INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study	:	Ph.D.
Thesis Title:		AN ELECTROCARDIOGRAM BASED SECURE PERSON ADAPTIVE CARDIOVASCULAR DISEASE DIAGNOSIS SYSTEM
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Thesis Submitted to the Department/ Center	:	EEE
Date of completion of Thesis Viva-Voce Exam	:	17.06.2024
Key words for description of Thesis Work	:	Electrocardiogram, Cardiovascular Disease, Biometrics, person-adaptive CVD diagnosis system, Long short term memory (LSTM) network, Representation learning.

SHORT ABSTRACT

The electrocardiogram (ECG) signal is the primary non-invasive diagnostic tool used by cardiologists for diagnosing cardiovascular diseases (CVDs). Timely identification of CVDs is critical for effective treatment and prevention of fatalities. The automated diagnosis of CVDs is crucial in assisting cardiologists and facilitating remote monitoring; contributing to the advancement of AI-based healthcare. However, the significant challenge lies in the inter-individual variability of morphological characteristics in the ECG signal, necessitating the development of a person-adaptive CVD diagnosis system. Additionally, automated diagnosis brings with it security and privacy considerations concerning wearable healthcare devices and the handling of sensitive medical data. This thesis work aims to learn deep temporal and spatio-temporal representations from multi-lead ECG signals with the overarching goal of developing an automated CVD diagnosis system and a robust biometric system. Additionally, a novel method is proposed to effectively leverage learned personspecific representations for the development of a person-adaptive CVD diagnosis system. In our first work, an ECG based person identification and verification system is developed by learning the underlying temporal representation of the ECG signal. A biometric system based on long shortterm memory (LSTM) network is designed for explicitly learning the temporal representation. Further, a novel attention based hierarchical LSTM (HLSTM) model is designed to learn the temporal variation of the ECG signal in different abstractions. Empirical findings demonstrate substantial performance enhancements by using multi-scale temporal information. In the second study, the multi-scale temporal dynamics learning network (MSTDLNet) is introduced to concurrently capture the local morphological representation and multi-scale temporal dynamics in the ECG signals for biometric applications. The experimental findings affirm that the multi-scale temporal representation learned by MSTDLNet yields robust and persistent performance, significantly improving outcomes in multi-session analyses. In the third work, an automated CVD diagnosis system using multi-lead ECG signal is proposed. Specifically, an attentive spatio-temporal learning network (ASTLNet) is developed to learn better diagnostic representation by exploiting the concurrent spatio-temporal variation of a multilead ECG signal. In the last work, an unsupervised person-adaptive CVD diagnosis system is designed by infusing the person-specific information into a diagnostic model. The person-adaptive cardiovascular disease (CVD) diagnostic framework adopts a modular structure compatible with various global CVD diagnosis models. The person-adaptive CVD diagnostic framework enhances the performance of global diagnostic models significantly.