Introduction to Computer Vision

# Recognition of license plates

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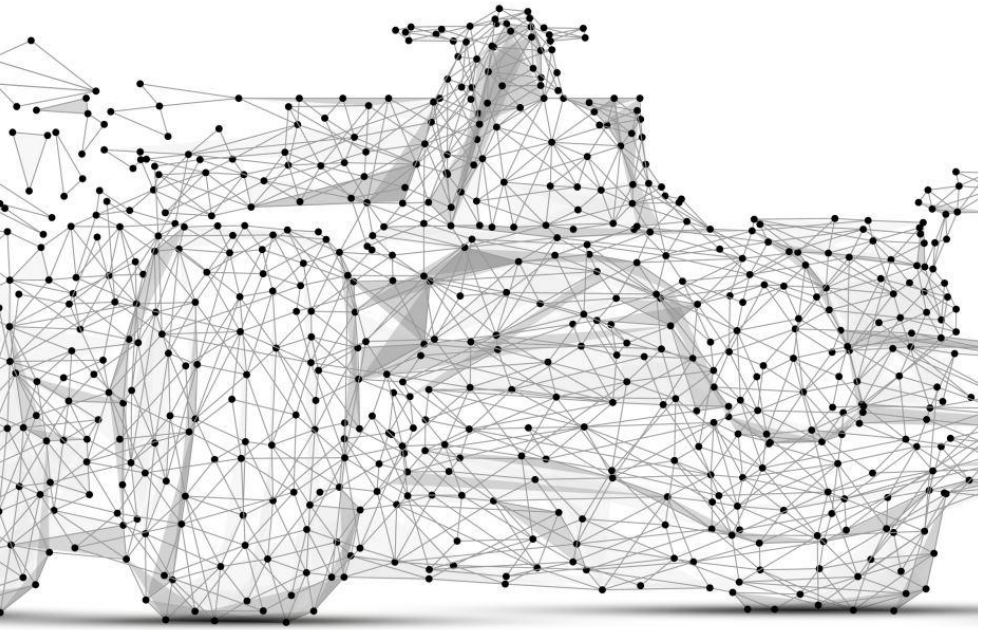


# Abstract

The presentation describes the stages of creating an application for automatic license plate recognition and vehicle number identification using neural networks and the machine learning approach, starting from data preparation for training and ending with performance testing. The network model was used to implement the license plate detection mechanism and the machine learning, OpenCV libraries was used for the optical recognition of identification numbers on the detected plates. The verification of the effectiveness of the application concerned the assessment of the correctness of the detection of license plates in vehicles and the recognition of identification numbers.

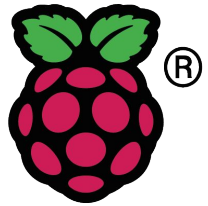
# Aim of the project

The goal of our project is to implement the registration plate recognition algorithm and the following individual letters and numbers from these plates. We plan to collect a photo base where the license plate will occur. Build a classifier that finds a registration plate from the database of collected photos, sets individual letters and numbers. Then the algorithm that interprets them.

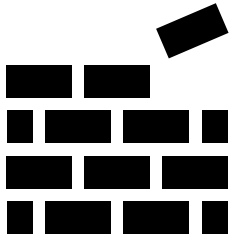
# Introduction

Recognizing a text from an image is a quite complex process and with an inadequate image that is very demanding in calculation. Now, neurons are used for this purpose, that are able to recognize the studied text. Validation depends on many factors, such as text size and picture quality. However, for algorithms to work quickly, it is necessary to prepare the image ahead of time to reduce interference.

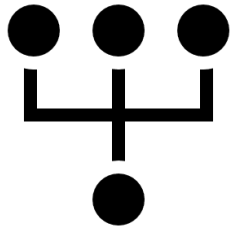
# Used technologies

- OpenCV 
- Python 
- Raspberry PI 
- Git 

# Project tasks

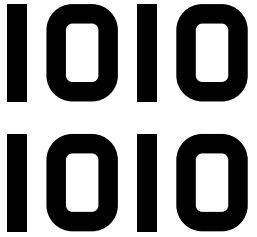


Collecting a photo database to the program



Implementing the classifier


Implementing the determination of individual letters from the table




Recognition algorithm of individual letters and numbers from plates

# Process of the project

The license plate recognition process consists of three stages:



