Heart Abnormality Detection Application Through ECG Data Preprocessing Method Optimization Using a Multilayer Perceptron Model

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ABSTRACT

The development of an abnormal heart detection application represents a significant contribution to the field of Medical Informatics. The dataset from Puskesmas Mlati II consists of 125 Electrocardiogram (ECG) recordings with very short durations (98 normal, 27 abnormal), a frequency of 500 Hz, and 8,500 samples. The challenge posed by the ultra-short duration (UST) of the recordings results in low temporal resolution, requiring the selection of relevant Heart Rate Variability (HRV) features to ensure that the data interpretation remains representative. Additionally, the class imbalance problem leads to model bias. To address these issues, this study proposes a comprehensive approach by applying an interpolation resampling method to the original signal and the RR Interval (RRI), and comparing their effectiveness. Resampling was performed at frequencies of 550 Hz, 600 Hz, and 650 Hz (upsampling) and 450 Hz, 400 Hz, and 350 Hz (downsampling), from 500 Hz. Feature selection for relevant HRV features under UST conditions was conducted, along with handling class imbalance using the Adaptive Synthetic Sampling (ADASYN) method. The model was built using the Multilayer Perceptron (MLP) algorithm, as it is effective in handling limited features. Among all the research scenarios, the best results were obtained with 600 Hz upsampling and the application of ADASYN, yielding a training accuracy of 96.59% and a testing accuracy of 95.91%. Precision was 100%, with recall at 93.15% during training and 92% during testing. The F1 Score was 96.45% for training and 95.83% for testing, and the AUC was 0.997 for training and 0.965 for testing.

Keywords: Electrocardiogram Resample, Ultra Short Term, Heart Rate Variability, ADASYN, Multilayer Perceptron.