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Guest Editorial

Current affairs and development in the field of biomedical engineering from several perspectives

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This special section of *Technology and Health Care* contains a collection of selected papers from the 14th International Conference BIOMDLORE2023, which was organized by the Institute of Biomedical Engineering at Bialystok University of Technology, the Medical University of Bialystok, Vilnius Gediminas Technical University and Kaunas University of Technology. The event was held on 22–24 October 2023 in Bialystok, Poland.

The main topic and focus of the conference is already reflected in its name – BIOMDLORE stands for **BIO**mechanics, **M**edical **D**iagnostics, **LO**comotion and **RE**habilitation. The broader scope of the conference focuses on various biomedical engineering problems: biomechanics of the human body, orthopedics and traumatology, assistive technologies, rehabilitation engineering, medical diagnostics, biosignal recording and processing, mathematical modeling, sports biomechanics, robotics, e-health challenges and AI solutions in healthcare and in the areas of a person's subjective well-being.

This special section is designed to present the latest scientific news and trends in the field of biomedicine by presenting the latest engineering solutions and the need for specific knowledge. In addition, the aim is to draw attention to today's modern problems both in the health sector and taking into account the quality of life and well-being of each person.

The contents of the special section present some of the research problems that are currently explored within the field of biomedical engineering and biomechanics. A total of 11 papers presented here are focused on various topics ranging from gait biomechanics to smart applications in various fields.

In "Design of intelligent monitoring of loneliness in the elderly using a serverless architecture with real-time communication API", the authors aim to design a customizable loneliness monitoring system capable of storing and the commercial activity bracelet. As a result, a new system has been proposed by combining wearable devices and Serverless Computing technology architecture. The developed architecture shows great potential for easy data collection, analysis, security, personalization, real-time

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inference, and scalability of sensors and actuators in the future. It has powerful benefits to apply in the health sector and reduces cases of depression and loneliness.

In "Experimental and theoretical investigation of aortic wall tissue in tensile tests", the authors perform a mechanical tensile test using canine aorta samples and create a numerical model of aortic tissue tension from the processed data. Results revealed that the logistic function described the nonlinear behaviour of the aorta soft tissue with an accuracy of 95% from the start of the tension to the media layer rupture. The numerical investigation confirmed that the non-linear soft tissue was validated by applying a logistic function approach to the mechanical properties of the aortic wall.

In "Estimation of the knee joint load using plantar pressure data, measured by smart", the authors aim to estimate the correlation between the plantar pressure, measured using smart socks, and forces, acting in the joints of the lower extremities. The results demonstrate the feasibility (a strong correlation was found) of the smart socks for the estimation of the forces in the knee joints. The established linear regression equation enables the calculation of the knee joint force with an uncertainty of 22% using the plantar pressure estimate. The accuracy of the classification of the joint force as excessive, i.e., being more than 90% of the maximal force, was 82%.

The paper "Sting and evaluation of a prototype of a mobility trainer – verticalizer for children (2 to 7 years) weighing up to 20 kg" aims to investigate and evaluate the technical characteristics and possibilities of a mobility trainer for children. The results demonstrated that prototype of a trainer is suitable for use with children aged 2 to 7 years. The exercise with the verticalizer had a positive effect on muscle tone, increased range of motion (ROM) of shoulder flexion and abduction and improved ROM of hip internal and external rotation and the flexion and extension of knee.

In "Parkinson's disease classification with CWNN: Using wavelet transformations and IMU data fusion for improved accuracy", the authors propose a convolutional wavelet neural network approach for Parkinson's disease classification using IMU. They aim to determine the optimal combination of wavelet transform and IMU data type that yields the highest classification accuracy for Parkinson's disease. The results demonstrate the impact of different wavelet functions and IMU data types on Parkinson's disease classification performance, revealing that the combination of Morlet wavelet function and IMU data fusion achieves the highest accuracy.

In "Study of foot support during gait in healthy children from neighbouring countries" authors aim to identify differences in gait support among children in neighbouring countries and create new reference knowledge. The results demonstrated statistically significant differences in different support parameters, as well as in the times of occurrence of max. forces in all three zones. This knowledge can help caregivers, as well as clinicians and researchers, understand how gait mechanics change with development and the growth course of the children of that country.

In "Automatic gender and unilateral load state recognition for biometric purposes", the author aims to recognize the gender or unilateral loading state of a walking human, as well as a combination of both of these characteristics, using ground reaction forces (GRFs) generated during human gait. The kNN classifier demonstrated the best results: recognized the gender of the individual with an accuracy of 99.37%, the unilateral load state with an accuracy reaching 95.74%, and the combination of those two states with an accuracy of 95.31%.

The study "Numerical modelling of an orthopedic brace with increased functional characteristics for the treatment of idiopathic scoliosis" aims to reduce the weight of the orthosis and improve its functionality while maintaining its corrective function. Optimizing the design reduced the weight of the orthosis by 39% while maintaining corrective stiffness. This indicates that the corrective function was largely preserved.

In "Exploring the impact of body mass change on fatigue and activity of the muscular system during a daily routine", the authors aim to determine the effect of weight change on fatigue and activity of the muscular system during daily activities. The change in body weight alters the functioning of the muscular system and thus the ability to perform activities. It was shown that in case of underweight, overweight or obese people, abnormal body weight can be the reason for occurrence of difficulties in performing the activities of lifting and holding object, as well as walking.

In "Prediction of exam scores using multi-sensor approach for wearable exam stress dataset with uniform preprocessing", the authors explore the effectiveness of physiological signals in predicting grades and assessing the impact of different models and feature selection techniques on predictive performance. The results are promising, as the highest scores achieved using 100 and 150 features suggest practical applications in the field of education, where the use of physiological signals can help students cope with exam stress and improve their academic performance.

The paper "Assessment of the disease severity in patients hospitalized for COVID-19 based on the National Early Warning Score (NEWS) using statistical and machine learning methods: An electronic health records database analysis" evaluated whether NEWS can be a predictor of COVID-19 patient status in the hospital. The results demonstrated that NEWS predictive ability can be increased by adding the patient's age at hospitalization, gender, clinical and laboratory variables (0.853 sensitivity, 0.992 specificity and F1-score – 0.859) in comparison with single NEWS (0.603, 0.995, 0.719, respectively). An evaluation of various models showed that stepwise logistic regression was the best method for in-hospital mortality classification.

The research results presented in this special section are of interest to a diverse audience from experts, practitioners to young researchers in engineering, medicine, rehabilitation, information technology and other engineering fields. We hope readers will find the papers interesting and enjoyable.