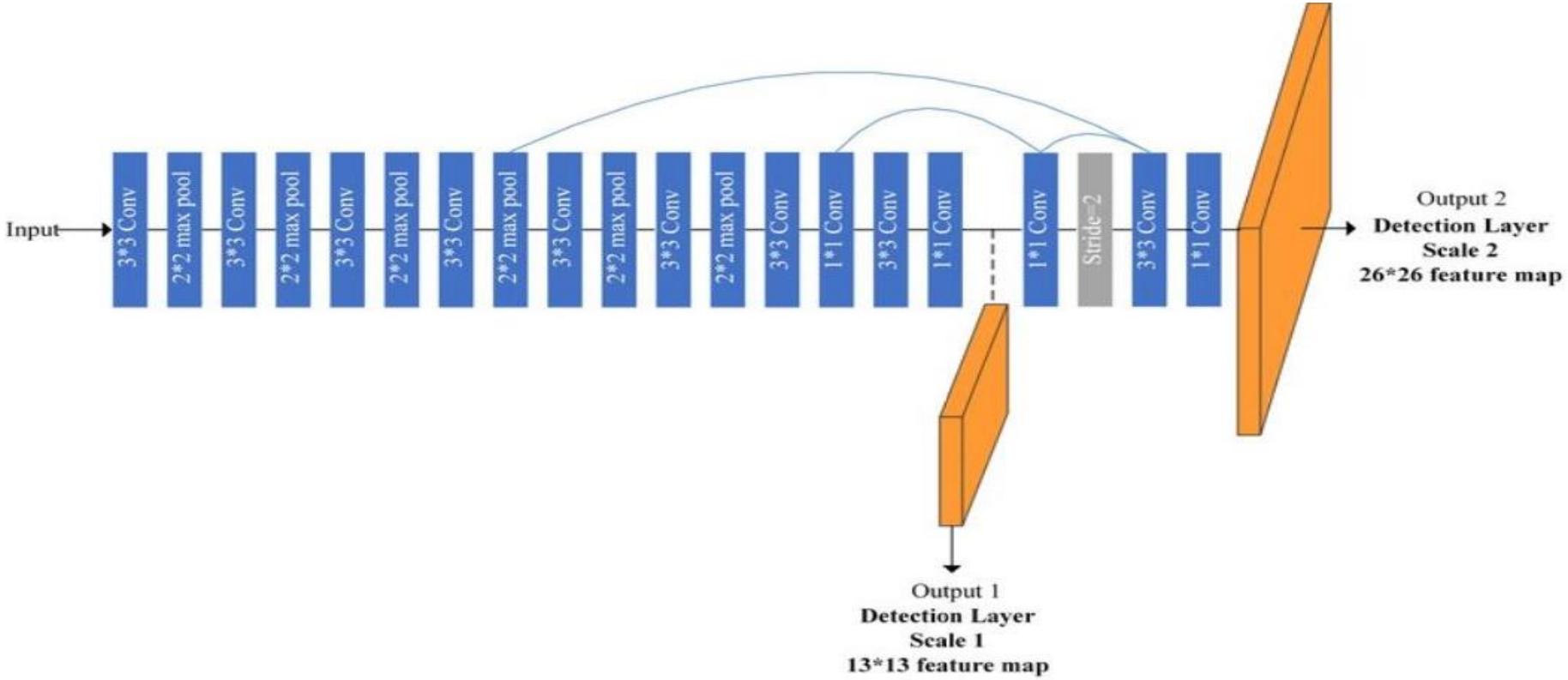
- Darkflow, the Tensorflow version of DarkNet, was used to detect cars.
- Car detection was made with the YoloV1 trained on the CoCo data set, which has 80 classes.
- The picture was cut on the coordinates of the detected vehicle and given as an input to the model that determined the region.

