



# License Plate Detection and Recognition System

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**Problem Statement** **01**

**Proposed Solution** **02**



**License Plate  
Detection** **03**

# TABLE OF CONTENTS

**04** **Character  
Segmentation**

**05** **Character  
Recognition**

**06** **Results and  
Discussion**



# 01

## Problem Statement

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# Problem Statement

As time passes, new cars are released into the highways every day. With the exponentially increasing number of vehicles, traffic violations appear more frequently in public traffic, such as fraud tolls on roads or parking, speeding, and theft of cars. Hence, there is a need to identify vehicles with their respective license plates for safety. Getting the information from a License plate can be used in different scenarios, such as access to flow control, monitoring border interchanges, highway toll stations ,and to fight crime by searching suspicious or registered vehicles.





02

**Proposed Solution**

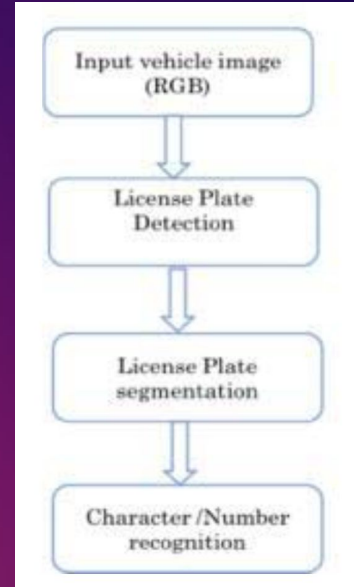
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# Proposed Solution

Our proposed solution for the License Detection and Recognition System is divided into three distinct subcategories:

- License plate detection: Get the ROI (Region of interest) rectangle that indicates the license plate and cropped image of a license plate.
- Character segmentation: After getting the license plate image cropped we proceed to identify each character.
- Character recognition: After getting each character we start making predictions on what letter could be.



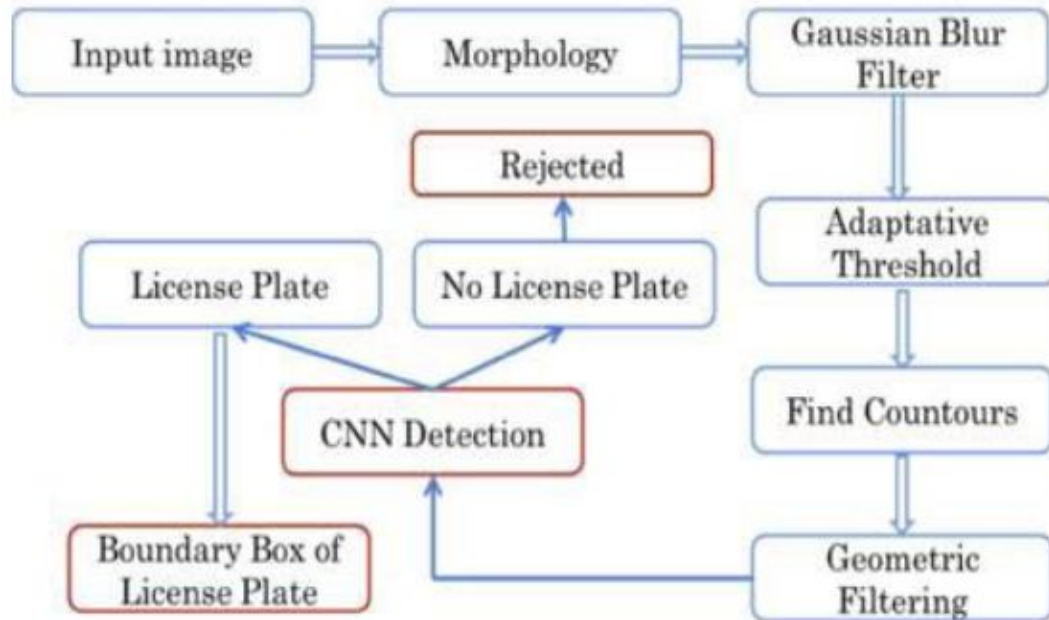


03

# License Plate Detection

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# License Plate Detection





# License Plate Detection

- Convert the input image from RGB to HSV:
- Morphology filtering to contrast maximization:
  - White top hat: is used to enhance bright objects of interest in a dark background.
  - Black black hat: is used to do the opposite, enhance dark objects of interest in a bright background.