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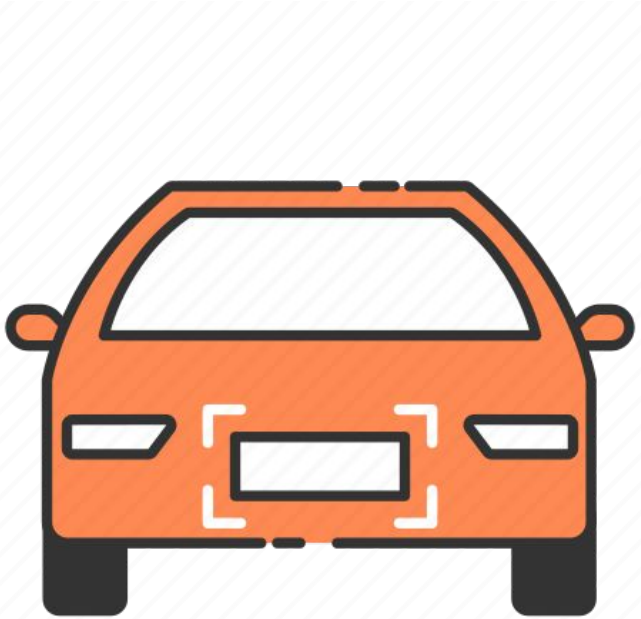
# Location of the license plate

The location of the license plate is the most important and most difficult part of the process. The license plate can be anywhere on the input image, the lighting conditions of the image may vary, and the background often contains objects with high detail. These factors help to create errors when locating the table that may prevent subsequent segmentation and correct identification of the characters. In current license plate detection algorithms, plate positions can be established by techniques such as morphological features, edge detection, adaptive threshold or vector quantification.

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# Location of the license plate

Licence plates have such a significant feature. It is a one-color text on a one-color background mainly with a high contrast. It causes that licence plate is characterised by many edges and corners in a small area. Our license plate location algorithm uses a method to detect and analyze the edges and corners in the image. Compared to the original algorithm, the image pre-processing process has been modified and a new way of determining the vertical boundaries of the array has been proposed. Edge detection was performed using Canny Edge Detection algorithm, while corners are search using Harris Corner Detection.




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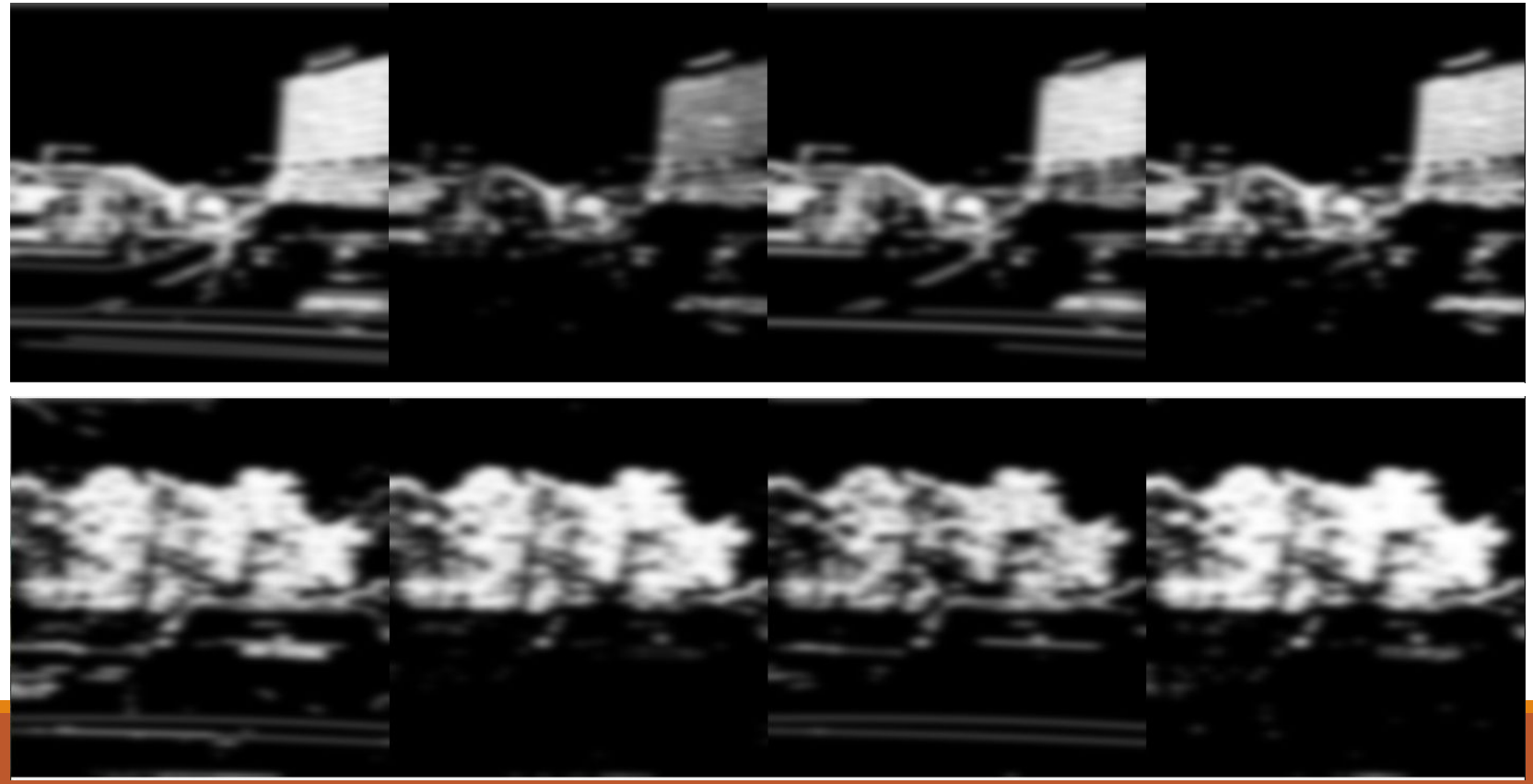
# Plate detection process

