Department of Electrical and Computer Engineering
North South University

Senior Design Project – CSE499 A&B

Human Activity Recognition Using Multiple Learning & XAI Techniques with Wearable Sensor Data

Monirul Islam Mahmud - 2011839042

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Faculty Advisor:

Intisar Tahmid Naheen

ECE Department

Spring 2023 & Summer 2023

LETTER OF TRANSMITTAL

13th December 2023

To,

Dr. Rajesh Palit

Chairman,

Department of Electrical and Computer Engineering

North South University, Dhaka

Subject: Submission of CSE499A&B Project Report on "Human Activity Recognition Using Multiple Learning & XAI Techniques with Wearable Sensor Data"

Dear Sir,

I hope this letter finds you in good health and high spirits. We are writing to formally submit our comprehensive CSE499A&B Project Report on "Human Activity Recognition Using Multiple Learning & XAI Techniques with Wearable Sensor Data," which serves as a crucial component of our BSc program.

This project delves into the intricate realm of identifying and predicting human actions based on data acquired from wearable sensors. The report meticulously analyzes and compares a spectrum of machine-learning techniques employed for human activity recognition (HAR).

We have dedicated significant effort and resources to conduct this research and prepare this report, and it is with great enthusiasm that we present it for your perusal. Your valuable judgment and insights on our work would be immensely appreciated. We earnestly hope that you find our report not only useful but also informative, providing a clear and comprehensive perspective on the subject matter.

Thank you for your time and consideration. We look forward to your feedback and guidance as we continue to explore the fascinating domain of human activity recognition.

Sincerely Yours,

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Monirul Islam Mahmud
ECE Department
North South University, Bangladesh

.....
Md. Shihab Reza
ECE Department
North South University, Bangladesh

.....
Hafeza Akter
ECE Department
North South University, Bangladesh

APPROVAL

Monirul Islam Mahmud (ID 2011839042), Md Shihab Reza (ID 1931229042) and Hafeza Akter (ID 1922175042) from Electrical and Computer Engineering Department of North South University, have worked on the Senior Design Project titled "Human Activity Recognition Using Multiple Learning & XAI Techniques with Wearable Sensor Data" under the supervision of Intisar Tahmid Naheen partial fulfillment of the requirement for the degree of Bachelors of Science in Engineering and has been accepted as satisfactory.

Supervisor's Signature

…….

Intisar Tahmid Naheen

Lecturer

Department of Electrical and Computer Engineering

North South University

Dhaka, Bangladesh.

Chairman's Signature

…….

Dr. Rajesh Palit

Chairman

Department of Electrical and Computer Engineering

North South University

Dhaka, Bangladesh.

DECLARATION

This is to declare that this project is our original work. No part of this work has been submitted elsewhere partially or fully for the award of any other degree or diploma. All project related information will remain confidential and shall not be disclosed without the formal consent of the project supervisor. Relevant previous works presented in this report have been properly acknowledged and cited. The plagiarism policy, as stated by the supervisor, has been maintained.

Students' names & Signatures

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1. Monirul Islam Mahmud

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2. Md. Shihab Reza

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3. Hafeza Akter

ACKNOWLEDGEMENTS

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ABSTRACT

Human Activity Recognition Using Multiple Learning & XAI Techniques with Wearable Sensor Data

Human Activity Recognition (HAR) is an important area of research in artificial intelligence, machine learning, and ubiquitous computing. It involves identifying or predicting human actions based on sensor data. This paper investigates Human Activity Recognition (HAR), a crucial area in artificial intelligence and multiple learning. It focuses on identifying human actions using sensor data. We analyze various machine learning techniques, including Random Forest, Gradient Boosting, AdaBoost, K-Nearest Neighbors (KNN), and the Voting Classifier, as well as deep learning models like CNN, ANN, CNN-ANN Hybrid, and LSTM with our collected 72,095 collected sensor data. We also employ XAI (SHAP) techniques to understand feature importance. Results indicate that, Random Forest leads with an 85% accuracy rate. Among deep learning models, ANN achieves the highest accuracy at 82%. LGB, CatBoost, and XGBoost perform well, each reaching an 84% accuracy rate. In Federated Learning, 72% accuracy is achieved by global model with ANN. We propose an app for activity detection and data collection. These findings emphasize the potential of machine learning in enhancing HAR systems, with implications for applications from healthcare to wearable technology.