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1.0 Introduction

- A rapid technical growth in the area of computer image processing has increased the need for an efficient and affordable security, thus resulted in the evolution of different kinds of solution based on computer image analysis.

- One type of these solutions is automatic license plate character recognition (ALPR).

- ALPR is a crucial subject of research due to its wide market applications to meet specific demands such as-
  i. automatic system steering to access protected area
  ii. route traffic monitoring system
  iii. electronic payment system (toll fee, parking fee payment) and etc.

2.0 Objective

• The objective of this project is to design a system to detect and recognise a vehicle's license plate.

• The project objective can be accomplished through the following efforts:

i) To retrieve properties of Signature Analysis that has been used in Vehicle localisation.

ii) To extract character's features.

iii) To form 56-element input vector to be trained in Neural Network.

3.0 Methodology

• The license plate recognition sequence, which is proposed in this paper, consists of three distinct parts.

• The first one deals with the further usage of properties obtained from Signature Analysis [1].

• The second part includes operations of thinning algorithm on the signature.

• Finally, the third part deals with the thinned character, where its features will be extracted to be trained Artificial Neural Network.

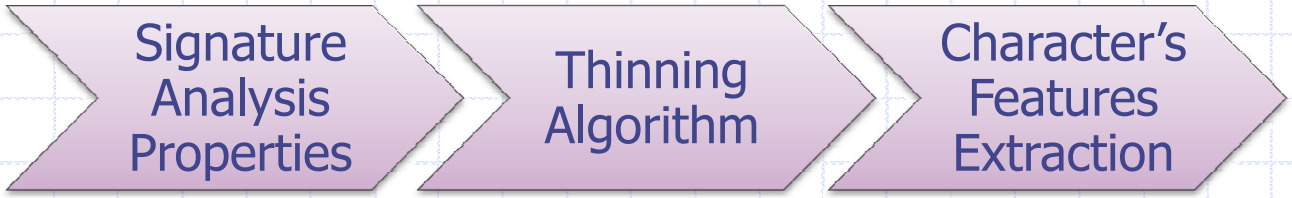
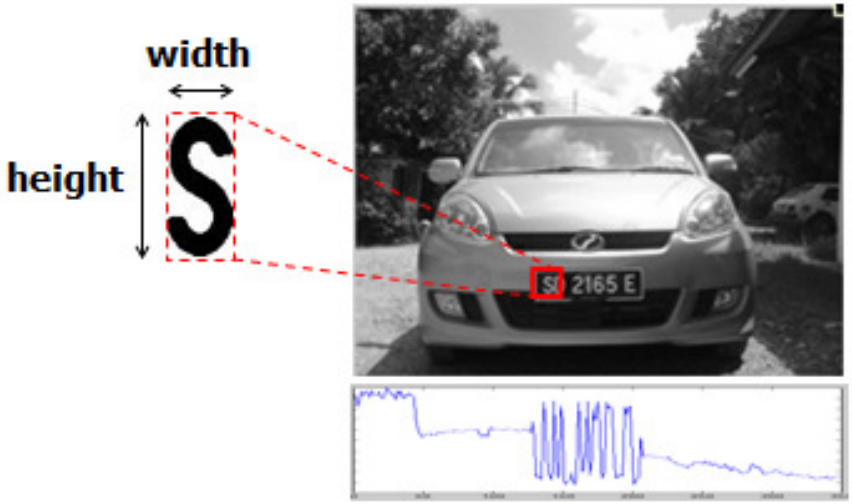


Figure 1 – Overview of license plate recognition sequence

3.0 Methodology

• Fig.2 shows how the properties obtained in Signature Analysis are used to form the WH ratio and later on to be trained in artificial neural network for recognition purpose. The size of this bounding box is crucial as only a certain width-to-height (WH) ratio of the bounding box as shown below will be considered in thinning and recognition stage.



$$W = \frac{w}{h}$$

Figure 2– Finding WH ratio

3.0 Methodology

• Features extraction is an approach used to extract geometric features of the character contour.

• After the shortest matrix for the character skeleton is found, the image is zoned into 9 equal size windows. Features extraction is applied on the individual zones rather than the whole image.

• Fig.3 shows that the horizontal line segment occurs in the upper zones, central zones and lower zones of character 'T', 'H' and 'L' respectively. On the other hand, a diagonal line segment may occur in character such as '2' and '7'.

