

# TABLE OF CONTENTS

<b>Chapter No.</b>	<b>Title</b>	<b>Page No.</b>
	<b>LIST OF TABLES</b>	x
	<b>LIST OF FIGURES</b>	xi
	<b>LIST OF ABBREVIATIONS</b>	xiv
	<b>LIST OF SYMBOLS</b>	xvi
	<b>ABSTRACT</b>	xviii
<b>1</b>	<b>INTRODUCTION</b>	
	1.1 Background	1
	1.2 Deep Learning	1
	1.2.1 Deep Learning Architectures	2
	1.2.1.1 Long Short-Term Memory (LSTM)	4
	1.2.1.2 Bi-Directional Long Short-Term Memory(Bi-LSTM)	4
	1.2.1.3 Fuzzy Convolution LSTM Classifier	4
	1.2.1.4 Fuzzy Convolution Bi- Directional LSTM Classifier	5
	1.2.1.5 Ensemble Deep Learning Classifiers	5
	1.3 Parkinson’s Disease Diagnostics	6
	1.3.1 Symptoms and Diagnosis of Parkinson’s Disease	7
	1.4 Feature Extraction	10
	1.5 Dimensionality Reduction	11
	1.6 Feature Selection	14
	1.7 Ensemble Feature Selection Categories	19
	1.8 Swarm Intelligence	21
	1.8.1 Fundamental Phases of SI Framework	23
	1.8.2 Wrapper Models Based on SI	24
	1.8.2.1 Butterfly Optimization Algorithm (BOA)	25
	1.8.2.2 Minimal Redundancy Maximal Relevance (mRMR)	25
	1.8.2.3 Cuckoo Search Algorithm (CSO)	25
	1.9 Problem Statement	26

<b>Chapter No.</b>	<b>Title</b>	<b>Page No.</b>
	1.10 Objectives of the Research	27
	1.11 Contributions of the Research	27
	1.12 Organization of the Thesis	28
	1.13 Summary	29
<b>2</b>	<b>LITERATURE REVIEW</b>	
	2.1 Introduction	30
	2.2 Feature Extraction Methods	30
	2.3 Dimensionality Reduction Methods	34
	2.4 Feature Selection Methods	35
	2.5 Optimization Based Feature Selection Methods	37
	2.6 Ensemble Based Feature Selection Methods	39
	2.7 Machine Learning and Deep Learning Techniques	41
	2.8 Summary	43
<b>3</b>	<b>KERNEL BASED DIMENSIONALITY REDUCTION AND FUZZY CONVOLUTIONAL LONG SHORT-TERM MEMORY BASED CONVOLUTIONAL NEURAL NETWORK</b>	
	3.1 Introduction	44
	3.2 Convolutional Neural Network	45
	3.3 Proposed Methodology	47
	3.3.1 Parkinson's disease Dataset	49
	3.3.2 Feature extraction	51
	3.3.3 Dimensionality reduction using KPCA	53
	3.3.4 mRMR based Feature Selection	56
	3.3.5 PD classification via FCLSTM-CNN classifier	57
	3.4 Experimental Results	61
	3.5 Summary	66
<b>4</b>	<b>FUZZY MONARCH BUTTERFLY OPTIMIZATION ALGORITHM BASED FEATURE SELECTION AND FUZZY CONVOLUTION BIDIRECTIONAL-LSTM CLASSIFIER</b>	

<b>Chapter No.</b>	<b>Title</b>	<b>Page No.</b>
	4.1 Monarch Butterfly Optimization Algorithm (MBOA)	67
	4.2 Proposed Methodology	69
	4.2.1 Feature Selection Using FMBOA	72
	4.2.2 PD classification using FCBi-LSTM classifier	76
	4.3 Experimental Results	80
	4.3.1 Performance Metrics	81
	4.3.2 Results Comparison	81
	4.4 Summary	83
<b>5</b>	<b>OPTIMIZATION BASED ENSEMBLE FEATURE SELECTION ALGORITHM AND FUZZY CONVOLUTION BIDIRECTIONAL-LSTM CLASSIFIER</b>	
	5.1 Levy Flight Cuckoo Search Algorithm	84
	5.2 Firefly Algorithm (FA)	86
	5.3 Proposed Methodology	87
	5.3.1 Optimization Based Ensemble Feature Selection	90
	5.3.2 Parkinson's Disease Classification using FCBi-LSTM Classifier	97
	5.4 Experimental Results	98
	5.4.1 Performance Metrics	99
	5.4.2 Results Comparison	99
	5.5 Summary	101
<b>6</b>	<b>OPTIMIZATION BASED ENSEMBLE FEATURE SELECTION AND ENSEMBLE DEEP LEARNING CLASSIFIER</b>	
	6.1 Ensemble Classifier and their types	102
	6.2 Contractive Auto-Encoder (CAE)	104
	6.3 Sparse Auto-Encoder (SAE)	105
	6.4 Proposed Methodology	106
	6.4.1. Optimization Based Ensemble Feature Selection (OBEFS)	107
	6.4.2. PD classification using EDL classifier	108

---

<b>Chapter No.</b>	<b>Title</b>	<b>Page No.</b>
	6.4.2.1. Fuzzy Convolution Bi-Directional Long Short-Term Memory (FCBi-LSTM)	109
	6.4.2.2 Sparse Auto-encoders (SAEs)	109
	6.4.2.3 Contractive Auto-encoder (CAE)	111
	6.4.2.4 Stacked Generalization	111
	6.5 Experimental Results	112
	6.6 Summary	124
<b>7</b>	<b>RESULTS AND DISCUSSIONS</b>	115
<b>8</b>	<b>CONCLUSION AND FUTURE WORK</b>	121
	<b>REFERENCES</b>	124
	<b>LIST OF PUBLICATIONS</b>	143
	<b>PLAGIARISM REPORT</b>	

---