CERTIFICATE

I certify that the thesis entitled "**Study on the Performance of Deep Learning Techniques for the Classification of Parkinson's Diseases**" submitted for the award of **Doctor of Philosophy (Ph.D.)** by **Mrs. B. Sabeena** is the record of research work carried out by her during the period from **July 2019 to February 2024** under my guidance and supervision, and that this work has not formed the basis for the award of any Degree, Diploma, Associateship, Fellowship or other Titles in this Institute or any other University or Institution of Higher Learning.

28/2/2024
Signature of the Head of the Department

28/2/2024
Signature of the Supervisor

28/2/24
Signature of the Dean

DECLARATION

I declare that the thesis entitled "**Study on the Performance of Deep Learning Techniques for the Classification of Parkinson's Diseases**" submitted by me for the award of Doctor of Philosophy (Ph.D.) is the record of the work carried out by me during the period from July 2019 to February 2024 under the guidance of **Dr. S. Sivakumari** M.E., Ph.D., Professor, Department of Computer Science and Engineering at Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore. And has not formed the basis for the award of any Degree, Diploma, Associateship, Fellowship, Titles in this Institute or any other University or other similar Institution of Higher Learning.

Signature of the Supervisor

Signature of the Research Scholar

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B. Sabeena

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LIST OF ABBREVIATIONS

ACO - Ant Colony Optimization

AFA - Adaptive Firefly Algorithm

ANN - Artificial neural Network

BFO - bacterial foraging optimization

BOA - Butterfly Optimization Algorithm

CFS - Correlation based Feature Selection

CNN - Convolutional Neural Network

CAD - Computer-Aided Diagnosis

CSA - Cuckoo Search Algorithm

DFA - Detrended Fluctuation Analysis

DLT - Deep Learning Techniques

DNN - Deep Neural Network

DT - Decision Tree

EA - Evolutionary Algorithm

EDL - Ensemble Deep learning

ELM - Extreme learning machine

EMD - Empirical mode decomposition

EWPT - Empirical wavelet packet transform

EWT - Empirical wavelet transform

FCBi-LSTM - Fuzzy Convolution Bi-Directional Long Short-Term Memory

FCLSTM-CNN- Fuzzy Convolution Long Short-Term Memory based Convolutional Neural Network

FFNN - Feed-Forward Neural Network

FMBOA - Fuzzy Monarch Butterfly Optimization Algorithm

FS - Feature Selection

GA - Genetic Algorithm

GNE - Glottal to Noise Excitation

GQ - Glottis Quotient

GWO - Grey Wolf Optimization

HFCC - Human Factor Cepstral Coefficients

IMFCC - Intrinsic Mode Function Cepstral Coefficient

KELM - Kernel Extreme Learning Machine

KNN - k-Nearest-Neighbor

LFCSA - Lévy Flights Cuckoo Search Algorithm

LSTM -Long Short-term Memory

MCC - Matthews Correlation Coefficient

MFCC - Mel-Frequency Cepstral Coefficient

MFEA - Multiple Feature Evaluation Approach

MLT - Machine Learning Technique

mRMR - Minimal redundancy maximal relevance

NB - Naive Bayes

NNMF - Non-Negative Matrix Factorization,

OBEFS - Optimization Based Ensemble Feature Selection

OBL - Opposition Based Learning

OCFA - Optimized Cuttlefish Algorithm

OCSA - Optimized crow search algorithm .

PCA - Principal Component Analysis

PD - Parkinson Disease

PPE - Pitch Period Entropy

PSO	- Particle Swarm Optimization
RFE	- Recursive Feature Elimination
RNN	- Recurrent Neural Network
RPDE	- Recurrence Time Density Entropy
SIANN	- space invariant Artificial Neural Network.
SI	- Swarm Intelligence
SRN	- Simple Recurrent Network
SSA	- Salp Swarm Algorithm
SVD	- Singular Value Decomposition
SVM	- Support Vector Machine
TQWT	- Tunable Q-factor Wavelet Transform
UPDRS	- Unified Parkinson’s disease Rating Scale
VFER	- Vocal Fold Excitation Ratio
WT	- Wavelet Transform

LIST OF SYMBOLS

(g_w) - gaussian weighted variable

(F_0) - gignal frequency

(fn) - ffalse negative

(fp) - false positive

(tn) - true negative

(tp) - true positive

* - sigmoid function

$\{a_i\}$ - dataset is represented

$f_i -$ - fitness value

f_i^{t+1} - novel feature solutions

$f_{pi} -$ past data fitness value best solution

$h_i(t) -$last two iterations

$h_t^f -$ forward LSTM result

$h_t -$ hidden state

$S_{max} -$ maximum walking

$x_i^{l,j} -$ convolutional layer

$y_t -$ classification results

$(\alpha) -$ weighted variable

$F_i -$ Assess Fitness

S_a's $-$ Eigenvector

$S_{fe} -$ Chosen features count

$a_i -$ Recorded Features Vector

$c_t -$ cell state

$f_{best} -$ feature vector

$f_i^{t+1} -$ new feature solutions

$f_t -$ forget gate

g_t − input modulation gate

i_t − input gate

o_t − output gate

up_j^k and low_j^k − upper and lower values

x_t − input data

σ_u^2 and σ_v^2 − correspondingly deviation

$\bigoplus$− entry-wise multiplication

b − bias weight

$FU_i$and FV_i − weights

h_W − cost functions

J − number of levels

Q− factor

r − redundancy

s(t) − state of cess

tanh(·)− hyperbolic tangent

u and v − normal distribution

x, z − fused by two classifiers

α + β + γ − diagnose PD

β − attractiveness

γ − light absorption

ζ − computed by equation

∏(a) − nonlinear transformation

Ψ − random vector

FW_{ih} − fuzzy weight

St_{Fe} − selected features

W − initial weights

$f(f)$ −Objective function

$prb_a \in$ − probability