



Akademia
Techniczno-Humanistyczna
w Sielsku Śląskim



WYDZIAŁ BUDOWY MASZYN
I INFORMATYKI

M O N O G R A F I A



**PRZETWARZANIE,
TRANSMISJA
I BEZPIECZEŃSTWO
INFORMACJI**

2022



Akademia
Techniczno-Humanistyczna
w Bielsku-Białej

Przetwarzanie, transmisja i bezpieczeństwo informacji

Patronat honorowy



Minister
Edukacji i Nauki



Polska Akademia Nauk
Komitet Budowy Maszyn



Polska Akademia Nauk
Komitet Inżynierii Produkcji

Bielsko – Biała 2022

Redaktor Naczelny Wydawnictwa:

dr hab. inż. Krzysztof BRZOZOWSKI, prof. ATH

Redaktor Działu: dr hab. inż. Dorota PAWLUS, prof. ATH

Redakcja: dr inż. Jacek RYSIŃSKI

dr inż. Dorota WIĘCEK

Sekretarz Redakcji: mgr Grzegorz ZAMOROWSKI

WYDAWNICTWO NAUKOWE
AKADEMII TECHNICZNO - HUMANISTYCZNEJ
W BIELSKU-BIAŁEJ

PL 43-309 Bielsko-Biała, ul. Willowa 2

ISBN 978-83-67652-00-1

DOI: <https://doi.org/10.53052/9788367652001>

Artykuły wydrukowano na podstawie materiałów dostarczonych przez autorów. Oryginały referatów (tekst i rysunki) reprodukowane są z uwzględnieniem uwag recenzentów na odpowiedzialność Autorów.



Publikacja dofinansowana ze środków budżetu państwa w ramach programu Ministra Edukacji i Nauki pod nazwą Doskonała Nauka – Wsparcie konferencji naukowych nr projektu DNK/SP/550674/2022 kwota dofinansowania 54 010 PLN całkowita wartość projektu 60 110 PLN.

Bielsko – Biała 2022

BERE Paul	Technical University of Cluj-Napoca, Romania
BRZOZOWSKI Krzysztof	University of Bielsko-Biala, Poland
CECCARELLI Marco	University of Rome Tor Vergata – IFToMM President, Italy
CZECH Piotr	Silesian University of Technology, Poland
CZEKAJ Edward	Foundry Research Institute, Krakow Poland
ČUBOŇOVÁ Nadežda	Žilinská Univerzita v Žiline, Slovakia
DANIELCZYK Piotr	University of Bielsko-Biala, Poland
DIMITROV Georgi P.	University of Library Studies and Information Technologies, Bulgaria
DIRGOVÁ LUPTÁKOVÁ Iveta	University of Ss. Cyril and Methodius in Trnava, Slovakia
DROBINA Robert	University of Bielsko-Biala, Poland
DULINA Ľuboslav	Žilinská Univerzita v Žiline, Slovakia
FOMIN Aleksey	École Polytechnique Fédérale De Lausanne, Switzerland
GREGOR Milan	Žilinská Univerzita v Žiline, Slovakia
GRYŚ Sławomir	Czestochowa University of Technology
HARLECKI Andrzej	University of Bielsko-Biala, Poland
HOLUB Sefhii	Cherkasy State Technological University, Ukraine
IVANCOVIC Igor	University of Montenegro, Montenegro
JANUSZ Jarosław	University of Bielsko-Biala, Poland
KARPIŃSKI Mikołaj	University of Bielsko-Biala, Poland
KAZAKOVA Nadiia	Odessa State Environmental University, Ukraine
KŁOSIŃSKI Jacek	University of Bielsko-Biala, Poland
KNEFEL Tomasz	University of Bielsko-Biala, Poland
KRAJČOVIČ Martin	Žilinská Univerzita v Žiline, Slovakia
KURIC Ivan	Žilinská Univerzita v Žiline, Slovakia
LOVASZ Erwin	Politechnica University of Timisoara, Romania
LUZHETSKYI Volodymyr	Vinnytsia National Technical University, Ukraine
MACZYŃSKI Andrzej	University of Bielsko-Biala, Poland
MARTSENYUK Vasyl	University of Bielsko-Biala, Poland
MIČIETA Branislav	Žilinská Univerzita v Žiline, Slovakia
NOWAKOWSKI Jacek	University of Bielsko-Biala, Poland
PARKHUTS Lyubomyr	University of Lviv, Ukraine
PEZDA Jacek	University of Bielsko-Biala, Poland
PLINTA Dariusz	University of Bielsko-Biala, Poland
POLACH Pavel	Research and Testing Institute Plzen s.r.o, Czech Republic
RANČIĆ Dejan D.	University of Niš, Nis, Serbia
ROM Monika	University of Bielsko-Biala, Poland
RYSIŃSKI Jacek	University of Bielsko-Biala, Poland
SKOŁUD Bożena	Silesian University of Technology, Poland
STADNICKI Jacek	University of Bielsko-Biala, Poland
TIMOFIEJCZUK Anna	Silesian University of Technology, Poland
TOMOVIC Savo	University of Montenegro, Montenegro
UNGUREANU Nicolae	Technical University of Cluj-Napoca, Romania
VASILIU Yerhen	Odessa National Academy of Telecommunications, Ukraine
WIĘCEK Dariusz	University of Bielsko-Biala, Poland
WIĘCEK Dorota	University of Bielsko-Biala, Poland
WOJNAR Grzegorz	Silesian University of Technology
WRÓBEL Ireneusz	University of Bielsko-Biala, Poland
WYRÓD-WRÓBEL Jolanta	University of Bielsko-Biala, Poland



