Department of Electrical and Computer Engineering
North South University

Senior Design Project

SLEEP APNEA DETECTION FROM RAW ECG SIGNAL USING DEEP LEARNING AND MACHINE LEARNING

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Faculty Advisor:

Md. Shahriar Hussain

Senior Lecturer

ECE Department

Summer, 2023

LETTER OF TRANSMITTAL

17th December, 2023
To
Dr. Rajesh Palit
Chairman,
Department of Electrical and Computer Engineering
North South University, Dhaka

Subject: **Submission of Capstone Project Report on "SLEEP APNEA DETECTION FROM RAW ECG SIGNAL USING DEEP LEARNING AND MACHINE LEARNING"**

Dear Sir,

With due respect, we would like to submit our **Capstone Project Report** on **"SLEEP APNEA DETECTION FROM RAW ECG SIGNAL USING DEEP LEARNING AND MACHINE LEARNING"** as a part of our BSc program. The report deals with SLEEP APNEA DETECTION FROM RAW ECG SIGNAL USING DEEP LEARNING AND MACHINE LEARNING. This project was very much valuable to us as it helped us gain experience from practical field and apply 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,

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Salem Shamsul Alam
ECE Department
North South University, Bangladesh

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Sumit Saha
ECE Department
North South University, Bangladesh

APPROVAL

Salem Shamsul Alam (1931849642) and Sumit Saha (1931415042) from Electrical and Computer Engineering Department of North South University, have worked on the Senior Design Project titled "SLEEP APNEA DETECTION FROM RAW ECG SIGNAL USING DEEP LEARNING AND MACHINE LEARNING" under the supervision of Md. Shahriar Hussain partial fulfillment of the requirement for the degree of Bachelors of Science in Engineering and has been accepted as satisfactory.

Supervisor's Signature

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Md. Shahriar Hussain
Senior Lecturer
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. Salem Shamsul Alam

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2. Sumit Saha

ACKNOWLEDGEMENTS

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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

SLEEP APNEA DETECTION FROM RAW ECG SIGNAL USING DEEP LEARNING AND MACHINE LEARNING

Sleep apnea, a prevalent yet underdiagnosed sleep disorder, necessitates robust and accurate diagnostic tools. In this project, we undertook an in-depth exploration of machine learning (ML) and deep learning (DL) models for sleep apnea detection, specifically utilizing raw electrocardiogram (ECG) signals. Our comparative analysis encompassed a range of ML models, including Random Forest, Logistic Regression, Decision Tree, AdaBoost, and XGBoost, and a specialized 1D-CNN model within the DL domain. Results underscore the exceptional performance of the 1D-CNN model, achieving a remarkable accuracy of 99.56%, sensitivity of 96.05%, and specificity of 99.66%. This outperforms traditional ML models, signifying the prowess of DL in extracting intricate patterns from raw ECG signals for accurate sleep apnea detection. The 1D-CNN model's ability to discern subtle features proves crucial for accurately identifying apnea events. Our study not only emphasizes the effectiveness of the 1D-CNN model for sleep apnea detection and highlights the transformative potential of deep learning in healthcare diagnostics. This research contributes valuable insights into the optimal choice of models for sleep apnea detection, paving the way for enhanced diagnostic accuracy and improved patient care.