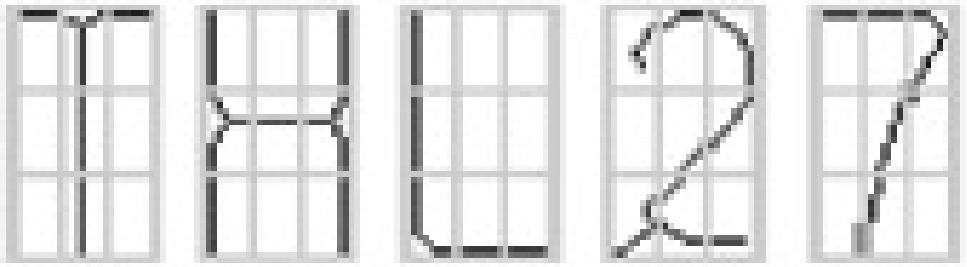


Figure 3 – Character zoning

3.0 Methodology

• Neural Network is constructed with 56 input and 34 neurons in its output layer.

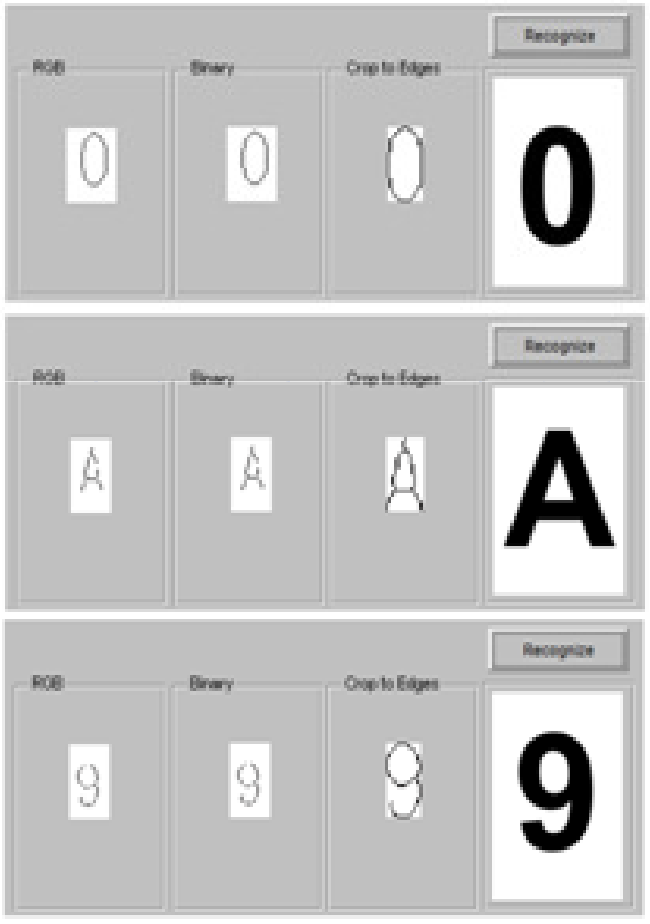
• The 56-input vector comprises of the following

i. no. of horizontal line in each zone
ii. no. of vertical line in each zone
iii. no. of left diagonal line in each zone
iv. no. of right diagonal line in each zone
v. actual number of pixels in the zone
vi. ratio of white pixels to black pixels in the zone
vii. WH ratio
viii. Character's Euler number

• Single hidden layer with 10 neurons.
• The network is trained with both ideal and noisy vectors (characters).
• Firstly, the network is trained on ideal vectors until it has a low sum-squared error.
• Then the network is trained on 136 of both ideal and noisy vectors.

4.0 Results and Discussions

- Figure beside shows character recognition experimental results based on the proposed algorithm.
- Sample of license plate characters were thinned before they were fed to the neural network for training.
- T1 shows successful recognition for ideal character input.



