License Plate Localization, Segmentation and Recognition
Interim Project Report

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Abstract

The focus of this project is to develop a system for localization, segmentation and recognition of licence plates in images. Reading from literature, we have tried three ways of localizing license plate.

I. MOTIVATION

Automatic car identification systems based on localization and recognition of number plates from images, form a fundamental problem in computer vision.

Quick developments in Image Processing and need for faster, cheaper and more efficient systems in automotive security and steering systems has resulted in development of sophisticated solutions to this problem.

A solution to such problem can be applied in many areas and can form a basis of automatic systems providing access to protected areas, route traffic monitoring for offences and traffic system violations.

Most countries have an elaborate network of surveillance camera throughout cities and yet don't have systems to automatize car identifying process. Solutions are still expensive and not deployed at a very large scale.

II. METHODOLOGY

A. PRE PROCESSING

The first step in the pipeline is to process the image. First we use Median Filter to remove the black and white noise from the image. This is followed by adding a gaussian blur to image using 3x3 Gaussian Kernel with a standard deviation of 0.5 (default in MATLAB). We then sharpen the image using unsharp mask.

Gaussian blur and sharpening removes a lot of noise around the license region and also makes the license plate text sharper.

B. LOCALIZATION

Second step in the pipeline is to localize the license plate region in the image. The goal of this step is to find the sub image in the original image that includes the license plate. This removed the background and makes the processing of the image faster. This stage strongly influences the results of OCR. A lot of techniques have been proposed for the same, we are going discuss them here.

1) Boundary and Edge information

Since the licence plate has a rectangular shape and always has a certain aspect ratio, we can find all rectangles in the image. And reject false positives based on their aspect ratio. However, we have noticed that many times plate might have some perspective transform in our data set. Hence, rejection based on aspect ratio doesn't always work. A way to solve this problem is to use vertical edge information.

2) Texture based localization

Licence Plates usually have rapid change in characters and background. This feature results in high edge density areas. These regions can be detected in two ways: Scan-line technique and sliding a window across image.

3) Color features

Licence plate usually have a particular color combination like black text on white background. However, a particular RGB value cannot be specified to localize plates because color of plate in the image depends on a lot of factors like weather, lighting, direct sunlight and also lack of light in many cases.

Some ways to change the RGB colors to hue, lightness and saturation have been proposed to increase accuracy.

4) Feature based localization

SIFT features in the image can used to compare SIFT features for a template and locate license plate in image. MSER Regions are used to assist this process. However, this requires a template image and high quality images to detect features.

C. LICENSE PLATE PROCESSING

This is the third part of the pipeline. We run adaptive thresholding on localized licence plate to get a binary image. A series of dilation and erosion are used on the image to get properly formed characters and join any broken ones. Affine transformation is also used to get an upright image before running OCR.

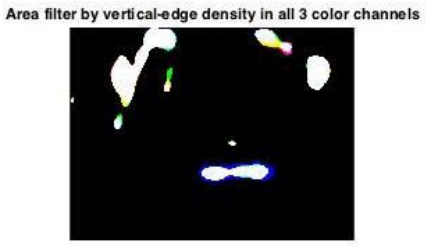
D. OBJECT CHARACTER RECOGNITION

The final part of the pipeline is running OCR. We would be using a trained OCR for License Plates. We would also try MATLAB's OCR or Tesseract. We would also like to try Google new Vision API to get OCR on images.

III. WORK DONE

We have tried to localise the region in image containing the license plate. From the above proposed approaches, we have tried multiple approaches and also tried to combine the first two approaches.

First step was to take Sobel Operator in vertical direction and find vertical edges in the image. Then we added gaussian blur to this image. Because of high contrast between characters and background, we applied the area filtering by vertical edge density for all 3 RGB channels, and filter out single color edges, such as that from rear light or environmental background



Using region labeling, we can label different regions and reject the areas based on the aspect ratio of a standard license plate.

As you can see from the image, License plate is localized in the high edge density regions.