Oddział w Bielsku-Białej



Oddział w Bielsku-Białej

Przetwarzanie, transmisja i bezpieczeństwo informacji**Processing, transmission and security of information****Mykhailo GOLOVAN..... 9****Supervisor: Viktor GNATYK**

System natychmiastowych wiadomości dla centrum kontaktowego

Instant messaging system for the contact center

Mikołaj GRYGIEL..... 19**Opiekun naukowy: Stanisław ZAWIŚLAK**

Najkrótsza ścieżka i cykl Eulera – aplikacja oraz historia

Shortest path and eulerian cycle in graphs – software and some historical remarks

Jakub JANIK 29**Opiekun naukowy: Robert DROBINA**

Nowoczesne metody zarządzania projektami w firmach IT

Modern project management methods in IT companies

Jakub JANIK 43**Opiekun naukowy: Robert DROBINA**

Informatyczne instrumenty wspierające zarządzanie projektami w nowoczesnych przedsiębiorstwach

Informatics instruments to support project management in modern companies

Olha KOVALCHUK, Ruslan SHEVCHUK, Gulmira SHANGYTBAYEVA 57**Supervisor: Mykhailo KASIANCHUK**

Model wspomagania decyzji w oparciu o analizę ryzyka i zagrożeń bezpieczeństwa międzynarodowego

Decision support model based on the analysis of international security risks and threats

Mateusz KUBIEŃ, Natalia BOCZAR, Damian KOLNY, Robert DROBINA..... 71**Opiekun naukowy: Robert DROBINA**

Rozwój technologiczny przedsiębiorstw produkcyjnych w kontekście cyfrowej transformacji i cyberbezpieczeństwa

Technological development of production enterprises in the context of digital transformation and cybersecurity

Mikołaj MOLGA	85
Opiekun naukowy: Sławomir HERMA, Dawid KOTRYS	
Aplikacja internetowa obsługująca grę miejską	
Web application for the urban game	
Mikoła PATLAIENKO, Olena OSHAROVSKAYA	95
Opiekun naukowy: Valentyna SOLODKA	
Jakościowa estymacja skompresowanych plików video typu dvc z zastosowaniem transformacji falkowych	
Quality estimation of distributed video codec based on wavelet transform	
Vasyl POBEREZHNYK, Oleh HARASYMCHUK, Ivan OPIRSKY	107
Supervisor: Ivan OPIRSKY	
Ochrona plików multimedialnych przed fałszowaniem i nielegalnym wykorzystaniem w oparciu o blockchain	
Media files protection against forgery and illegal use based on blockchain	
Yanina SHESTAK, Anna TORCHYLO, Serhii DAKOV	119
Supervisor: Serhii TOLIUPA	
Neural network algorithms for data centers cybersecurity	
Algorytmy sieci neuronowych dla cyberbezpieczeństwa centrów danych	
Taisiya TRETIAKOVA	125
Opiekun naukowy: Alexander MOLNAR, Vitaly GERASIMOV	
Mobilny system telemetrii medycznej	
Mobile medical telemetry system	
Yurii SHCHERBYNA, Nadiia KAZAKOVA, Oleksii FRAZE-FRAZENKO	131
Wykorzystanie generatora Xorshift do symulacji procesów stochastycznych	
Using the Xorshift generator to simulate stochastic processes	
Andrii VLASOV, Oleksandr SIEVIERINOV	145
Opiekun naukowy: Gennady KHALIMOV	
Technologiczne aspekty przetwarzania informacji wideo z kontrolą bezpieczeństwa zasobów informacji	
Technological aspects of video information processing with information resource security control	

