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EDITORIAL

Smart technologies and its application for medical/healthcare services

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1 Introduction

Intensive development of such fields as the Internet of Things (IoT), Big data, Cloud computing, and Artificial Intelligence, observed in recent years, provides new opportunities for developing digital Medical/Healthcare services in different areas. Using all or only part of these tools allows for building intelligent systems for various medical and healthcare purposes. Its development, implementation, and application aim to improve the quality of life for countless patients in hospitals, ambulatory care facilities, or long-term care settings.

Diagnostic, prevention, and treatment tasks using intelligent systems and technologies acquire a slightly different meaning. In this case, such a system conducts round-the-clock monitoring of the patient's condition, supports his activities, evaluates the prescribed treatment's effectiveness, and so on. It collects smart sensor data's, transmits data via mobile Internet, analyzes it using Artificial Intelligence tools, and advises the patient, his caregiver, or doctor on the necessary corrections or possible further actions. However, this approach has many problems, the effective solution of which will allow the practical use of such services. The primary ones are the accuracy of the smart system, its speed, and reliability. These problems significantly depend on the quality and quantity of data, methods of its pre-processing, technologies of its transfer, tools of its storage and intellectual processing, the efficiency of the chosen machine learning model for prediction/classification, etc. The rational solution to all these tasks will help create new or improve existing Medical/Healthcare Services. It must meet the needs of all parties of the Medical/Healthcare ecosystem intelligently.

This Special Issue aims to disseminate and discuss the reliable AI-based models, methods, and technologies that support complex solutions for smart health. It presented improvements of Medical/Healthcare services in different essential fields. We have considered only science-intensive solutions that expound the problems with smart healthcare and propose reliable, accurate, or fast solutions.

We obtained original, previously unpublished research on the following topics:

- Reliable healthcare services
- Small data approaches in medicine
- Big data and IoT for medical applications
- Medical image processing and interpretation
- Deep learning models in biomedicine
- Neuro-fuzzy system and its modifications
- Smart biomedical manufacturing and services
- Real-time healthcare technologies and solutions
- Data-driven services design and management
- Machine learning approaches for critical healthcare
- Explainable AI for healthcare
- Reinforcement learning approaches for healthcare
- Intelligent environments for healthcare
- Context-aware services for healthcare
- Complex healthcare monitoring systems

Some of it was accepted after a careful review and published in the proposed special issue.

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2 Review of the accepted works

Paper [1] is dedicated to developing blockchain information technology for medical data management. The authors demonstrated the high relevance of this topic, especially for improving the quality of healthcare in Ukraine. They developed an information technology for quantitative assessment of the sufficiency level of medical data, which, in the case of their insufficiency, provides recommendations to the user on the possibility of supplementing such data. In addition, the authors proposed a method of performing transactions on medical data for its effective management in real healthcare information systems in Ukraine. Conducted experimental studies with real medical data demonstrated the viability and veracity of the proposed approach.

In Ref. [2], the authors investigated the problem of overcoming the consequences of the COVID2019 pandemic. In particular, they have developed a non-iterative machine learning method for predicting children's hospitalization levels in the Lviv region, Ukraine. The basis of the proposed approach is the use of a linear non-iterative neural-like structure based on the model of successive geometric transformations, which was developed by Prof. Roma Tkachenko. To increase the forecasting accuracy, the authors performed several effective data pre-processing procedures. Experimental modeling on real-world data confirmed the high forecasting accuracy using the developed method. It was established through comparison that the developed method provides the highest work efficiency in terms of accuracy and duration of training procedures compared with all the studied methods. In general, the proposed approach provides the possibility of more effective management of the resources of a medical institution, which will increase the quality of the hospital's medical services.

The authors in Ref. [3] investigated the problem of early diagnosis of heart disease. Because current methods focus on expert judgment or clinical evaluation, they are not available to the public. In addition, such approaches introduce subjectivity into the decision-making process. Existing intelligent methods of solving the stated task are mainly based on known machine learning methods, which in most cases, do not provide sufficient classification accuracy. That is why the authors of this paper have developed a new method of early diagnosis of coronary heart disease based on a multi-level artificial neural network using the backpropagation algorithm. Numerous experimental results made it possible to obtain the optimal structure of such a network, which provides high accuracy of medical diagnosis. The results' reliability was also confirmed using cross-validation and statistical evaluation. The proposed approach provides the highest accuracy of early diagnosis of coronary heart disease, which allows for avoiding several complications with its treatment in case of late diagnosis.

Investigation [4] is dedicated to the problem of effective blood pressure monitors. The authors describe the structure and main functions of the Oranta-AO medical expert system developed by them. The authors demonstrated the main capabilities of the proposed system and described the algorithms that are its basis. In addition, the authors proposed expanding this system due to new methods of arterial oscillograms. They are based on the model of the cyclic random process. The results of mathematical modeling presented in the paper demonstrated the high efficiency of using the developed methods. Moreover, their implementation as components of the Oranta-AO expert system significantly increased the practical value of the latter. In addition, the main advantage of the updated system is the possibility of its practical application, as evidenced by the certification that this system passed in Ukraine.

Paper [5] is dedicated to the problem of remote collection and analysis of information about human activity for diagnostic and therapeutic purposes. The authors consider the task of human activity recognition based on signals collected by sensors of portable IoMT devices. The authors investigated the problem of personalized solutions in this field with traditional machine learning tools and deep neural networks. Experimental studies of the performance of the studied methods were carried out using several well-known datasets. Because of experimental studies, it was established that personalized solutions are effective only when traditional machine learning methods are used. At the same time, as noted by the authors, personalization can also be effective with deep machine learning tools, but only in cases with a large and heterogeneous sample of data.

Paper [6] also considers the problem of human activity prediction. However, unlike the previous work, this task is complicated by the complex nature of the human activity, which is closer to real-world situations. Accordingly, such a problem is more relevant, has a stochastic character, and is quite challenging to solve. The authors' approach uses contextual data within a smart home. Using such prompts in the general forecast model increases human activity prediction accuracy within the limits of a specific, predetermined environment. Experimental studies on the effectiveness of the proposed approach were conducted on a well-known dataset. The authors achieved almost 10% higher accuracy of human activity recognition using their proposed method compared to the analog. Despite this, the error of its work within 25% determines the need for further research in this complex but relevant direction.

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