

**Institute of Technology, Carlow**

**B.Sc. Hons. in Software Engineering**

**CW228**

# **Requirement Specification**

**Project Title:** Number Plate

Recognition

**Name:** Dongfan Kuang

**Login ID:** C00131031

**Supervisor:** Nigel Whyte

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# 1. Introduction

## 1.1. Purpose

This requirement specification specifies the requirements of the Number Plate Recognition (NPR), which is a kind of software that enables computer systems to read the registration number of vehicles from digital images. This document is the basis of the guideline for the entire software development. It will also be useful for the clients to ensure all requirements and specifications.

## 1.2. Project Introduction

NPR is as frequently can be divided into two main parts, one part is usually some closed-circuit televisions or road-rule enforcement cameras which used to capture the digital image of vehicle, another part is a special form of optical character recognition (OCR) which can read the registration number automatically from the number plate area in digital image and change the number into plain ASCII text. This project is only deal with the software part of NPR, it will analysis the inputted digital image and output the registration number of a vehicle.

## 2. Overall Description

### 2.1. Product Perspective

The process of NPR can be divided into 5 main steps: image pre-processing, canny edge detection, number plate localization, segmentation, and character recognition. Each main step is contains several sub-steps. The system flow is shown in figure 2-1.

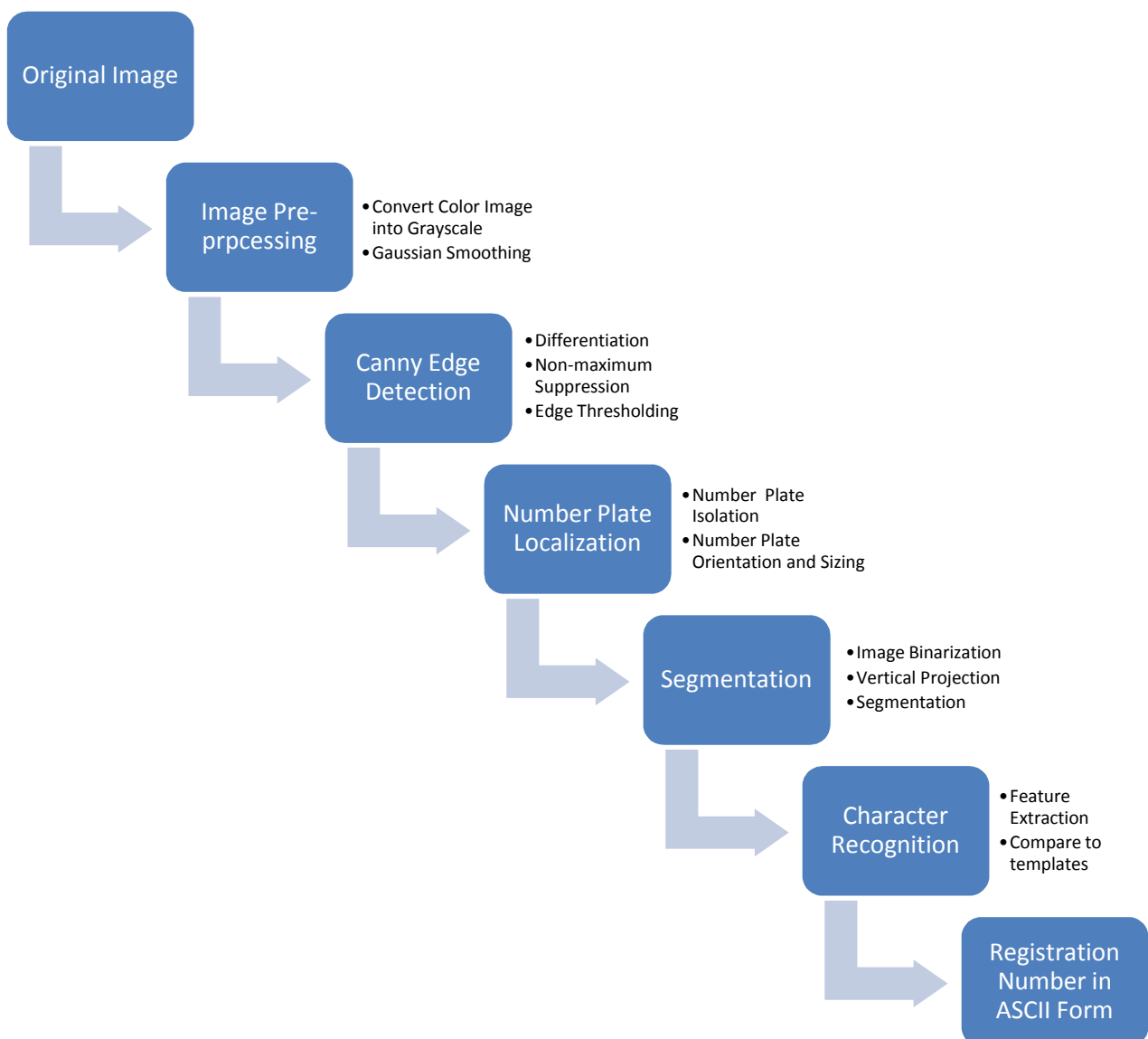


Figure 2-1 system flowchart

## 2.2. Product Function Overview

The whole system can be divided into four main parts: Image Pre-processing, Number Plate Localization, Character Segmentation and Character Recognition. Each main part contains some important functions as is shown in figure 2-2.