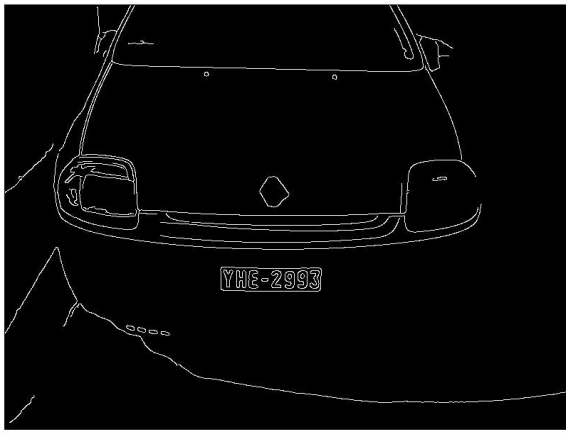
IV. OTHER APPROACHES

Some other approaches that we tried.

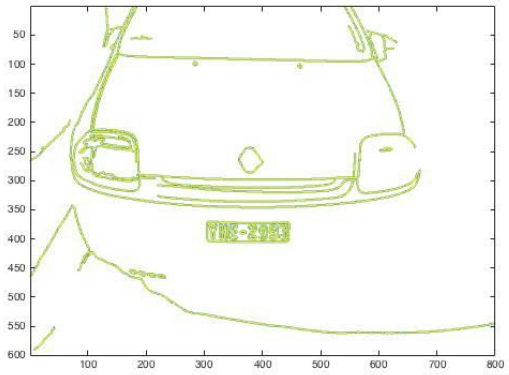
1) Contours

Another way to detect rectangles is to use Contours.

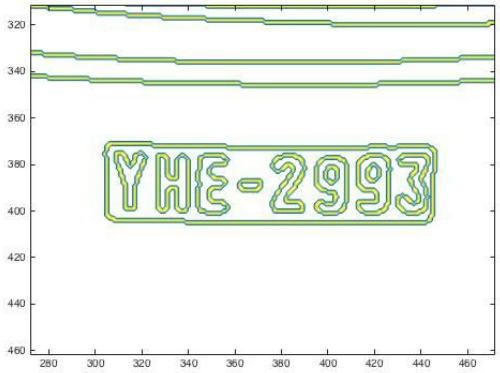
After preprocessing the image as mentioned earlier, we took the canny edge output. We adjusted the threshold to remove all the clutter.



In an attempt to detect the rectangular license plate, we used contours. We got all the contours including the characters on the number plate and the number plate itself.



Rejecting contours based on Geometry isn't very effective.



2) MSER Features

We tried to detect text regions in an image using MSER features. The aim was to detect all probable regions which might contain text and then use threshold to narrow down to the region containing text. We tried out the inbuilt MSER feature detector in Matlab. But we found that command detectMSERFeatures in Matlab does not return the connected components which is required to detect text regions based on various properties such as aspect ratio, eccentricity, etc.We also tried VLFeat MSER region detector to extract the connected components data structure. However, we chose not to explore this further since license plate localisation through MSER is slow and time consuming. Moreover, we had to change threshold for every image manually and are still researching for appropriate threshold values.

V. FUTURE WORK

The method proposed above is not highly accurate for the dataset we are using. Sometimes aspect ratio doesn't match with the plate in the image. Hence, a part of image is located.

We plan to work on the thresholds so that we can match aspect ratios and locate the complete plate for the complete dataset.

We also plan to look into other ways of localization to improve accuracy, as this step is the deciding factor for accuracy of the entire pipeline. Our next focus shall be to segment the image of localised number plate and perform character recognition through OCR such as Tesseract.

We also plan to look into other OCR options where we can train it for License Plate specific characters, if Tesseract and other options do not perform accurately.

VI. WORK DIVISION

Since we are team of two, we plan to divide work equally. This includes equal division of coding, evaluation and testing in the project.

VII. REFERENCES

[1] Licence Plate Recogniton System
[2] Licence Plate Recognition in Video
[3] ALPR: State of Art Review