Region Detection



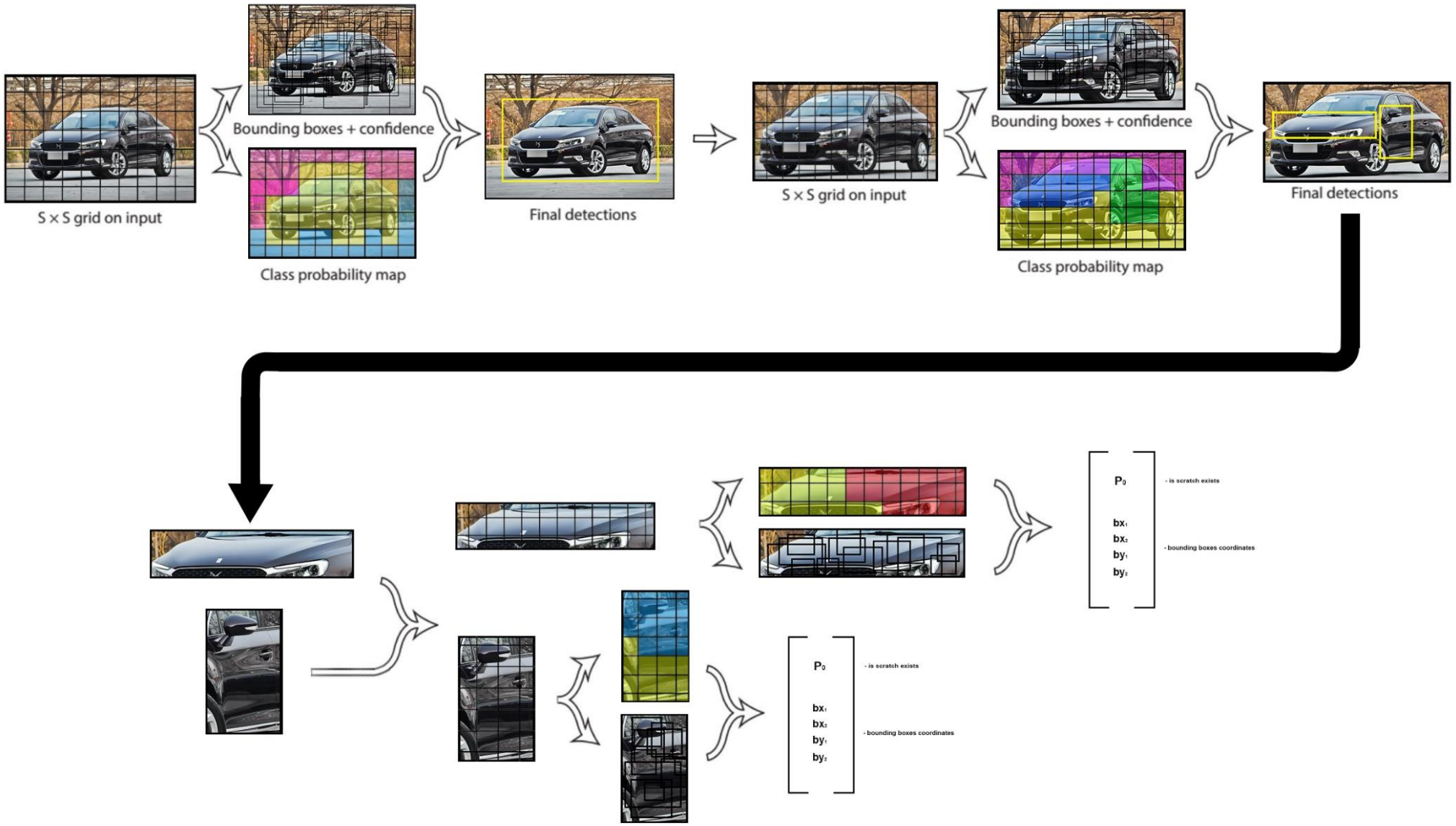
- Tiny-Yolo, which is a lighter model than YoloV1, was used to find the regions faster via the vehicle image given as input.
- The detected areas were cut on the vehicle and given as an input to the model making the scratch detection.

