MINISTRY OF EDUCATION AND RESEARCH OF THE REPUBLIC OF MOLDOVA
Technical University of Moldova
Faculty of Computers, Informatics, and Microelectronics
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Integration of artificial intelligence techniques in the healthcare system in Moldova.

Master's project

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ADNOTARE

Pentru diploma: "Integrarea tehnicilor de inteligență artificială în sistemul de sănătate din Moldova.", dezvoltată de Basso Nicolae, Chișinău, 2025.

Cuvinte-cheie: inteligență artificială, învățare automată, predicția diabetului, preprocesarea datelor, modele predictive.

Scopul lucrării: Scopul acestei lucrări este de a dezvolta modele predictive bazate pe inteligență artificială pentru identificarea riscului de diabet, sprijinind astfel diagnosticul timpuriu și optimizarea resurselor medicale. Lucrarea explorează integrarea soluțiilor AI pentru a sprijini personalul medical și a îmbunătăți rezultatele clinice.

Instrumente utilizate: Python, Google Colab, biblioteci pentru învățare automată (Scikit-learn, XGBoost, LightGBM).

Structura lucrării: Structura lucrării include o listă de figuri, o listă de listări de cod, introducere, cinci capitole, concluzie și bibliografie.

Capitole:

- **Capitolul 1:** Implicații etice și sociale ale AI în predicția diabetului;
- **Capitolul 2:** Provocări și limitări în predicția diabetului bazată pe AI;
- **Capitolul 3:** Strategii pentru implementarea AI în sănătatea diabetului;
- **Capitolul 4:** Evaluarea modelelor AI pentru predicția diabetului;
- **Capitolul 5:** Direcții viitoare pentru AI în predicția și gestionarea diabetului.

ANNOTATION

For the diploma: "Integration of artificial intelligence techniques in the healthcare system in Moldova." developed by Basso Nicolae, Chișinău, 2025.

Keywords: artificial intelligence, machine learning, diabetes prediction, data preprocessing, predictive models.

Objective: The objective of this work is to develop AI-based predictive models for identifying diabetes risk, thereby supporting early diagnosis and optimizing medical resources. The thesis explores the integration of AI solutions to assist medical professionals and improve clinical outcomes.

Tools Used: Python, Google Colab, machine learning libraries (Scikit-learn, XGBoost, LightGBM).

Structure: The structure of the thesis includes a list of figures, a list of code listings, an introduction, five chapters, a conclusion, and a bibliography.

Chapters:

- **Chapter 1:** Ethical and Social Implications of AI in Diabetes Prediction;
- **Chapter 2:** Challenges and Limitations in AI-based Diabetes Prediction;
- **Chapter 3:** Strategies for AI Implementation in Diabetes Healthcare;
- **Chapter 4:** Evaluating AI Models for Diabetes Prediction;
- **Chapter 5:** Future Directions for AI in Diabetes Prediction and Management.

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LIST OF ABBREVIATIONS

AI – Artificial Intelligence

Artificial Intelligence refers to the simulation of human intelligence processes by machines, especially computer systems. It involves tasks such as learning, reasoning, problem-solving, and natural language understanding.

ML – Machine Learning

Machine Learning is a subset of AI that enables systems to learn patterns from data and make predictions or decisions without explicit programming.

IoT – Internet of Things

Internet of Things refers to the network of physical devices embedded with sensors, software, and other technologies that communicate and exchange data over the internet.

AUC-ROC – Area Under the Receiver Operating Characteristic Curve

AUC-ROC is a performance metric used to evaluate the classification accuracy of machine learning models by measuring the trade-off between sensitivity and specificity across various thresholds.

GDPR – General Data Protection Regulation

GDPR is a legal framework established by the European Union to protect personal data and privacy for individuals within the EU, setting strict guidelines for data collection, processing, and sharing.

GDP – Gross Domestic Product

Gross Domestic Product is the total monetary or market value of all the finished goods and services produced within a country's borders in a specific time period, serving as a comprehensive measure of economic activity.

XGBoost – Extreme Gradient Boosting

XGBoost is an advanced machine learning algorithm based on gradient boosting, optimized for speed and performance, commonly used for structured data prediction tasks.

API – Application Programming Interface

An Application Programming Interface is a set of defined protocols and tools that allow different software components to communicate and interact with each other.

LGBM – Light Gradient Boosting Machine

Light Gradient Boosting Machine is a machine learning algorithm that is an efficient implementation of gradient boosting, designed to handle large-scale datasets and high-dimensional data.

INTRODUCTION

The healthcare system in Moldova [**2**], like many other developing nations, faces numerous challenges, ranging from limited resources and outdated medical technologies to difficulties in providing consistent, high-quality care across the country. As Moldova continues to modernize, it remains critical to address these issues in a way that ensures accessibility, efficiency, and quality in healthcare services. One of the most promising avenues for achieving these goals is through the integration of artificial intelligence [**3**] (AI) techniques like Machine Learning [**4**] (ML) into the healthcare sector.

