Comparative Analysis of Machine Learning Models for Parkinsonś Disease Detection Using Spiral Drawing Dataset

Muhammed Usman,22p-9071

Department of Computer Science
FAST NUCES
Email: p229071@pwr.nu.edu.pk

***Abstract*—Parkinson's Disease (PD) is a neurodegenerative disorder affecting motor skills, observable through irregularities in hand-drawn spirals. This study conducts a comparative analysis of four machine learning models—K-Means, K-Nearest Neighbors (KNN), Logistic Regression, and Linear Regression—on the Spiral Drawing Dataset to detect Parkinson's Disease. Performance metrics such as accuracy, precision, recall, and F1-score are used. The results demonstrate that supervised models outperform unsupervised clustering in classification tasks.**

***Index Terms*—Parkinson's Disease, Machine Learning, K-Means, KNN, Logistic Regression, Linear Regression, Classification**

I. Introduction

Parkinson's Disease is commonly diagnosed via clinical assessments, but ML-based image analysis presents a promising alternative. Spiral drawings, as motor function tests, offer quantifiable features suitable for automated analysis. This paper evaluates the performance of several ML models using the Parkinson's Spiral Drawing Dataset.

II. Related Work

Prior research has shown potential for detecting PD using both traditional machine learning and deep learning. Many methods focus on analyzing handwriting dynamics and spiral drawings. Our approach emphasizes interpretable models with low computational complexity.

III. Methodology

A. Dataset and Preprocessing

Grayscale spiral images were resized to 64x64 pixels and flattened. Labels (0: Healthy, 1: Parkinson's) were extracted from filenames and stored in a metadata CSV. StandardScaler was applied to normalize pixel values.

B. Model Implementation

- **K-Means:** Used for unsupervised clustering with $k = 2$.
- **KNN:** Supervised classifier with $k = 3$.
- **Logistic Regression:** Binary classification.
- **Linear Regression:** Applied for UPDRS score prediction (optional).

IV. Results and Discussion

A. Evaluation Metrics

The following tables summarize classification reports for each model.

1) K-Means:

- Accuracy: 60%
- Precision: 0: 0.57, 1: 1.00
- Recall: 0: 1.00, 1: 0.14
- F1-score: 0: 0.73, 1: 0.25

2) KNN:

- Accuracy: 53%
- Precision: 0: 0.56, 1: 0.50
- Recall: 0: 0.62, 1: 0.43
- F1-score: 0: 0.59, 1: 0.46

3) Logistic Regression:

- Accuracy: 67%
- Precision: 0: 0.64, 1: 0.75
- Recall: 0: 0.88, 1: 0.43
- F1-score: 0: 0.74, 1: 0.55

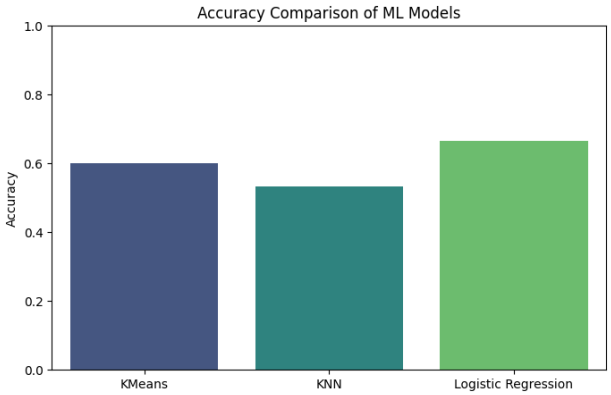

Fig. 1: Accuracy Comparison Across ML Models

V. Conclusion

Among the models tested, Logistic Regression achieved the best performance, followed by K-Means and KNN. K-Means

showed high precision but poor recall for Parkinsonś class, suggesting its limitations in unsupervised scenarios. Further work can explore more advanced deep learning techniques and feature extraction methods.

REFERENCES

REFERENCES

[1] Kaggle Spiral Drawing Dataset. [Online]. Available: https://www.kaggle.com/datasets/kmader/parkinsons-drawings
[2] Scikit-learn: Machine Learning in Python. [Online]. Available: https://scikit-learn.org/