## **Contents**

Title Page No.	
Certificate of approval	, i-ii
Declaration	iii
Acknowledgement	iv
Abstract	V
Chapter 1 Introduction	1-2
Chapter 2 Back Ground	3
2.1 Digital Image Processing	3
2.2 Neural Network	4-5
Chapter 3 Literature Review and Previous Work	6
3.1 Image acquisition	6
3.2 Number Plate Extraction	6-7
3.3 Character Segmentation	.7
3.4 Recognition	8-9
3.5 Some Commercial Products	9
<ul><li>3.5.1 Integrated Multi-pass System</li><li>3.5.2 Perceptics</li><li>3.5.3 Hi-Tech Solution</li></ul>	9 9 9
3.6 Summary	10
Chapter 4 System Architecture	11
4.1 Flowchart of the System Architecture	11
4.2 Number Plate Localization and Extraction	12
<ul><li>4.2.1 Colour Arrangement of the Plate</li><li>4.2.2 Number Plate Detection Module</li><li>4.2.3 Labelling and Filtering</li><li>4.2.4 Rotation Adjustment</li></ul>	12 12-15 15-17 18

## Title Page No.

4.2.5 Candidate Decomposition	19
4.2.6 Flow Chart of the Module	20
4.3 Character Segmentation	20
4.3.1 Number Plate Binarization	20-21
4.3.2 Segmentation Based on Horizontal Projections	22
4.3.3 Flow Chart of the Module	23
4.4 Optical Character Recognition	24
4.4.1 Architecture of MLP used	24
4.4.2 Image Coding	24
4.4.3 ANN Training algorithm	25
4.4.3.1 Back Propagation algorithm	26-28
4.4.4 Training of the Proposed Ann	28-29
4.4.5 Flow Chart of the Module	30
Chapter 5 Experimental Results	31
5.1 System Settings	31
5.2 Result Analysis	31-32
5.3 Problems Encountered	32
Chapter 6 Conclusion and Future Scope	33
6.1 Conclusion	33
6.2 Future Work	33
Chapter 7 GUI Developed	34
7.1 Matlab	34
7.2 Screen Shots of the GUI Developed	35-40
References	41_43

## List of Figures

<u>Figure</u>	Page No.
Three Layered Feed Forward Neural Network.	4
2. Flow Chart of the Proposed System	11
3. HSI Color Model	12
4. Segmentation of a Number Plate Based on HSI	15
5. Labelled Number Plate Region after Morphological Operations and Filter	ring. 17
6. Adjustment of Rotated Number Plate	19
7. Flowchart of the Number Plate Detection Module	20
8. Binarized Number Plate	21
9. Segmented Character from Binarized Number Plate	22
10. Flowchart of the Character Segmentation Module	23
11. Architecture of MLP Used	24
12. Sample Image Code for Digit 7	25
13. Representation of Characters in Binary( Outputs of ANN used)	25
14. An example of a Multi-layered Feed Forward Network	26
15. Architecture of designed Neural Network architecture	29
16. Flowchart of Optical Character Recognition	30
17. GUI of the developed System	34
18. Loading a test Image in GUI	35
19. Test image loaded in GUI	35
20. Segmenting Number Plate Based On HSI	36
21. Number plate Region Filtered	36
22. Number Plate Region Extracted	37
23. Determination of angle of rotation of number plate	37
24. Number Plate Cropped	38
25. Number Plate Binarized	38
26. Individual Character Segmented	39
27. Individual Character Recognized	40
28 Number Plate Character Recognized	40

## List of Tables

<u>l'able</u>	Page No.
1. Style of Indian car number plates.	12
2. Filtering Properties.	16
3. Plate Localization Accuracy	31
4. Character Segmentation Accuracy	31
5. OCR Accuracy	31