Scratch Detection

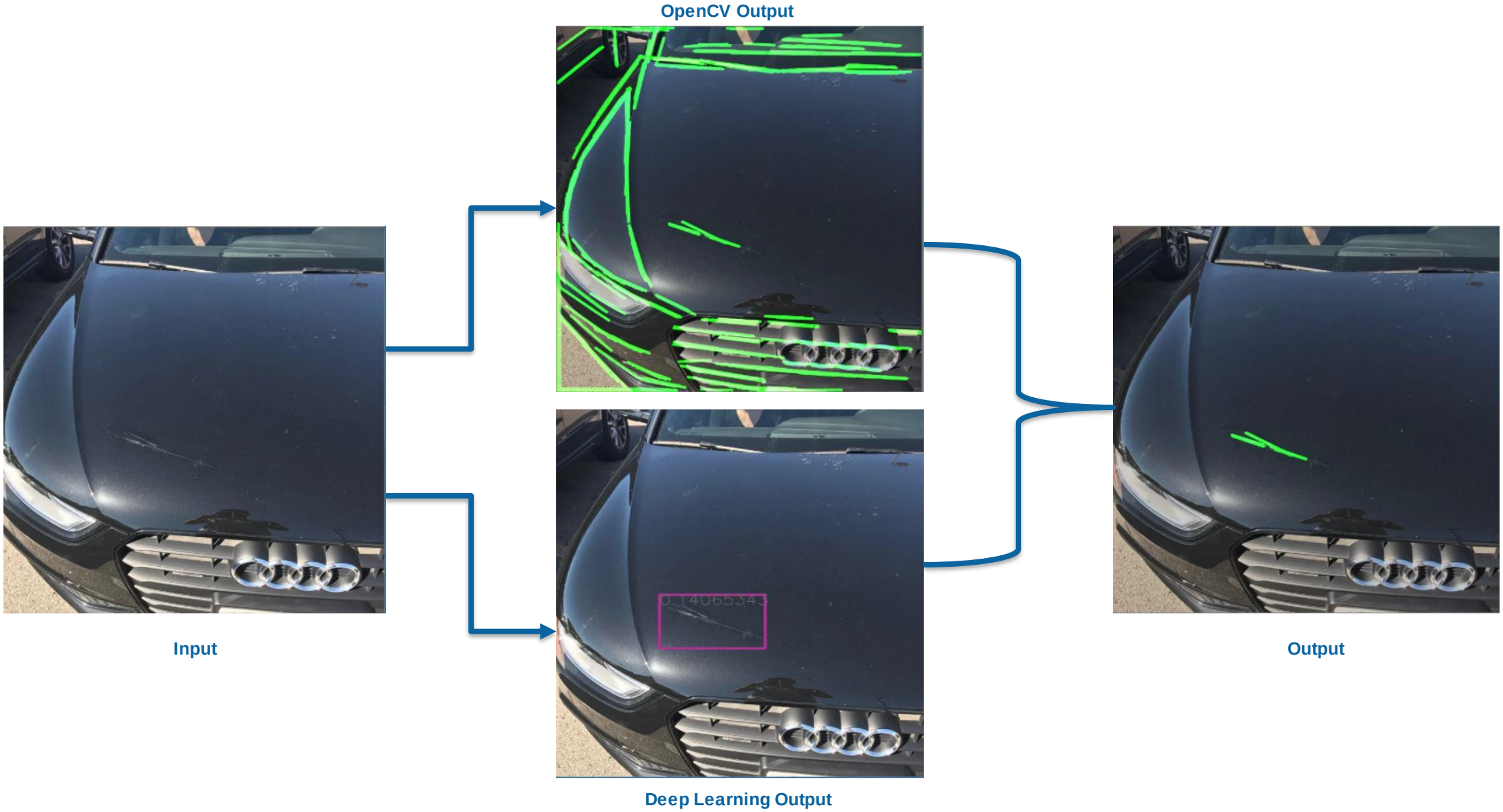


- Scratch detection was made with Tiny-Yolo on vehicle areas taken as input.

Damage Detection Algorithm



Combining OpenCV and Deep Learning Model



Application

The section where we can view the images from the camera on the line live after the models come out.