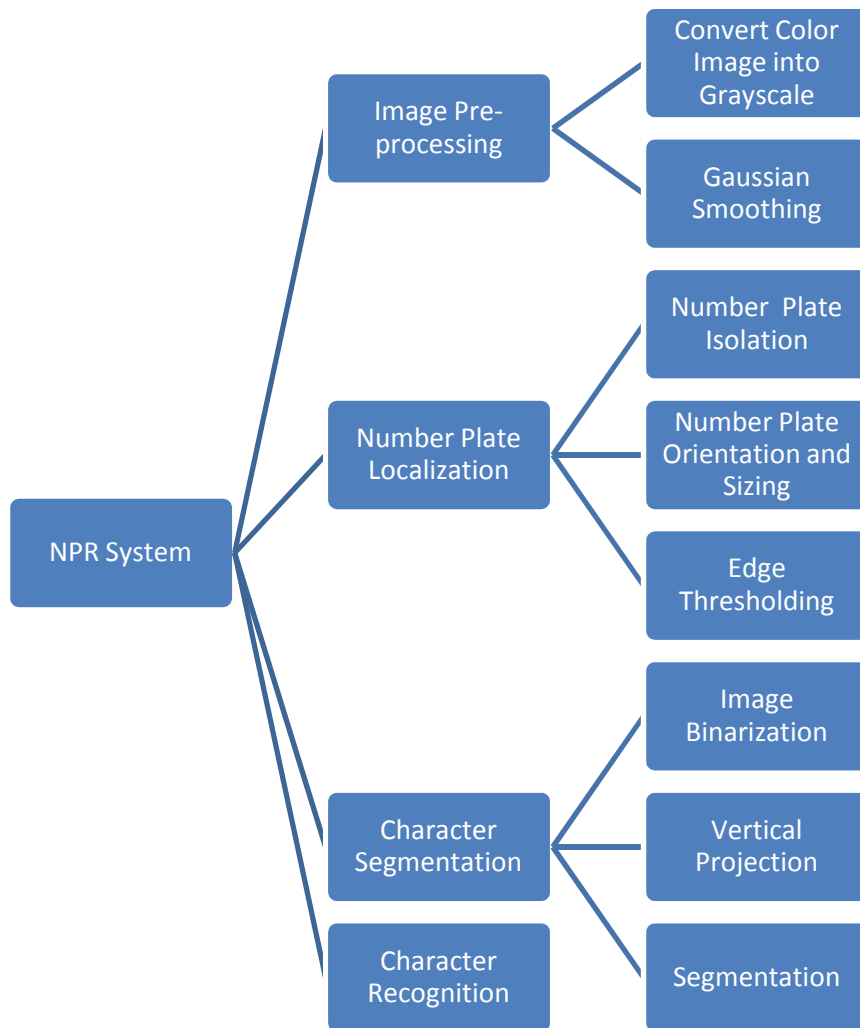


Figure 2-2 system functions diagram

## 3. Functional Requirements

### 3.1. GUI Prototype Screenshots

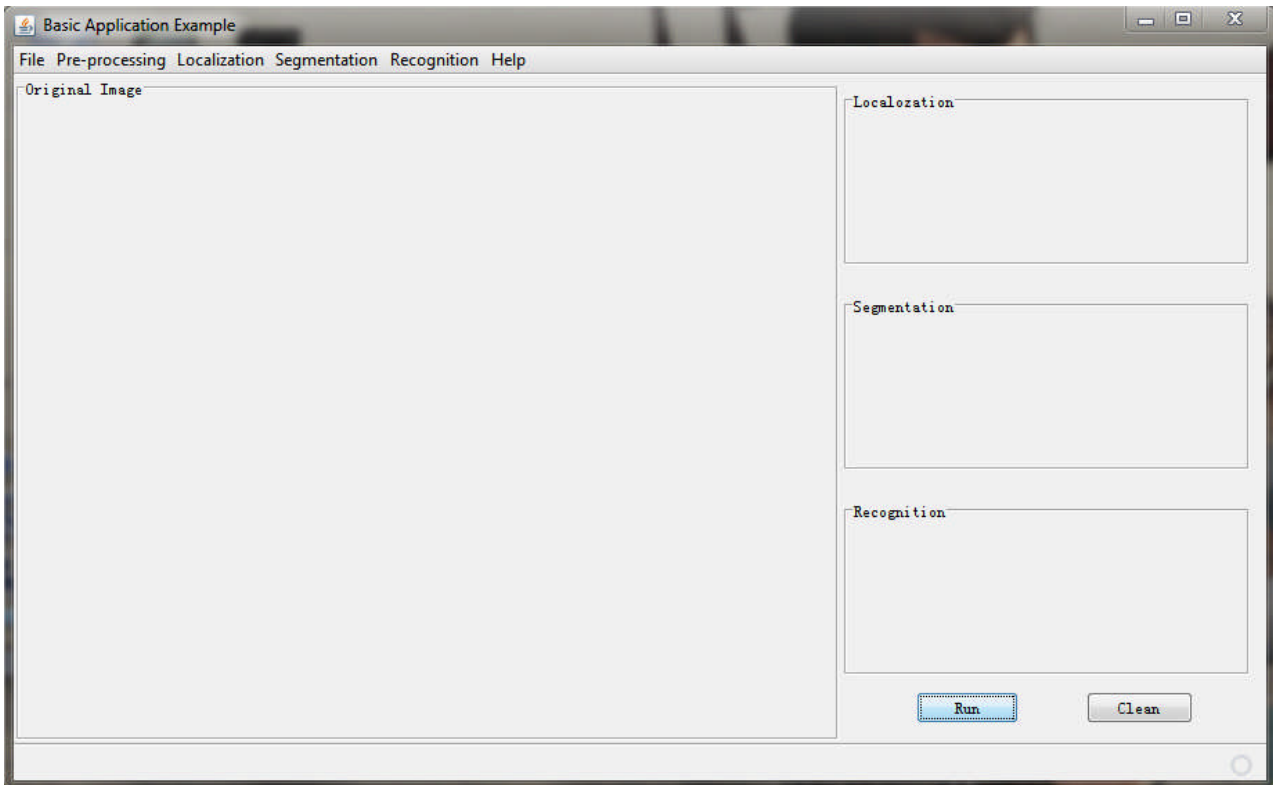


Figure 3-1 NPR screenshot

The menu bar of NPR contains 6 menus: File, Pre-processing, Localization, Segmentation, Recognition and Help. All the functions of NPR are listed in these menus.

Below the menu bar is four panels: Original Image Panel, Localization Panel, Segmentation Panel and Recognition. When NPR is running, the result of each step will be displayed in these panels.

Two bottoms in the lower right of the software: Run and Clean, which can run the software to output the registration number of the vehicle and clean all the changes to let the software return its original state.

