

SPECIMEN FORMAT FOR THESES OF MONTH

Faculty : School of Engineering

Department : Computer Science and Engineering

Branch/ Area: : Computer Science and Engineering

Sub Subject Heading: : Deep Learning Techniques

Candidate's Name : Sabeena.B

Candidate's Address with email : 1/17, Preetha Illam, Ajantha Nagar 1st Street,
Poochiyur road, NSNpalayam,
Coimbatore-641031
Email:Sabeena.bheeman@gmail.com

Title of the thesis : Study on the Performance of Deep Learning
Techniques for the Classification of Parkinson's
Diseases

(i) In Roman Script -

(ii) In roman Script -

Nomenclature of Degree: : Ph.D

Month & Year of Enrolment: : July & 2019

Month & Year of Registration: : July & 2019

Month &Year of Submission: : February & 2024

Month &Year of Award : August & 2024

Name of Supervisor : Dr.S.Sivakumari

Designation of Supervisor : Professor & Head

Centre/department/school in : Computer Science and Engineering / School of
which research was conducted Engineering

University's Name & Address : Avinashilingam Institute for Home Science and
Higher Education for Women & 3VRW+J75,
Pannimadai, Varappalayam, Tamil Nadu 641017

Abstract within 300 words:

Machine Learning (ML) and Deep Learning (DL) technologies are increasingly valuable in medical diagnostics, offering objective and reliable tools for disease detection. These models have shown promise, sometimes surpassing human performance in diagnosing conditions like Parkinson's disease (PD). PD is a neurodegenerative disorder that impairs dopaminergic neurons in the brain, leading to symptoms such as bradykinesia, dysarthria, anxiety, depression, sleep disturbances, and cognitive decline, all of which significantly impact patients' quality of life. Research has identified a link between genetic factors and the risk of developing PD, with early stages often marked by vocal impairments. This has led to a focus on using DL to detect vocal disorders as early indicators of PD. The research aims to develop a robust framework using DL techniques, particularly emphasizing ensemble learning for effective feature selection and classification. The study begins by reducing data dimensions through Kernel-based Principal Component Analysis (KPCA), which isolates a lower-dimensional space where PD-related features are most prominent. The minimum Redundancy Maximum Relevance (mRMR) technique is then applied to select the most informative features while removing redundancies. To address classification challenges, a Fuzzy Convolution Long Short-Term Memory-based Convolutional Neural Network (FCLSTM-CNN) is used, overcoming NP-hard problems in mRMR with Swarm Intelligence methods. The second phase introduces the Fuzzy Monarch Butterfly Optimization Algorithm (FMBOA) for feature selection, which enhances detection accuracy by refining feature weights with a Gaussian fuzzy membership function. The final phase combines this with the Optimization Based Ensemble Feature Selection (OBEFS) algorithm, integrating multiple methods to select optimal features. Ensemble Deep Learning (EDL) classifiers, including FCBi-LSTM, Contractive Auto-encoder (CAE), and Sparse Auto-encoder (SAE), are then utilized, showing improved performance. The developed classifier is validated using data from the UCI Machine Learning repository.

i) Major objectives:

- To extract, transform the features using dimensionality reduction technique, rank the features using mrMR and use Fuzzy Convolution Long Short-Term Memory Based CNNs for Parkinson's disease classification.
- To optimize the features using Fuzzy Monarch Optimization algorithm and then Classify the Parkinson's disease using Bi-Directional LSTM.
- To apply Ensemble Feature Selection method for the Parkinson's disease classification.
- To apply Ensemble Deep Learning Classifiers for the optimized features.

ii) Hypothesis:

Deep Learning techniques, particularly those involving ensemble learning and advanced feature selection methods, can provide a highly accurate and reliable framework for the early detection of Parkinson's disease (PD), outperforming traditional diagnostic methods by effectively analyzing complex medical data, such as vocal impairments, and selecting the most relevant features for classification.

This hypothesis is based on the premise that using these advanced methodologies will enhance the detection rate and classification accuracy for PD, potentially improving early diagnosis and patient outcomes.

iii) Methodology:

The methodologies discussed encompass key techniques in dimensionality reduction, feature selection, and classification. Dimensionality reduction is achieved using Kernel-based Principal Component Analysis (KPCA), followed by the application of the minimum Redundancy Maximum Relevance (mRMR) technique for effective feature selection. For classification, the Fuzzy Convolution Long Short-Term Memory-based Convolutional Neural Network (FCLSTM-CNN) is employed.

Further techniques include the use of the Fuzzy Monarch Butterfly Optimization algorithm for feature selection, along with the Fuzzy Convolution Bi-Directional Long Short-Term Memory (FCBi-LSTM) method for classification.

In addition, an Optimization Based Ensemble Feature Selection approach is introduced, which integrates the Fuzzy Monarch Butterfly Optimization, Levy Flight Cuckoo Search, and Adaptive Firefly Algorithms to select the most relevant features for Parkinson's disease classification. These optimal features are then used to train an Ensemble Deep Learning classifier. This classifier combines FCBi-LSTM, Contractive Autoencoders (CAE), and Sparse Autoencoders (SAE) through stacked generalization, resulting in enhanced classification accuracy.

iv) Findings:

- In this research work, Parkinson's Disease detection using deep learning is proposed by using various methods.
- In first phase, KPCA+ mRMR is proposed to operate in the real feature space computing the reduced feature subset and then FCLSTM-CNN classifier is applied on the subset of features.

- The combination of MFCC + Wavelet + Concat yielded the highest accuracy (94.2557%), making it the most effective feature extraction approach among the tested combinations. The F-Measure is generally high across all combinations, with the TQWT + MFCC + Wavelet combination. The MCC values which has moderate correlation across the table, with slight variations among the combinations.
- In second phase, Feature Selection based Fuzzy Monarch Butterfly Optimization algorithm (FMBOA) and Fuzzy Convolution Bi-Directional Long-Short Term Memory (FCBi-LSTM) classifier is proposed to improve interpretability and performance.
- The combination of MFCC + Wavelet + Concat yielded the highest accuracy (96.2865%), making it the most effective feature extraction approach among the tested combinations. The F-Measure is generally high across all combinations, with the TQWT + MFCC + Wavelet combination. The MCC values which has moderate correlation across the table, with slight variations among the combinations.
- In third phase, Optimization Based Ensemble Feature Selection (OBEFS) and Fuzzy Convolution Bi-Directional Long-Short Term Memory (FCBi-LSTM) classifier is proposed to improve robustness.
- The combination of MFCC + Wavelet + Concat yielded the highest accuracy (98.7720%), making it the most effective feature extraction approach among the tested combinations. The F-Measure is generally high across all combinations, with the TQWT + MFCC + Wavelet combination. The MCC values which has moderate correlation across the table, with slight variations among the combinations.
- In fourth phase, Optimization Based Ensemble Feature Selection (OBEFS) and Ensemble Deep Learning (EDL) Classifier used to improve accuracy.
- The combination of MFCC + Wavelet + Concat yielded the highest accuracy (99.903%), making it the most effective feature extraction approach among the tested combinations. The F-Measure is generally high across all combinations, with the TQWT + MFCC + Wavelet combination. The MCC values which has moderate correlation across the table, with slight variations among the combinations.
- The experimental results prove that the proposed OBEFS-EDL has better accuracy, F1-score and MCC than other methods for PD detection.

Examiners

Internal Examiner : Dr. V. Mareeswari
India

External Examiner : Dr. L. Wang
Associate Professor
Nanyang Technological University
Singapore – 639798