Radosław WALUŚ	153
Opiekun naukowy: Sławomir HERMA, Dawid KOTRYŚ	
Liczby nadpierwsze	
Super-primes	
Serhii YEYSEIEV, Serhii POHASII, Anna STRELNIKOVA, Stanislav MILEVSKYI	157
Opiekun naukowy: Serhii YEYSEIEV	
Metody ochrony informacji w systemach cyber-fizycznych	
Information protecting methods in cyberphysical systems	
Ruslana ZIUBINA, Olga VESELSKA, Maksym HEDEON.....	173
Steganograficzna ochrona informacji z wykorzystaniem zmodyfikowanego algorytmu LSB	
Steganographic protection of information using modified LSB algorithm	

Taisiya TRETIAKOVA¹

Opiekun naukowy: Alexander MOLNAR², Vitaly GERASIMOV³

MOBILNY SYSTEM TELEMETRII MEDYCZNEJ

Streszczenie: Opracowaliśmy miniaturowy system telemetrii medycznej, który gromadzi informacje o parametrach fizycznych człowieka (tętno, poziom tlenu we krwi SpO₂, ciśnienie tętnicze, elektrokardiogram, zmienność rytmu serca, częstość oddechów, temperaturę ciała, poziom cukru we krwi) oraz przesyła dane przez Bluetooth do smartfona i zapisane na dysku lokalnym w celu dalszego przetwarzania i zapisywania jak osobista czarna skrzynka (w samolocie). System oparty jest na platformie MAXREFDES100# Health Sensor Platform z dodatkowymi czujnikami, które upraszczają i przyspieszają rozwój. Oprogramowanie dla komputerów PC kompatybilnych z IBM i dla systemu Android pozwala konfigurować, gromadzić i przetwarzać „surowe” dane z czujników. Zmodyfikowaliśmy tę platformę, zmieniając wbudowane oprogramowanie, które pozwala zdefiniować dodatkowe parametry, takie jak ciśnienie krwi i częstość oddechów.

Słowa kluczowe: telemetria medyczna, bioczujniki, parametry człowieka

MOBILE MEDICAL TELEMETRY SYSTEM

Summary: We have developed miniature medical telemetry system which gathers information of physicals human's parameters (pulse rate, blood oxygen level SpO₂, arterial pressure, electrocardiogram, heart rate variability, breathing rate, body temperature, blood sugar level) and data are transmitted by Bluetooth to a smartphone and saved in local drive for further processing and saving like personal black box (which on the plane). The system are based on MAXREFDES100# Health Sensor Platform with additional sensors which simplify and speeds up development. Software for IBM-compatible PC and for Android allows you to configure, accumulate and process "raw" data from sensors. We have modified this platform by changing the built-in software, which allows you to define additional parameters such as blood pressure and respiratory rate.

Keywords: medical telemetry, biosensors, human's parameters

¹ Uzhhorod National University, Department of the Physics of Semiconductors, Biomedical Engineering: treyakova.tajisiya@student.uzhnu.edu.ua

² Dr., Professor, Uzhhorod National University, Department of the Physics of Semiconductors: alexander.molnar@uzhnu.edu.ua

³ Ph.D. Mukachevo State University, Faculty of Economics, Management and Engineering, vitgerv@gmail.com

1. Introduction

Today, we have a lot of varieties of systems and methods for monitoring biomedical parameters of human. All of them need improvement, but sometimes completely new equipment is created.