T1

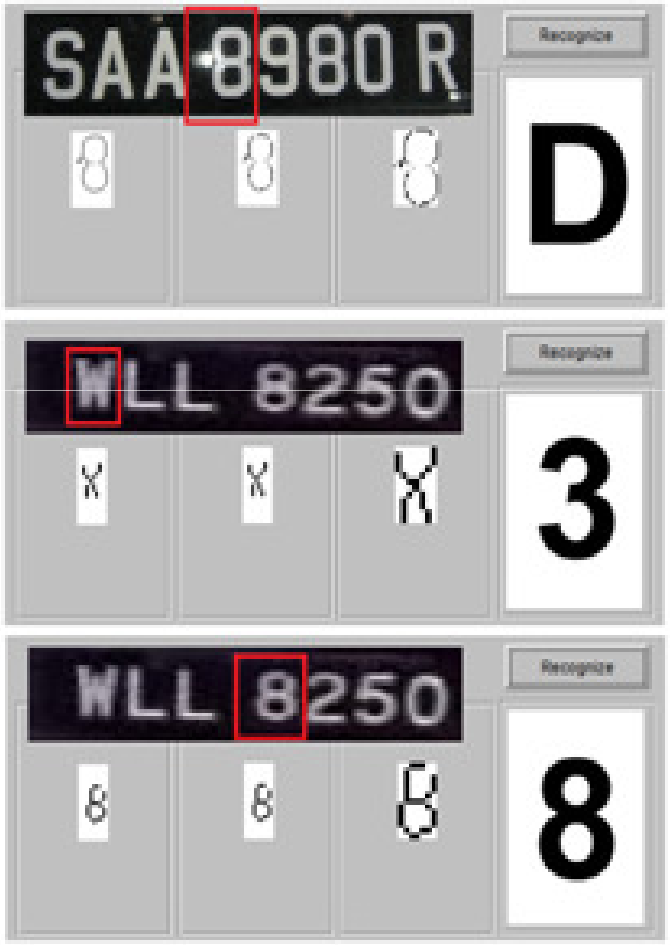
Figure 7 - T1

4.0 Results and Discussions

- T2 shows two examples of unsuccessful results, where both character '8' and 'W' (case 1 and 2 of T2) were misidentified as 'D' and '3'.

- In the first case of T2, the character '8' was affected by the surrounding light intensity that causes reflection and results in wrong character recognition.

- However, the proposed algorithm, successfully recognised character '8' although it was presented in a low quality input.



T2

Figure 8 – T2

4.0 Results and Discussions

- In T3, the algorithm capable to differentiate and recognised the given characters correctly.

- Features extracted from each zone gave more details on all the lines and points that form a particular character, and thus leads to more reliable character recognition

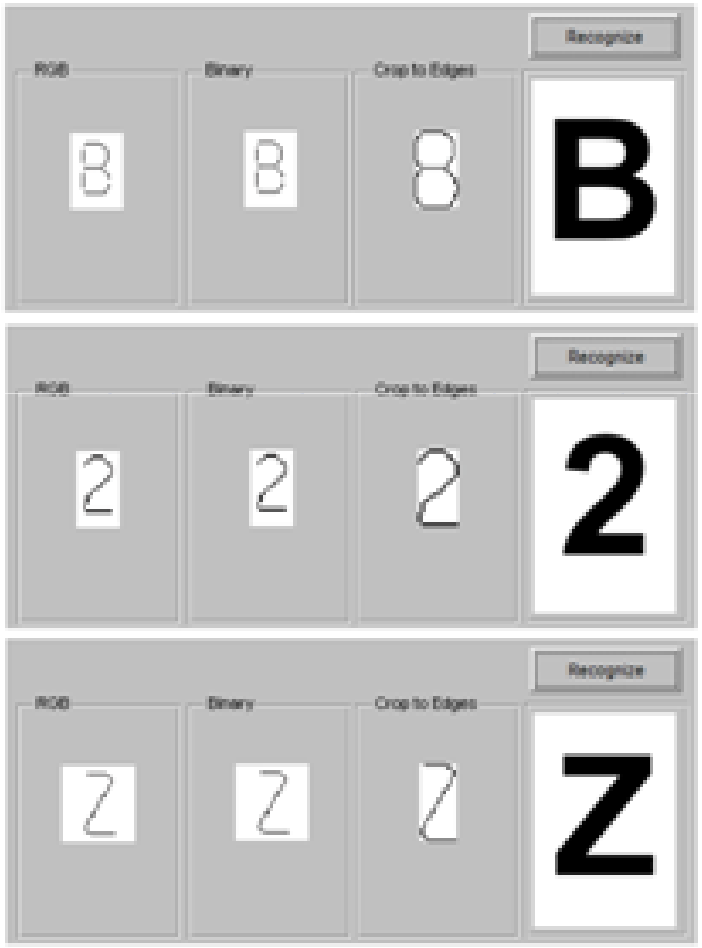


Figure 8 – T3

5.0 Conclusion

- There are many methods that can be used in recognising license plate character.

- The existing Signature Analysis properties obtained from vehicle localisation process is gathered to be trained for the later character recognition. This approach may reduce the execution time of the overall system performance.

- The proposed License Plate Character Recognition via Signature Analysis and Features Extraction has successfully recognised both ideal and non-ideal characters. However, characters with very low resolution were failed to recognise.

- The system also capable to tackle the common character misclassification problems due to similarity in characters such as '2' and 'Z', '5' and 'S', '8' and 'B'. This system needs to be further enhanced in the future to tackle the mentioned restrictions.