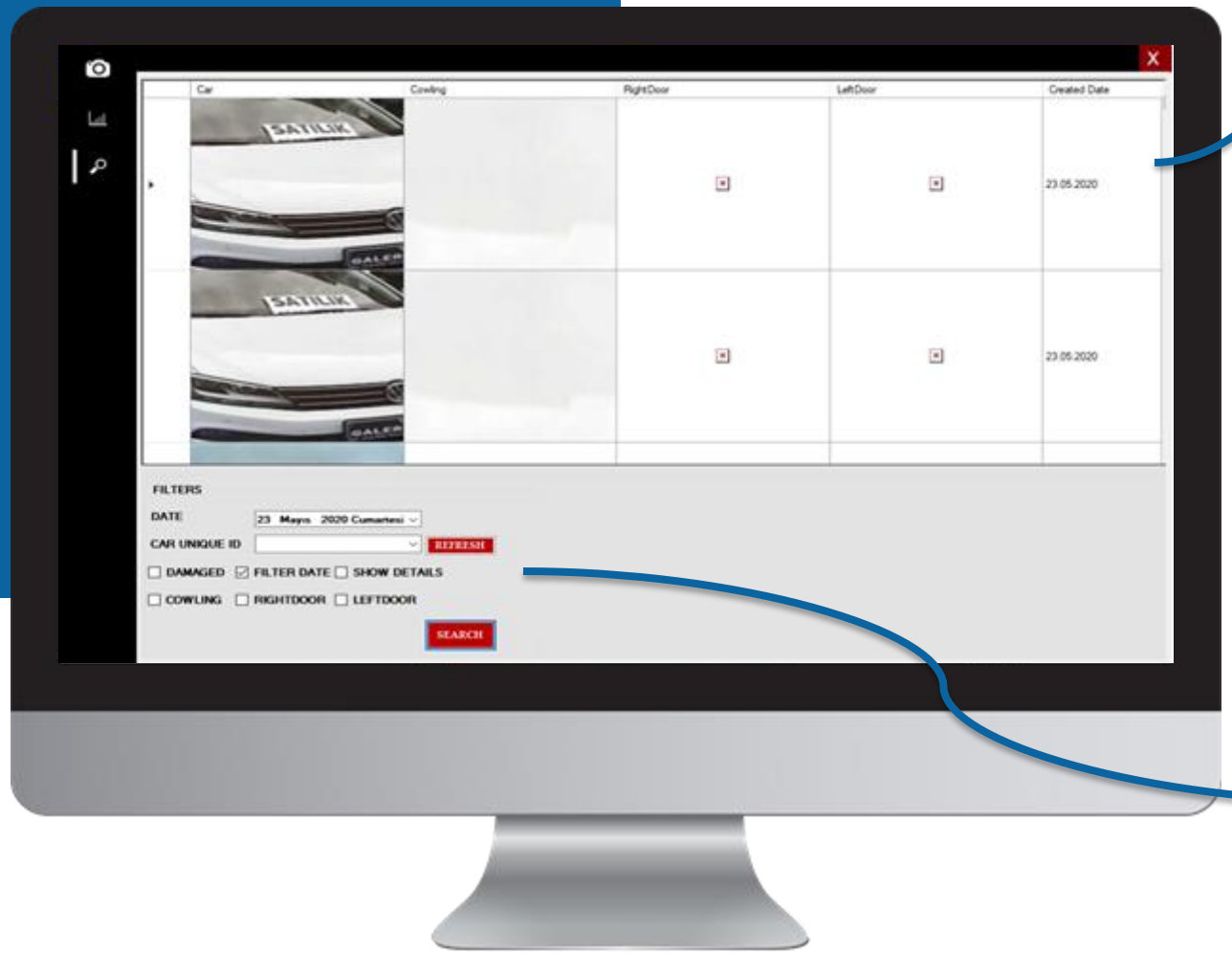
The section where we connect to cameras on the line and socket server.

The section that displays the numerical data of the car and the car features in the camera angle.

Real-time section of all vehicles traded during the day.

