INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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According to the World Health Organization (WHO), cardiovascular diseases cause approximately 17.9 million fatalities yearly, which is estimated to be 31% of the global mortality rate. An electrocardiogram (ECG) is a biosignal that provides information on the patient's heart's electrical activity. ECG enables the diagnosis of various cardiac abnormalities, from acute coronary syndrome to cardiac arrhythmias. Therefore, ECG monitoring in daily life is necessary for early diagnosis of heart disease. Hardware and software developments have led to the development of machine learning enabled wearable healthcare devices, such as smartwatches and chest patches, which can continuously monitor cardiac functioning easily. The wearable devices provide critical alerts for events that require prompt medical attention or hospitalization, making them highly efficient and practical. A conventional wearable device has three primary modules. The first module is the sensors and analog front, responsible for acquiring the ECG signals and converting them to digital samples. The second module consists of an ECG co-processor, incorporating a feature extraction block and a machine learning-based classifier responsible for ECG signal analysis and classification of cardiovascular diseases. The final module comprises data compression and transmitter blocks, which transmit ECG data and the classifier output to the cloud servers. In wearable devices, battery life is critical because most devices monitor ECG continuously. Further, these devices should be small and easy to use. Therefore, area and power-optimized algorithms and their VLSI architectures are required for continuous monitoring of ECG on wearable devices. Thus, we present optimized ECG signal processing algorithms and their low-power and resource-efficient VLSI architectures for cardiovascular disease detection, such as cardiac arrhythmia and myocardial infarction, for wearable devices.