ORIGINAL RGB



ORIGINAL HSV



Original GRAY



Tophat



Blackhat



# License Plate Detection

Tophat



Blackhat



# License Plate Detection

Gray + Tophat



Blackhat - (Gray + Tophat)



# License Plate Detection

- Gaussian blur filter
- Adaptive threshold

Previous Filtering



After Filtering



After Adaptive Threshold





# License Plate Detection

- Finding all contours
- Geometric Filtering

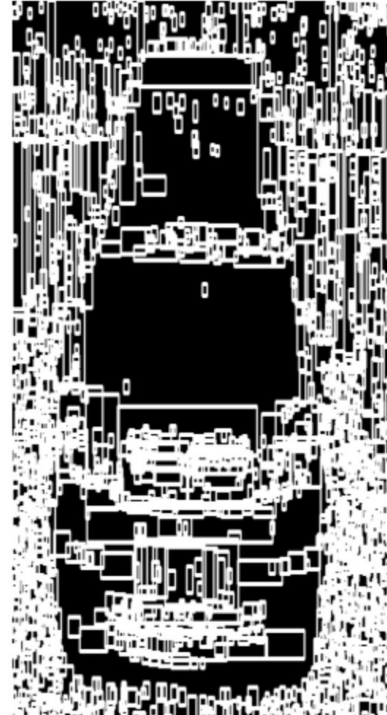
Original



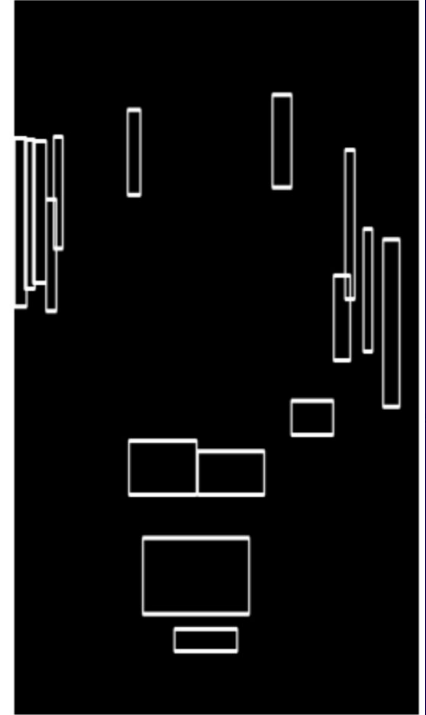
Original with all contours



Output with boxed contours



After filtering geometrically contours





# License Plate Detection

- CNN model structure
- Classes are composed by License Plate and Non-License Plate

Layer Type	Parameters
Softmax	#2 classes
Fully connected	#2. neurons
Dropout	0.5
Fully connected	# 4224 neurons
Maxpooling	P :2 x 2, stride :2
ReLU	
Convolution	#filters : 32, kernel : 5x5, stride
Maxpooling	P :2 x 2, stride :2
ReLU	
Convolution	#filters : 16, kernel : 5x5, stride
Input	100 x 36 gray-scale image