1. The first step is to reduce the size of the picture. The image consists of pixels and each pixel is described by three RGB (Red, Green, Blue) colours. Image size is the product of the height in pixels, the width in pixels, and the colour in bytes. The colour is usually described by 24 bits. This product gives the size of the image in bits. However, if you convert an image as shades of gray, the colour of the 1 pixel will describe only 8 bits, which will reduce the size by 16 times
2. The second step is to extract features from the grayscale image. As was said before on the plates we can observe higher density of corners and edges.
3. The third step is to apply the MLP to detect which area are high possibility to contains a license plate
4. The final step is determine rois where algorithm is sure that the area contains license plate

# License plate detection

For license plate detection we used a MLP model structured as follows: 5 layers each 800 neurons and LeakyReLU between them. MLP was learned with images features extracted by morphological operations and edge and corners detectors.

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# License plate segmentation

The character segmentation step is to extract the individual characters from the table in a preset area on the image. You can segment the characters using, for example, the horizontal projection of brightness. Another approach could be to use the connected components method or the clustering analysis method. If you segment characters incorrectly (for example, two characters combined into one or one character broken into several parts), the detected characters will not be recognized later.

# License plate segmentation

License plate segmentation is made by quite simple algorithm. Found plate is thresholded and then is skeletonized using erosion and dilation morphological transformation. After skeleton is obtained individual signs are separated and can be easily extracted.

