Department of Electrical and Computer Engineering

North South University

Senior Design Project

Fall Prediction Using Machine Learning Method

Faizullah Farhan **1931708642**

Jubaer Al Noman **1931536642**

Faculty Advisor:

DR. MOHAMMAD MONIRUJJAMAN KHAN

Associate Professor

ECE Department

Spring, 2023

LETTER OF TRANSMITTAL

24th November, 2023

To

Dr. Rajesh Palit

Chairman,

Department of Electrical and Computer Engineering

North South University, Dhaka

Subject: **Submission of Capstone Project Report on "Fall Prediction Using Machine Learning Method"**

Dear Sir,

With due respect, we would like to submit our **Capstone Project Report** on **"Fall Prediction Using Machine Learning Method"** as a part of our BSc program. The report deals with Fall Prediction Using the Machine Learning Method. This project was very valuable as it helped us gain experience in artificial intelligence (AI), such as machine learning, and apply it in real life. We tried to the maximum competence to meet all the dimensions required from this report.

We will be highly obliged if you kindly receive this report and provide your valuable judgment. It would be our immense pleasure if you find this report useful and informative to have an apparent perspective on the issue.

Sincerely Yours,

.....

Faizullah Farhan

ECE Department

North South University, Bangladesh

.....

Jubaer Al Noman

ECE Department

North South University, Bangladesh

APPROVAL

Faizullah Farhan (ID # 1931708642), Jubaer Al Noman (ID # 1931536642) from Electrical and Computer Engineering Department of North South University has worked on the Senior Design Project titled “Fall Prediction Using Machine Learning Method” under the supervision of Dr. Riasat Khan partial fulfillment of the requirement for the degree of Bachelors of Science in Engineering and has been accepted as satisfactory.

Supervisor’s Signature

…….

DR. MOHAMMAD MONIRUJJAMAN KHAN

Associate Professor

Department of Electrical and Computer Engineering

North South University

Dhaka, Bangladesh.

Chairman’s Signature

…….

Dr. Rajesh Palit

Professor

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

---

1. Faizullah Farhan

_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

2. Jubaer Al Noman

ACKNOWLEDGEMENTS

The authors would like to express their heartfelt gratitude towards their project and research supervisor, DR. MOHAMMAD MONIRUJJAMAN KHAN, Associate Professor, Department of Electrical and Computer Engineering, North South University, Bangladesh, for his invaluable support, precise guidance, and advice pertaining to the experiments, research and theoretical studies carried out during the course of the current project and also in the preparation of the current report.

Furthermore, the authors would like to thank the Department of Electrical and Computer Engineering, North South University, Bangladesh, for facilitating the research. The authors would also like to thank their loved ones for their countless sacrifices and continual support.

ABSTRACT

Fall Prediction Using Machine Learning Method

The occurrence of falls among the elderly population poses a substantial concern in the realm of public health due to the high prevalence of severe injuries and the subsequent negative impact on their overall well-being and quality of life. The significance of establishing procedures to reduce falls becomes more pronounced with the rise in the older population. This research study comprehensively examines the application of multiple machine-learning algorithms for fall detection and prevention. In this study, we are looking into nine popular machine-learning techniques. These include support vector machines (SVM), random forests, naive Bayes, logistic regression, and linear discriminant analysis (LDA), voting classifiers, K-nearest neighbors (KNN), AdaBoost, and gradient boosting. The implemented algorithms were trained using a dataset that included factors relevant to fall detection, such as acceleration, direction, and positional data. The experiments included a dataset of samples from wearable devices equipped with sensors, representing both fall and non-fall scenarios in real-world settings. A complete evaluation methodology was employed, incorporating cross-validation techniques and performance measures such as accuracy to ensure the correctness and reliability of our findings. The results obtained from our study have revealed the promising capabilities of machine learning in the context of fall prevention systems, yielding positive outcomes. The Random Forest, Gradient Boosting, and Voting Classifier models exhibited the best accuracy rates, with a 97% accuracy in fall detection. Support vector machines, logistic regression, LDA, and AdaBoost performed exceptionally, achieving accuracy levels ranging from 95% to 97%. In contrast to other approaches, Naive Bayes had a comparatively lower accuracy rate of 48%. On the other hand, our study achieved 98% accuracy using a deep CNN model. Based on our research findings, it is commonly observed that ensemble techniques, such as the random forest model, the gradient boosting model, and the CNN model, tend to exhibit superior performance compared to individual algorithms. Moreover, the findings underscore the importance of feature engineering and choosing appropriate machine learning algorithms to augment fall prevention systems' efficacy. This research contributes to the existing knowledge of fall prevention by providing intuition into the suitability of different machine-learning methods for real-time fall detection and prevention. The discovery of this study

can provide valuable insights for researchers, practitioners, and healthcare professionals in their selection of optimal algorithms for the effective implementation of dependable fall prevention systems. The present work undertook a detailed assessment of various classification models within the domain of fall prevention, employing machine learning methodologies. The Decision Tree and Random Forest models demonstrated high levels of accuracy, with rates of 94% and 96%, respectively. This highlights their robust predictive capabilities in the domain of fall detection. In addition, Logistic Regression, Gradient Boosting, AdaBoost, Artificial Neural Networks (ANNs), Convolutional Neural Networks (CNNs), Gaussian Process, Support Vector Machines (SVM), K-Nearest Neighbors (KNN), and Multilayer Perceptron (MLP) models exhibited recall, significant precision, and F1-score metrics, showing their embryonic suitability in diverse fall detection scenarios. Despite Naive Bayes demonstrating relatively lower accuracy, it displayed noteworthy recall values, suggesting its potential suitability in specific fall detection scenarios. The findings above offer valuable insights for healthcare professionals and researchers aiming to apply machine learning techniques to prevent falls.