

## SUMMARY OF DOCTORAL DISSERTATION

**Author:** Marek Czerw

**Title:** Autonomous, mobile system for monitoring cardiac rehabilitation based on ECG recording and respiratory parameters using an innovative textronic shirt

Cardiovascular diseases are the cause of the largest number of deaths among non-communicable diseases in Poland and worldwide, indicating an urgent need to develop effective strategies for prevention and, consequently, reduction and solution of this significant public health problem. Therefore, an attempt was made to develop and test an innovative technological solution that can provide a diagnostic and therapeutic tool that meets the expectations of patients and the cardiology community. The doctoral thesis took up the challenge of developing a maintenance-free but inexpensive cardiology monitoring system fulfilling a diagnostic function, supporting medical therapeutic and rehabilitation procedures.

This scientific dissertation addresses the problem of the lack of clear evidence confirming the availability of a medical system of an autonomous cardiac monitoring system that does not require the support of medical personnel. In particular, this refers to the use in patients after severe cardiac events as an effective tool in hybrid cardiac rehabilitation.

In connection with the above, the initiative to provide and disseminate a proven and easy-to-use tool for supervised cardiac rehabilitation seems justified. This is a significant undertaking aimed at developing and certifying a system for monitoring and cardiology therapy as an effective medical solution. Considering the fact that such a system can support medical specialists in diagnosing circulatory system diseases and its availability can influence the pro-health behaviors of broad social groups.

The developed system is based on personal textronic clothing and is closely related to the need for continuous monitoring of important signals and biomedical parameters, such as ECG and HR, respiratory rate. Analysis of the collected and processed data can support current cardiological diagnostics. The electronic system equipped with the latest technology components, including a processor for embedded applications, can be used not only for cardiological supervision during rehabilitation. Thanks to the use of Bluetooth radio transmission in combination with a mobile application, the ultra-miniature module will also be used for cardiological diagnostics and long-term monitoring, in medical units, but also outside them thanks to the use of telemedicine technologies. The work reviews various techniques for monitoring breathing using methods that are the least inconvenient and comfortable to use and wear. The results of tests of various respiratory sensors were used to select the optimal solution, which had to take into account simultaneous recording of a two-channel ECG. At the same time, further models of textronic clothing were developed and tested, on which conductive connections and circular fields acting as dry ECG electrodes were printed.

The final stage of the work included the development and testing of a prototype system consisting of a series of printed textronic clothing, integrated with an electronic module for recording biomedical signals and a mobile application supervising the process of monitoring and collecting medical data. The developed system is documented in accordance with the requirements of the quality management system for medical devices, for the purpose of its certification and final implementation.