# Recognize individual letters

The final step in the license plate recognition process is character recognition. The whole mechanism is based on machine learning. The entire collection of letters was made up of collected pictures. We expanded the set by moving the letters up, down, to the left and by imposing a blur. At first, the classifier (SGDClassifier) is being coaching. Training is performed by providing images and mapping image descriptions. After this process, it knows the letter shapes and is able to recognize new images. However, this process is not 100% effective and there are images that are detected incorrectly.

```
Found D9DW337WG3W5WWW correct DW337WG s level 0.6363636363636364
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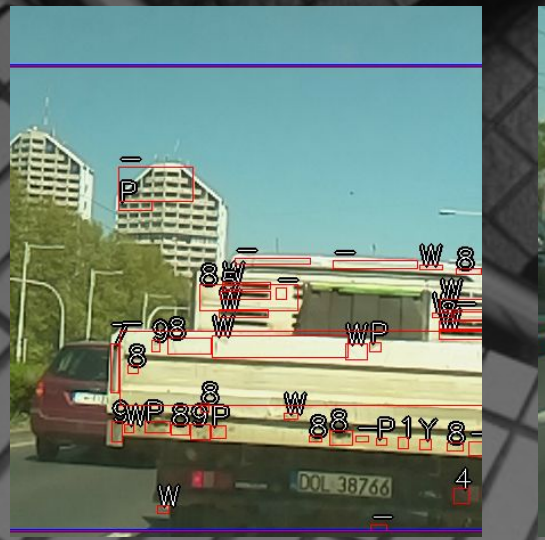
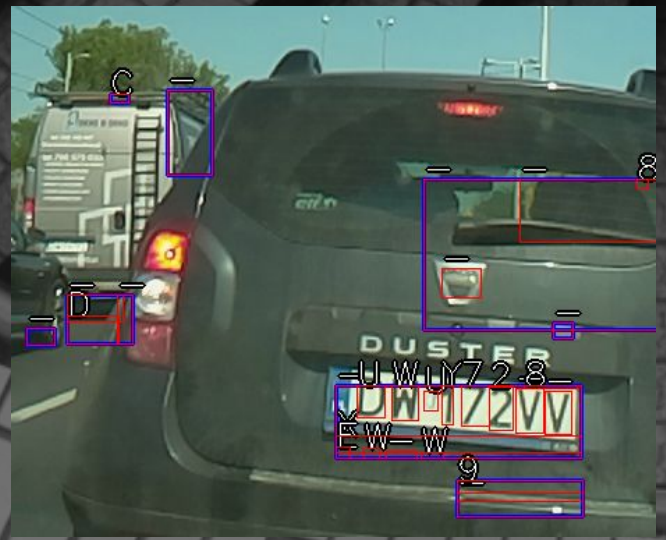
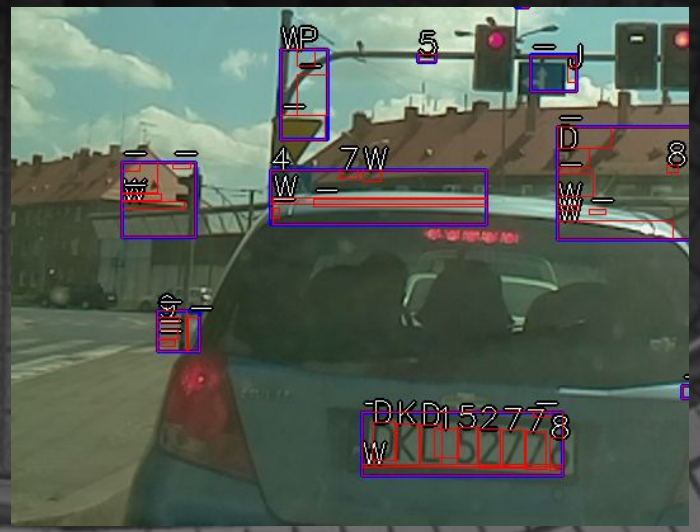
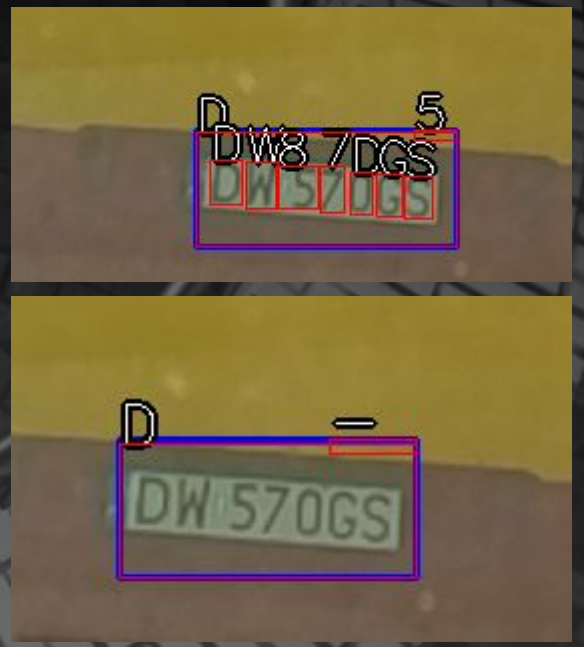
# Research and testing

License plate recognition has been tested for correct image recognition. The test uses an 80 image of the tables taken under various atmospheric conditions. The effect of distance from the device was also examined. Depending on the colour of the car or the intensity of the light, the algorithm has better or worse been able to find a recording on the photo. Photos with dirty plates clearly show that the higher the noise, the less precise the text.







# Summary

The detection of license plates is a very important and at the same time, a very difficult stage in the automatic license plate recognition process. License plate detection algorithms consisted of appropriate pre-processing (filtering), detection of vertical and horizontal boundaries, appropriate selection of structural elements and methods for threshold and selection and verification of candidate areas. The tests have shown that the distance from the object being measured is important. The test has also shown that there are case letters that cannot be read. Interference with the subject registration will reduce the accuracy of finding the registration. Our approach was characterized by 71% plate searching efficiency and 41 % recognition correlation level. Mean time of analyzing individual image was 0.753 s.

# Bibliography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