

**Designing a non-invasive seizure forecasting device for patients with epilepsy**

Kulasingham JP<sup>1</sup>, Gooneratne IK<sup>2</sup>, Dayanath BHE<sup>3</sup>, De Silva RN<sup>3</sup>, De Silva WPN<sup>3</sup>, Delgahawatta DYDUS<sup>3</sup>, Deshani JAT<sup>3</sup>

<sup>1</sup>Senior Lecturer, Department of Electronic and Telecommunication Engineering, University of Moratuwa

<sup>2</sup>Senior Lecturer, Department of Medicine and Mental Health, University of Moratuwa

<sup>3</sup>Medical student, Faculty of Medicine, University of Moratuwa

**Introduction** - Epilepsy is a chronic neurological disorder affecting over 50 million people worldwide, and the unpredictable nature of seizures remains one of the greatest challenges for patients and caregivers. While invasive electroencephalography (EEG) systems have demonstrated potential in seizure forecasting, their long-term use is often limited by discomfort, surgical risks, and low patient acceptability. This research project aimed to design “ForeSei,” a non-invasive, wrist-worn seizure forecasting device to provide early warnings and improve the quality of life of individuals living with epilepsy.

**Materials and Methods** - A comprehensive literature review was conducted to identify physiological parameters and technological approaches that could be combined for optimal forecasting. Heart rate variability (HRV), photoplethysmography (PPG), electrodermal activity (EDA), accelerometry, and electromyography (EMG) were selected as key bio signals due to their proven associations with seizure activity. State-of-the-art wearable sensors and advanced data processing techniques were evaluated, with deep learning models, particularly long short-term memory (LSTM) networks, chosen for their ability to capture temporal patterns in multimodal signals.

**Results** - The proposed device integrates these sensors into a lightweight wristband connected via Bluetooth to a dedicated mobile application named the “Foresei App”. Data is processed locally and on a cloud platform, allowing personalized seizure risk forecasts. The device delivers real-time alerts to both patients and caregivers through vibration, visual cues, and smartphone notifications.

**Discussion** - Design requirements were informed by user-centered considerations such as comfort, continuous wearability, and cost-effectiveness. This study demonstrates the feasibility of combining multimodal bio signal monitoring with machine learning to develop a practical, non-invasive seizure forecasting system that has the potential to empower patients, reduce uncertainty, and enhance safety in daily life.