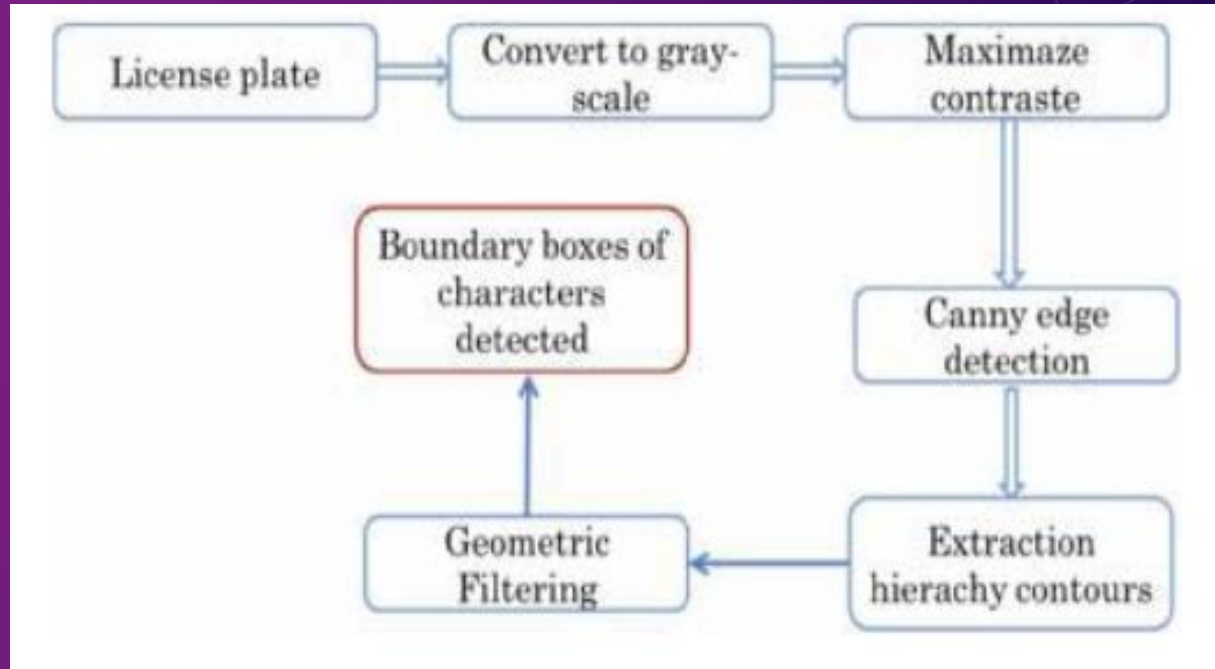
# 04

## Character Segmentation

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# Character Segmentation



# Character Segmentation

- RGB to Gray Scale
- Maximize contrast
- Canny edge detection
  - Implemented an Auto Canny function
  - The Auto-canny function that requires two arguments:
    - A single-channel image
    - A sigma value

Original RGB



Original GRAY



Bitwise



Erode



dilate

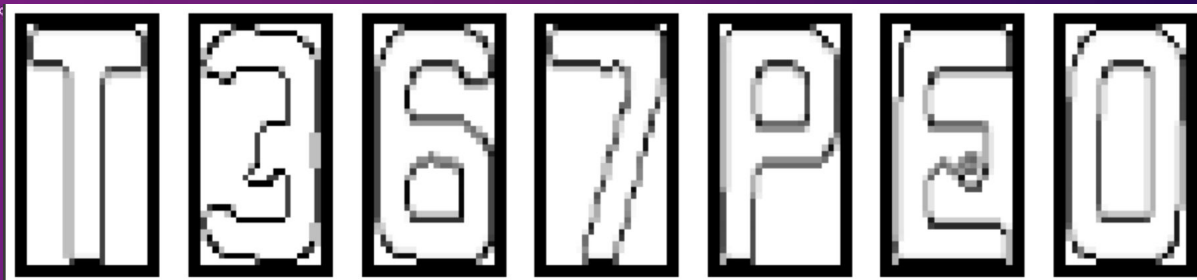
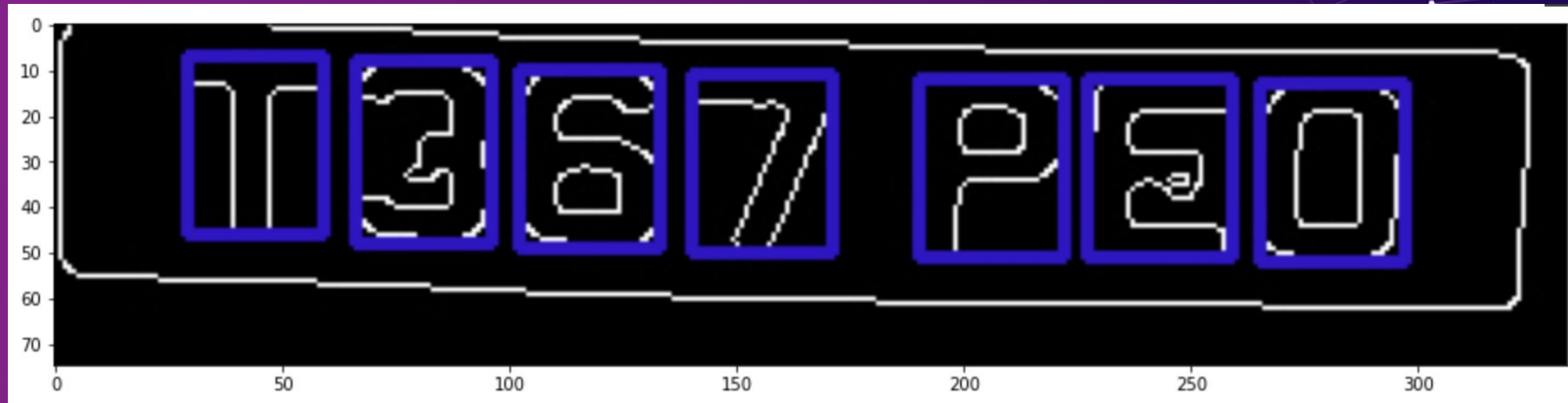