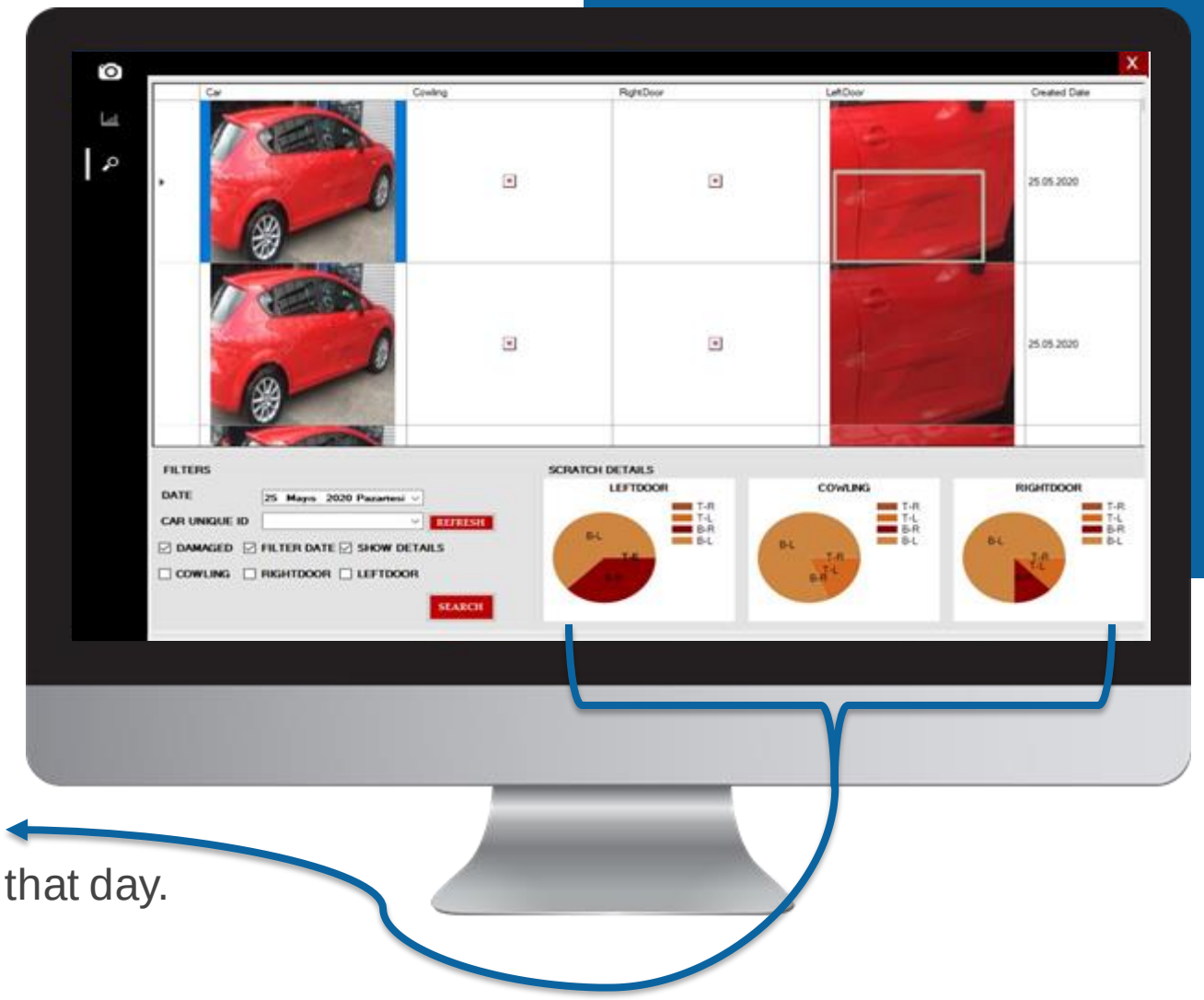
The section in which the damaged cars passing in the day are located and the number of examinations are shown graphically.

In the section where there are errors, the section with the graphics showing the location frequencies of the errors.