The development and improvement of these systems depend on the indicators that we need to obtain. Also, high accuracy of the investigated values is also very important. Our purpose is a development of a miniature system for gathering biomedical parameters of person for the intention of complex patients diagnoses during the performance of his usual actions, including those physical exertion.

This system can be used to monitor the health of sportsmen, especially during the rehabilitation period.

2. System Description

We modernized system for researching biomedical parameters of human. System has glucometer added for researching stable sugar level. Also we can follow sportsmen muscles condition.

It is multisystem which can fixate several basic life parameters. These are: pulse rate, blood oxygen level SpO₂, arterial pressure, electrocardiogram, heart rate variability, breathing rate, body temperature, blood sugar level.

Our system based on MAXREFDES100# Health Sensor Platform with additional sensors which simplifies and speeds up development. Software for IBM-compatible PC and for Android allows you to configure, accumulate and process "raw" data from sensors.

3. MAXREFDES100# health sensor platform

Maxim MAXREFDES100# health sensor platform is an integrated sensor platform that helps customers evaluate Maxim's complex and innovative medical and high-end fitness solutions. The platform integrates one biopotential analog front-end solution (MAX30003/MAX30004), one pulse oximeter and heart-rate sensor (MAX30101), two human body temperature sensors (MAX30205), one 3-axis accelerometer, one 3D accelerometer and 3D gyroscope, and one absolute barometric pressure sensor.

Modes of Operation

The Health Sensor Platform can be used in any of the three modes listed below.

- **Tethered Mode:** The user can connect the Health Sensor Platform to a PC-based GUI using a USB-C cable. This mode supports all sensors installed on the board including ECG, Optical, and Temperature sensors. The GUI provides options to run quick demos (with default register settings) and to evaluate any of the sensors in detail by changing the register settings of each individual sensor or analog front end.

- **Untethered Mode (Offline):** The Health Sensor Platform collects data and saves it to the onboard flash. The data can be downloaded later for post-processing. This mode requires the Health Sensor Platform to be connected to the PC GUI, as in Tethered Mode, to configure the sensors and write the mission to the onboard flash, which later can be disconnected and run untethered. To operate in this mode, the battery holder and the coin cell (not included in the box) must be installed.
- **Untethered Mode (Real time):** Customers can stream data in real time to an Android. We have provided a few functions to demonstrate how to connect the platform to the app. Customers can use the source code provided to develop the app to address their specific use cases. Here is the list of functions enabled in the app:
 - Temperature using Temp Sensors
 - Barometer Pressure using Pressure Sensor
 - HR using ECG Analog Front End
 - Position of the board using Accelerometer
 - The first two functions stream as soon as the HSP board is connected to the app. The last two functions need customers to set up a mission before connecting to the app.

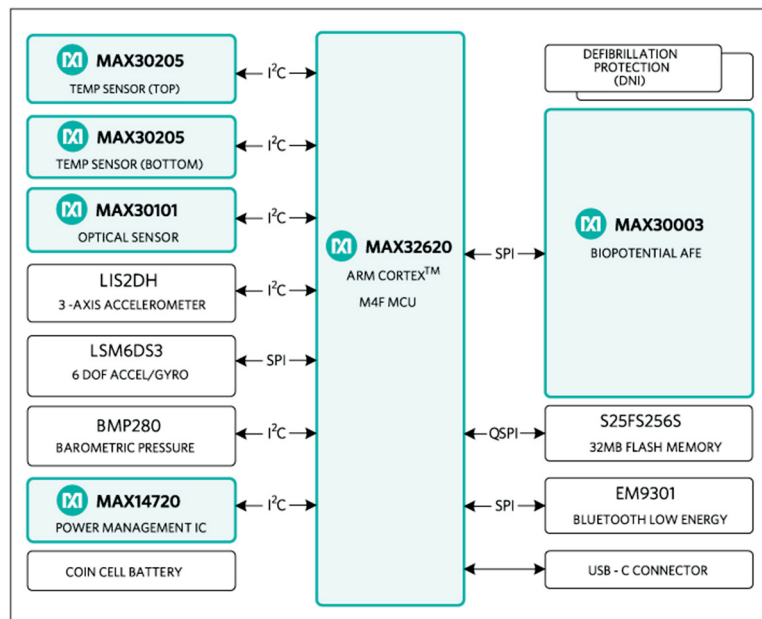


Figure 1. The MAXREFDES100# health sensor platform internal structure

PC and Android applications are provided on the Design Resources tab to help you get up and running quickly. The PC application provides a graphical user interface (GUI) allowing you to configure and interact with all the sensors over a USB

connection. The Android application provides the ability to monitor sensor data over BLE. Instructions for installing and running the applications are found on the details tab.

