ABSTRACT

Heart disease is the leading cause of death worldwide, accounting for 17.7 million (31%) deaths globally. One of its manifestation is arrhythmia, a condition caused by disturbances in the generation or conduction of cardiac impulses, resulting in irregular heartbeats. Arrhythmia detection and monitoring are typically performed using electrocardiogram (ECG), which are analyzed manually by medical professionals. However, manual analysis is often time-consuming, subjective and prone to errors. Therefore, this study proposes an automatic arrhythmia classification system based on ECG signals using Long Short Term Memory (LSTM), Bidirectional LSTM (BI-LSTM and Nested LSTM (NLSTM) architectures.

The classification was carried out on eight types of arrhythmia ryhthms using the MIT-BIH Arrhythmia Database. The process involved balancing the duration of each arrhythmia class, signal filtering using a Butterworth filter with zero -phase filtering, generating sliding *window*s with lengths of 3, 5 and 10 heartbeat complexes as model inputs, followed by normalization and label encoding. The processed data were then fed into the models using combinations of *optimizer*s (Adam, RMSprop, SGD) and batch size (16, 32, 64). Performance was evaluated usinh accuracy, precision, recall, F1-score, confusion matrix, AUC and ROC.

The result showed that the LSTM model with a 10 complex *window*, optimizaer RMSpop and batch size of 32 achieved the best performance, with an accuracy of 96.51%. BI-LSTM performed second best with a 5 complex *window*, while NLSTM yielded the lowest performance due to model complexity and hardware limitations, which led to out of memory issues. Although data duration wa balanced, the number of *window*a per class varied due to differences in heartbeat patterns.

Keywords: Arrhythmia, arrhythmia detection based on rhythm, electrocardiography, BI-LSTM, classification, heart rhythm, LSTM, NLSTM.