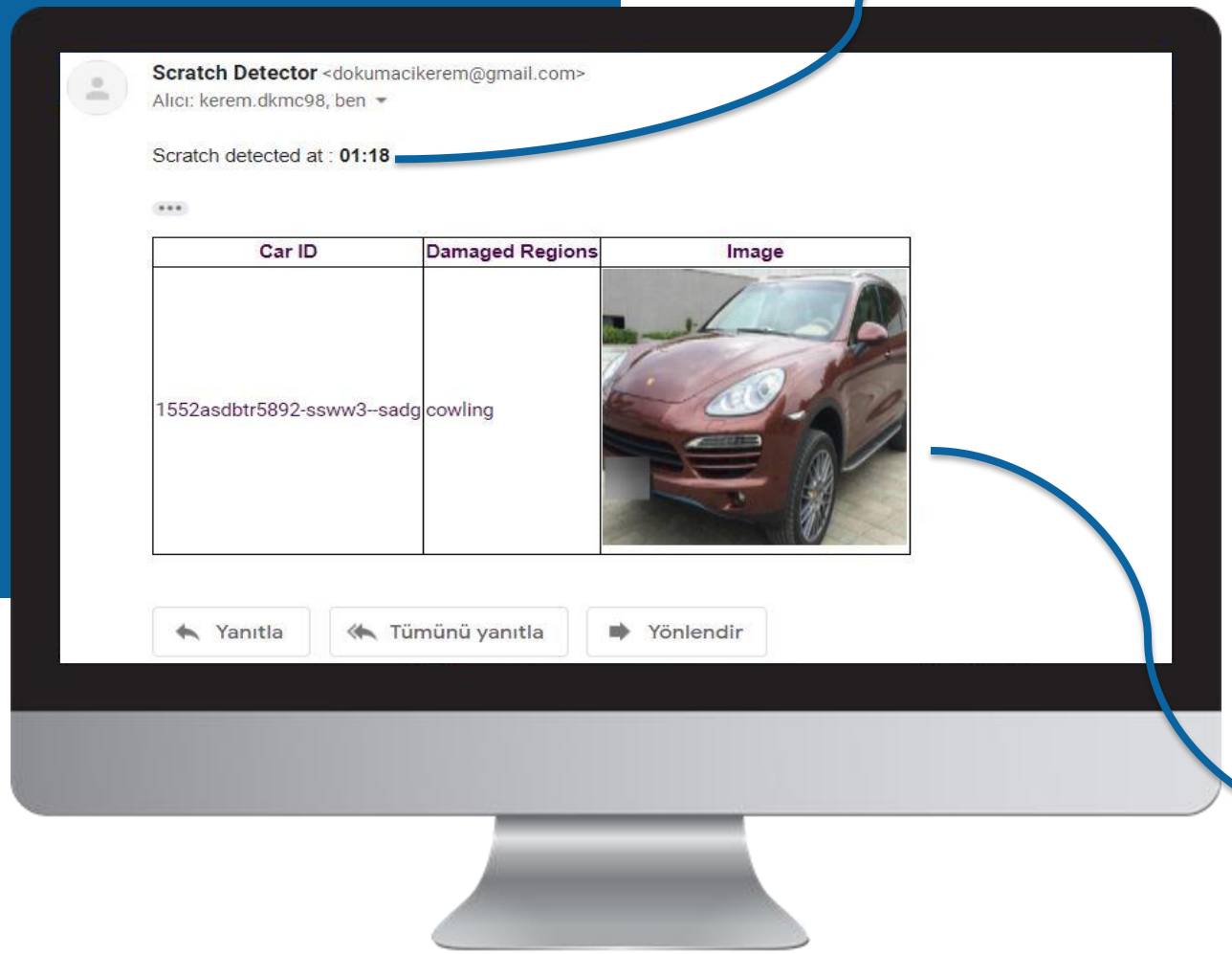
The section that can be searched on all vehicles registered in the database with the filters to be selected.

The section with the filters to be used to make inquiries on all vehicles registered in the database.



Depending on the selected day,
the section containing the location
distribution graphs of the damages within that day.

When the scratch is seen.



The UniqueID value of the car which is seen as scratched, which region of the car is scratched and the image of the car are indicated in the mail.