The ARM mbed development environment is supported for developers who want to customize the operation of the platform. The companion MAXREFDES100HDK# programming adapter that ships with the platform provides driverless drag-and-drop programming for firmware updates as well as a virtual UART interface and CMSIS-DAP compatible debugger. For more details on firmware development and source code examples visit the MAX32620HSP platform page on the ARM mbed developer site [1].

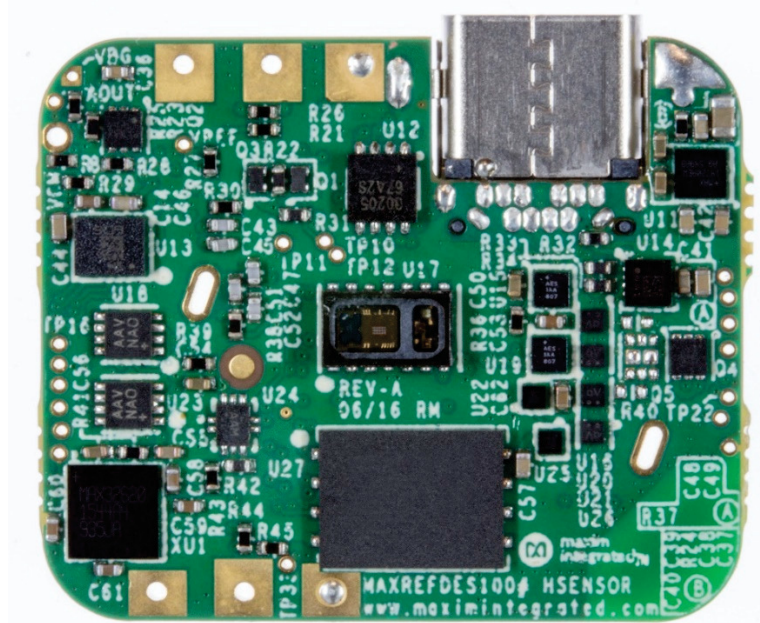


Figure 2. The MAXREFDES100# external view (approx. 3x2 cm²).

3.1. Maxim Blood Pressure Trending System

Maxim Blood Pressure Trending (MaximBPT) is a BP measurement system using a photoplethysmography (PPG) signal obtained from the fingertip. The system requires user-specific calibrations, and successive measurements are relative to this calibration point. The goal of the system is to make BP measurements readily available to the user through widely available consumer devices like smartphones or wellness watches. The system is most useful and accurate when measurements are taken in a resting state, as in traditional cuff-based BP systems.[2]

3.2. SpO2 Subsystem

The SpO₂ subsystem contains ambient light cancellation (ALC), a continuous-time sigma-delta ADC, and proprietary discrete time filter. The ALC has an internal Track/ Hold circuit to cancel ambient light and increase the effective dynamic range.

The SpO₂ ADC has a programmable full-scale ranges from 2 μ A to 16 μ A. The ALC can cancel up to 200 μ A of ambient current. The internal ADC is a continuous time oversampling sigma-delta converter with 18-bit resolution. The ADC sampling rate is 10.24MHz. The ADC output data rate can be programmed from 50sps (samples per second) to 3200sps.

3.3. Temperature Sensor

The MAX30101 has an on-chip temperature sensor for calibrating the temperature dependence of the SpO₂ subsystem. The temperature sensor has an inherent resolution 0.0625 $^{\circ}$ C. The device output data is relatively insensitive to the wavelength of the IR LED, where the red LED's wave-length is critical to correct interpretation of the data. An SpO₂ algorithm used with the MAX30101 output signal can compensate for the associated SpO₂ error with ambient temperature changes.

