

POLITECHNIKA ŚLĄSKA
WYDZIAŁ INŻYNIERII BIOMEDYCZNEJ

ROZPRAWA DOKTORSKA

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WYBRANE METODY
PRZETWARZANIA I ANALIZY SYGNAŁÓW
ELEKTROKARDIOGRAFICZNYCH
W ZASTOSOWANIACH TELEMEDYCZNYCH

PROMOTOR

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SUMMARY

Selected methods of processing and analyzing electrocardiographic signals in telemedicine

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Health monitoring and related technologies are a rapidly growing area of research. To this day, the electrocardiogram (ECG) remains a popular measurement tool in the evaluation and diagnosis of heart disease. However, the number of solutions involving ECG signal monitoring systems is growing exponentially in the literature.

On this thesis, an approach for mobile electrocardiographic signal processing is proposed. The concept of the designed solution included ECG telemonitoring, considering the scheme and architecture of the ECG LoRa device, aspects of signal processing, and cardiac risk assessment. The ECG abnormalities were identified using feature detection and classification. In feature detection, a novel algorithm for R-wave detection, as well as a method for extracting QRS complexes was proposed. In terms of classification, original models based on classical classifiers and artificial neural networks was determined. In addition, a proprietary algorithm for ECG signal compression was proposed, as well as it specified the determination of how to store ECG fragments in a byte array. In both cases, the Orthogonal Matching Pursuit algorithm was used. Finally, the transmission process was implemented using a novel approach using LoRa WAN technology.

Regardless of the issue, the performance of algorithms proposed to implement the research methodology was evaluated using publicly available databases PTB Diagnostic ECG Database and PTB-XL Database. Application of Orthogonal Matching Pursuit algorithm in the compression issue, with optimal choice of parameters allowed to obtain MSE at the level of 0.0015 for compression factor 25. The realization of classification issues achieved the highest accuracy at 90.4% in recognition of 2 classes, while less than 78% for 5 classes and 71% for 15 classes.