Canny image



# Character Segmentation

- Extraction of hierarchy contours
- Geometric filtering





# Character Segmentation





05

# Character Recognition

# Character Recognition

- Classes are A-Z, 0-9, and error class

Layer Type	Parameters
Sofmax	#37 classes
Fully connected	#37. neurons
Dropout	0.5
Relu	
Fully connected	#1024 neurons
Maxpooling	P :2 x 2 , stride :2
ReLU	
Convolution	#filtres 256 kernel :3 x3 , stride :1
ReLU	
Convolution	#filtres 128 kernel :3 x3 , stride :1
Maxpooling	P :2 x 2 , stride :2
ReLU	
Convolution	#filtres : 64 kernel :3 x3 , stride :1
Maxpooling	P :2 x 2 , stride :2
ReLU	
Convolution	#filtres : 32, kernel :5x5, stride :1, p :0
Input	32 x 32 gray-scale image

The background features a complex network of white dots of varying sizes connected by thin white lines, creating a web-like or molecular structure. The dots are more densely clustered on the left side and become sparser towards the right. The lines vary in length and orientation, forming a series of interconnected triangles and polygons. The overall color scheme is a gradient of purple, from a lighter shade on the left to a darker shade on the right.

# 06

## Results and Discussion

# Results and discussion

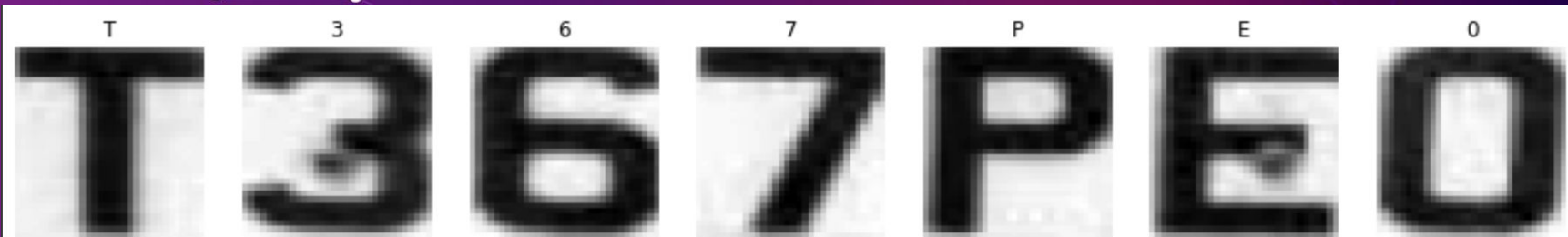
## Overall System Results Summarize

Compared with the results from the paper our results differ a lot for plenty of reasons, such as not working with the same datasets, different criteria for the geometric filtering and other parameters that were set by our own because they were not completely detailed in the paper.

ORIGINAL IMAGE



PLATE IMAGE







# License Plate Detection and Recognition System

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