

CONTENTS

Chapter No	Title	Page No.
	LIST OF TABLES	i
	LIST OF FIGURES	ii
	LIST OF ABBREVIATIONS	v
	ABSTRACT	ix
1	INTRODUCTION	1-25
1.1	Overview to the Research Topic	1
1.2	Blood Types and Leukemia Types	2
1.2.1	Blood Types	3
1.2.2	Types of Leukemia	5
1.3	Acute Lymphoblastic Leukemia	6
1.3.1	Symptoms	8
1.3.2	Diagnosis Process	9
1.4	Automatic ALL Identification System	10
2	REVIEW OF LITERATURE	26-48
2.1	Preprocessing	26
2.1.1	Contrast Enhancement	29
2.1.2	Edge Enhancement	
2.1.3	Denoising Algorithms	30
2.2	WBC Segmentation	33
2.3	Machine Learning Classifiers	40
2.4	Deep Learning Classifiers	44
2.5	Chapter Summary	47
3	METHODOLOGY	49-60
3.1	Development Methodology, Phases and Interactions	51
3.2	Phase I : Preprocessing	51
3.2.1	Noise Removal	53
3.2.2	ROI-Extraction	53

Chapter No	Title	Page No.
3.3	Phase II : Classification Using Machine Learning Algorithm	55
3.3.1	Feature Engineering	55
3.3.2	Classification	56
3.4	Phase III : Classification Using Deep Learning Algorithm	58
3.5	Experimental Results	59
3.6	Chapter Summary	60
4	DESIGN OF PREPROCESSING ALGORITHMS	61-96
4.1	Image Enhancement	61
4.1.1	Contrast Enhancement Algorithm	61
4.1.2	Noise Removal	65
4.1.3	Edge Enhancement Algorithm	75
4.1.4	Proposed UCED Algorithm	78
4.2	WBC Detection	81
4.2.1	Watershed-Based Segmentation Algorithm	82
4.2.2	Clustering-Based Segmentation Algorithm	88
4.2.3	Combining Segmentation Results	91
4.2.4	Post Processing	95
4.3	Chapter Summary	96
5	ALL-C USING MACHINE LEARNING CLASSIFIER	97-131
5.1	Feature Engineering	97
5.1.1	Feature Extraction	99
5.1.2	Feature Fusion	104
5.1.3	Feature Selection	106
5.2	Machine Learning Ensemble Classification	114
5.2.1	Base Classifier	115
5.2.2	Construction of EC System	118
5.2.3	Aggregation Method	119
5.2.4	Design of EC System	120
5.3	Enhanced EC Systems	121
5.3.1	Training Set Optimization Algorithm	123
5.3.2	Selection of Optimal Base Classifiers	124

Chapter No	Title	Page No.
5.4	Chapter Summary	131
6	CLASSIFICATION USING DEEP LEARNING CLASSIFIER	132-151
6.1	Deep Learning Classifier	132
6.2	DLC Used in the Research Work	136
6.3	Database Preparation	137
6.4	CNN Base Model	139
6.5	Proposed Hybrid CNN-Ensemble SVM Classification Model	144
6.5.1	Conventional Hybrid CNN-SVM Model	145
6.5.2	Enhanced Hybrid CNN-Ensemble SVM Classifier	146
6.5.3	Weighted Ensemble of Networks Method	150
6.6	Chapter Summary	151
7	RESULTS AND DISCUSSION	152-186
7.1	Experimental Setup	152
7.1.1	Dataset Used	153
7.1.2	Performance Metrics	153
7.2	Analysis of Preprocessing Algorithms	155
7.2.1	Analysis of Enhancement Algorithms	155
7.2.2	Analysis of Segmentation Algorithms	163
7.3	ALL-C Classification Using Machine Learning Classifier	174
7.3.1	Effect of Feature Fusion and Selection of ALL-C System	174
7.3.2	Analysis of Ensemble Classifiers on of ALL-C	176
7.4	ALL-C Classification Using Deep Learning Classifier	182
7.5	Chapter Summary	186
8	SUMMARY AND CONCLUSION	187-190
9	FUTURE RESEARCH DIRECTIONS	191
	BIBLIOGRAPHY	192
	PUBLICATIONS	219
	PLAGIARISM REPORT	220