Human Activity Recognition Using Smartphone Sensor Data: Analysis and Classification using Azure ML and Power BI

Séamus Knightly
1MECE1
University Of Galway
Galway, Ireland
s.knightly1@universityofgalway.ie

Seán Kelly
1MECE1
University Of Galway
Galway, Ireland
s.kelly178@universityofgalway.ie

***Abstract*—blah blah**

***Index Terms*—IoT, Remote Patient Monitoring, Accelerometer, Gyroscope, Classification, Assisted Living**

I. Introduction

Human Activity Recognition (HAR) is an important area in the domain of machine learning and medical computing. The focus is the identification and classification of human physical activities based on provided sensor data. The data can be collecte by a wide range of devices, from stationary room sensing video or radar that can monitor multiple subjects, to wearable or mobile devices that can monitor individual subjects. HAR has become an important component in applications such as remote patient monitoring and assisted living.

There are a number of large, labelled datasets available for human activity recognition. For this project, the *Human Activity Recognition Using Smartphones* dataset [1] was chosen. This dataset contains sensor data collected from smartphone accelerometers and gyroscopes as 30 participants performed 6 daily activites, such walking, sitting, and standing. The observations are represented by multiple time and frequency features extracted from the motion signals. Sensor signals from the device's accelerometer and gyroscope were recorded at 50 Hz and processed into 561 time and frequency features.

This dataset was chosen over other datasets, such as HARTH dataset [2] [3] for its simplicity, requiring only 1 worn sensor. And for the simpler set of classifications, which correspond better with scenarios that would arise in a care facility or other healthcare setting.

This paper aims to analyse and classify human activities using the UCI HAR dataset by developing and evaluating multiple machine learning models in Azure Machine Learning Studio. Power BI is employed to visualize data characteristics, feature distributions, and model performance metrics. The results provide insights into the role of sensor based data and machine learning in Human Activity Recognition.

The introductory paper [**?**] demonstrated that a multiclass Support Vector Machine (SVM) model could achieve an overall classification accuracy of 96% on this dataset, comparable to or exceeding the performance of systems using specialised wearable sensors. Their work highlighted the feasibility of using simpler accelerometer and gyroscope sensors, such as smart phones, as unobtrusive, affordable, and reliable sensing tools for HAR.

II. Dataset Description

A. Dataset Source

B. Feature Overview

C. Data Preparation

III. Data Analysis

A. Characteristics

B. Trends and Patterns

IV. Feature Comparison

A. Visual Comparison

B. Discussion

V. Box Plot Analysis

A. Box Plots (or Violin Plots idk change this)

B. Findings

VI. Machine Learning Model Development and Evaluation

A. Single Feature Models

B. Combination of Features

C. All Features

D. Feature Selection Methods

VII. Results Comparison and Discussion

A. Performance Comparison

B. Discussion of Findings

VIII. Conclusion

References

[1] J. Reyes-Ortiz, D. Anguita, A. Ghio, L. Oneto, and X. Parra. "*Human Activity Recognition Using Smartphones*", UCI Machine Learning Repository, 2013 [Online]. https://doi.org/10.24432/C54S4K.

[2] A. Logacjov, K. Bach, A. Kongsvold, H. B. Bårdstu, and P. J. Mork, "HARTH: A Human Activity Recognition Dataset for Machine Learning," *Sensors*, vol. 21, no. 23, Art. no. 23, Jan. 2021, https://doi.org/10.3390/s21237853doi: 10.3390/s21237853.

[3] K. Bach, A. Logacjov, A. Kongsvold, H. B. Bårdstu, and P. J. Mork, "A Machine Learning Classifier for Detection of Physical Activity Types and Postures During Free-Living," *Journal for the Measurement of Physical Behaviour*, vol. 1, no. aop, pp. 1–8, Dec. 2021, https://doi.org/10.1123/jmpb.2021-0015doi: 10.1123/jmpb.2021-0015.

[4] D. Anguita, A. Ghio, L. Oneto, X. Parra, and J. L. Reyes-Ortiz, "A Public Domain Dataset for Human Activity Recognition Using Smartphones," *Proceedings of the 21st European Symposium on Artificial Neural Networks, Computational Intelligence and Machine Learning (ESANN 2013)*, Bruges, Belgium, pp. 437–442, Apr. 2013.