## 3.2. Function Description

### 3.2.1. File Menu

There are two options in File menu:

**Open:** choose an image file from a file choose dialog, this image will be displayed in the Original Image Panel.

**Exit:** close the whole software.

### 3.2.2. Pre-processing Menu

There are two options in Pre-processing menu:

**Convert color image to grayscale:** change the imported color image into grayscale image and displays the grayscaled image in the Original Image Panel. This option is only available when an image is imported.

**Gaussian Smoothing:** this option is used to smooth the imported image by removes the noises in it. This can increase the successful rate of character recognition step.

### 3.2.3. Localization Menu

There are three options in the Localization menu:

**Edge Detection:** perform the edge detection algorithm to the imported image to remove all the other information except the edges. After perform this algorithm the edge information in the original image that displayed in the Original Image Panel will be changed into white color and all the other area will be changed into black.

**Number Plate Isolation:** separate the number plate area from the image by moving a pre-defined slid window around in the image to find the area that contains the maximum number of white pixel, the isolated sub-image will be displayed in the Localization Panel. Because the pre-defined slid window is usually bigger than the number plate, so the isolated area is bigger than the

number plate. This option is only available when the edge detection algorithm is performed to the image.

**Number Plate Orientation and Sizing:** resize the isolated number plate by remove the border around the plate. This option is only available when number plate is isolated from the image.

### 3.2.4. Segmentation Menu

There are three options in the Segmentation menu:

**Image Binarization:** get the sub-image from the original image as the same size and position of the resized number plate area, convert the sub-image into binary image and display it in the Localization Panel. This option is only available after the number plate is isolated and resized.

**Vertical Projection:** apply vertical projection on the binary sub-image to count the number of white pixels column by column, display the information as a curve in the Segmentation Panel.

**Character Segmentation:** separate binary sub-image into several parts by using the information from vertical projection, each separated part is supposed to contains one character and all of these parts are displayed in the Segmentation Panel.

### 3.2.5. Recognition Menu

There is one option in Recognition menu:

**Character Recognition:** perform the character recognition algorithm onto the separated parts of the sub-image to recognize the character contains in them, change the character into ASCII form and display them into the Recognition Panel.

### 3.2.6. Help Menu

**NPR Help:** a user manual will be opened to teach user how to use the software.

**About NPR:** a dialog window will be opened to show the information of the software.



## 4. User Classes and Characteristics

The range of user that will use NPR is very wide, they can be roughly divided into two categories:

**Commercial users:** this kind of user will use NPR in commercial applications, for example: parking, access control, tolling, traffic control, and so on.

**Academic user:** this kind of user will use NPR in academic purpose, for example: teaching, research the algorithm about edge detection or character recognition, and so on.

## 5. Metrics

- **Supported image type:** support two kinds of common image type: BMP and JPG.
- **Image quality:** allow the image be taken in front of the number plate around 3 meters with a tilt angle less than  $5^\circ$ , allow complex background and certain amount of noises the imported image.
- **Number plate localization rate:** the success rate of number plate localization is higher than 95%.
- **Recognition rate:** the correct read rate of number plates is higher than 90%.
- **High efficiency:** keep the time for each recognition process as short as possible.
- **Easy to use:** the functions should be practical with friendly interface to allow user to get familiar to it quickly.

## 6. Precedent Similar Software

Talon Automatic Number Plate Recognition Systems (Talon ANPR System) is a software based processor which designed to be work on computers running the Windows operating system. Talon ANPR System is based on a neural network recognition engine. Neural network is a very

new and powerful technology, it usually has higher correct read rate of number plate than other alternative character recognition solutions.

In the Talon ANRP recognition process, Talon first using a 'plate finding' algorithm to detect the presence of number plate in the camera's field of view. Then Talon segments the plate into individual characters and fed each character into a software neural network. The network produces an estimate for every character and output a string of characters, which is the best estimate for the number plate.

The recognition process of my project is also contains number plate localization, character segmentation and character recognition, which is very similar with Talon. The biggest difference is in character recognition phase Talon use neural network technology to identify character, but I use template based character recognition technology. Although neural network is a very new technology offers high performance and accuracy, but it is very hard to understand and implement. Template based character recognition is a more mature technology that can be implemented easier than neural network and also offers high efficiency.