National Institute of Technology Rourkela

Synopsis Seminar

Seminar Title	: An Integrated Artificial Intelligence and Advanced Signal Processing Framework for Early Prediction of Sudden Cardiac Death from ECG signal
Speaker	: Shaik Karimulla (Rollno : 520ee1006)
Supervisor	: Dipti Patra
Venue	: EE-401, Seminar Hall
Date and Time	: 26 Jun 2025 (10 AM)

Abstract : Sudden Cardiac Death (SCD) remains one of the most abrupt and fatal manifestations of cardiovascular disease, often striking without warning and contributing significantly to global cardiac mortality. Its unpredictable nature, coupled with a critically narrow window for intervention, makes proactive and early prediction an urgent clinical challenge. This research addresses that gap by proposing a robust, multi-stage artificial intelligence (AI) driven framework for the early prediction of SCD using ECG signals, with a key focus on achieving clinically actionable prediction within a one-hour horizon. The pipeline evolves through five interconnected methodologies starting with long-duration ECG analysis using 77 HRV features across time, frequency, nonlinear domains, and CQNSGT spectrogram based. With ANOVA and SFS-based selection, a Gradient Boosting Classifier yields 96.43% accuracy. To address limitations of handcrafted features, a short-segment (10s) analysis is introduced using Variational Mode Decomposition (VMD) and Recurrence Plot (RP) fusion. A custom dual-path CNN (SCDNet) is trained on this fused input, improving accuracy to 98.11%. The third phase fuses multiple time&ndashfrequency representations STFT, WT, ST, and SLT to generate composite spectrograms and scalograms, which are processed by pre-trained CNNs, pushing performance to 99.55%. Next, a hybrid model using Wavelet Scattering Transform (WST) and ResNet SE further refines temporal-spectral learning on 1-minute segments, achieving 99.7% accuracy. Finally, a morphology-driven approach extracts denoised P-QRS-T wave features and classifies them using an Ensemble Growing (EG) model, peaking at 99.82% accuracy with enhanced interpretability. Together, these stages deliver a robust, scalable, and clinically actionable solution for SCD prediction.

Keywords:

Artificial Intelligence (AI) Electrocardiogram (ECG) Signal Analysis Fusion Heart rate variability Morphological Feature Extraction Sudden Cardiac Death (SCD) Signal Processing Signal decomposition Time&ndashFrequency Transformation