3.4. LED Driver

The MAX30101 integrates red, green, and IR LED drivers to modulate LED pulses for SpO₂ and HR measurements. The LED current can be programmed from 0 to 50mA with proper supply voltage. The LED pulse width can be programmed from 69 μ s to 411 μ s to allow the algorithm to optimize SpO₂ and HR accuracy and power consumption based on use cases.[3]

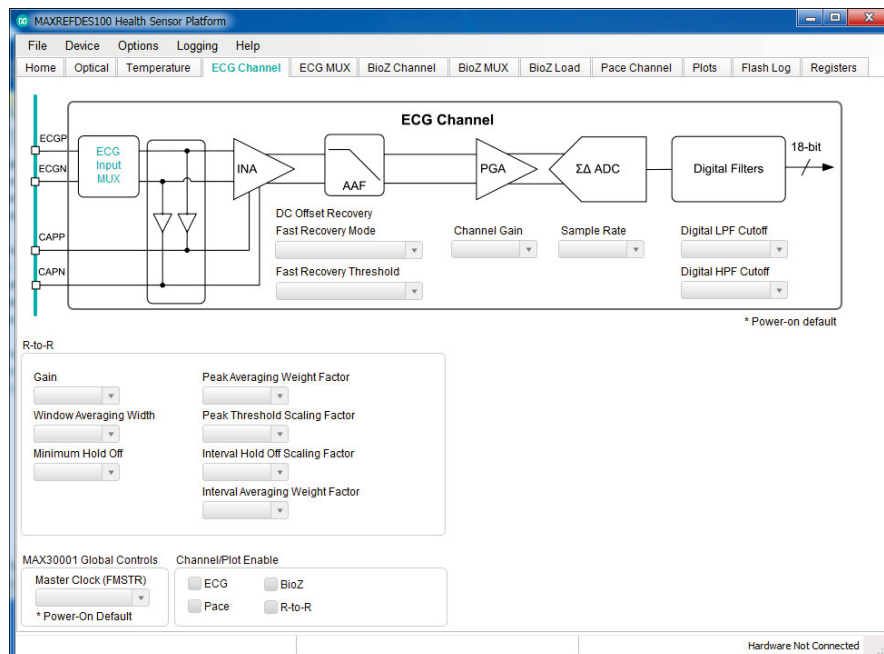


Figure 3. The MAXREFDES100# Health Sensor Platform v.3.02.

4. Control Software

The source codes of the software built into the controller are available on the website of the MAXIM company, which provides us with the possibility of modifying the firmware of the platform. The idea was that by processing the raw data of the cardiogram by low-frequency modulation of its amplitude, it is possible to determine the patient's respiratory rate, and based on the photoplethysmography data, we can determine the blood pressure. True, the last parameter is only approximate, and is not suitable for medical use (requires calibration for a specific person), however, this accuracy is quite enough to check the condition of athletes during training.

5. Conclusion

The use of the MAXREFDES100# reference design allowed us to quickly develop a human condition monitoring system that determines the main parameters of human life, such as pulse rate, cardiogram, blood oxygen level, body temperature, blood pressure, respiratory rate and body position in space (important when falling). The use of such systems at a relatively low cost allows you to monitor patients (older people, children, emergency workers, military, etc.) in real time. In addition, by equipping this platform with a relatively large amount of memory, it can be used as a personal analogue of the "aviation black box". Due to its ultra-low power consumption, this platform can be powered by an alternative ferroelectric-based energy harvester, which allows it to operate almost indefinitely [4].

LITERATURA

1. Serwis internetowy Maxim Integrated a subsidiary of Analog Devices: <https://www.maximintegrated.com/en/design/reference-design-center/system-board/6312.html>, 01.11.2022
2. Serwis internetowy Maxim Integrated a subsidiary of Analog Devices: <https://www.maximintegrated.com/en/design/technical-documents/app-notes/7/7082.html>, 01.11.2022
3. Serwis internetowy Maxim Integrated a subsidiary of Analog Devices: <https://www.maximintegrated.com/en/products/interface/signal-integrity/MAX30101.html>, 01.11.2022
4. MOLNAR A., GAL D., BAN H., GERASIMOV V. Ferroelectric Based Multi-Type Energy-Harvesting Device to Power a Mobile Medical Telemetry System. *Integrated Ferroelectrics*, **220**(2021)1, 110-119.