AI has already begun to transform healthcare systems in many developed nations by automating tasks, improving diagnostic accuracy, and optimizing resource allocation. However, in Moldova, the integration of AI technologies is still in its infancy. Despite global advancements, Moldova's healthcare system has yet to adopt AI solutions on a significant scale, largely due to infrastructural, financial, and expertise-related barriers. The potential for AI to revolutionize Moldova's healthcare system, therefore, remains untapped but highly promising.

This thesis investigates how AI can be effectively integrated into Moldova's healthcare sector to address its most pressing challenges. Specifically, it will focus on several key areas where AI can make the most substantial impact, including improving diagnostic accuracy, automating routine administrative tasks, enhancing telemedicine, and applying predictive analytics for better healthcare planning. By leveraging AI, Moldova's healthcare system can evolve into a more resilient, efficient, and patient-centered model of care.

Healthcare Challenges in Moldova

Moldova's healthcare system is under significant strain. With limited financial resources, aging medical infrastructure, and a shortage of healthcare professionals, the system struggles to meet the needs of its population. Rural areas, in particular, face acute difficulties in accessing healthcare services, with long distances to medical facilities and a lack of specialists. Patients in these regions often experience delays in diagnosis and treatment, which can lead to poor health outcomes. The administrative side of the healthcare system is also burdened with inefficiencies, such as outdated patient record systems and resource allocation issues.

In this context, AI can offer solutions that are not just innovative but also urgently needed. By integrating AI-driven technologies, Moldova's healthcare system could alleviate some of these pressures, offering faster, more accurate diagnostics and improving access to care through telemedicine. AI's potential to automate administrative tasks and optimize resource allocation can also reduce operational inefficiencies, allowing healthcare professionals to focus more on patient care.

Global AI Trends and Moldova's Opportunity

Globally, the use of AI in healthcare has seen rapid adoption, particularly in areas such as diagnostic imaging, predictive analytics, and personalized medicine. AI algorithms are now capable of detecting diseases like cancer at earlier stages, predicting patient outcomes with high accuracy, and personalizing treatments based on a patient's unique genetic makeup. Countries with advanced healthcare systems, such as the United States, the United Kingdom, and Estonia, have already

implemented AI-driven solutions that have led to tangible improvements in healthcare delivery and outcomes.

Moldova, although facing resource limitations, stands at a crucial juncture where the adoption of AI can serve as a catalyst for transforming its healthcare sector. By learning from the successes of other countries and tailoring AI solutions to its specific needs, Moldova has the opportunity to leapfrog traditional healthcare development hurdles. AI can enable the country to modernize its healthcare system more rapidly than through conventional means, addressing critical gaps in service delivery, diagnostic accuracy, and resource management.

Why AI is the Future for Moldova's Healthcare

AI offers several advantages that are particularly well-suited to Moldova's healthcare challenges. First, it allows for scalable solutions. Once AI algorithms are developed and deployed, they can continuously learn and improve, providing high-quality care to large populations without the need for proportionate increases in healthcare staff. This scalability is crucial for a country like Moldova, where there is a shortage of trained healthcare professionals, especially in specialized fields such as radiology and oncology.

Secondly, AI can provide rural areas with better access to healthcare through telemedicine. With AI-powered tools, patients in remote areas can receive consultations and diagnoses without traveling long distances to see specialists. AI can assist doctors by interpreting medical images or analyzing patient data, making it easier for general practitioners to provide expert-level care in underserved regions.

Finally, the use of predictive analytics can help Moldova's healthcare system better anticipate and respond to public health challenges. By analyzing data on patient admissions, disease outbreaks, and resource usage, AI can forecast healthcare trends, allowing hospitals and clinics to prepare more effectively. This capability is especially valuable in Moldova, where limited resources make it imperative to manage them as efficiently as possible.

Research Focus and Objectives:

This research aims to identify the most effective ways to integrate AI into Moldova's healthcare system, focusing on key areas where the technology can have the greatest impact. The objectives of this study include:

- improving diagnostic accuracy: investigating how AI algorithms can be used to enhance the precision of medical diagnoses, particularly in fields like radiology and pathology, where diagnostic errors can have serious consequences;
- automating routine administrative tasks: exploring how AI can be deployed to streamline administrative processes such as patient scheduling, billing, and record-keeping, thus freeing healthcare workers to focus on clinical care;
- enhancing telemedicine and remote monitoring: assessing how AI can enable telemedicine services, allowing for remote consultations and patient monitoring, particularly in Moldova's

rural and underserved areas;

– applying predictive analytics: evaluating how AI-driven predictive models can be used to forecast disease outbreaks, manage hospital resources, and anticipate patient needs more effectively.

By addressing these objectives, the thesis aims to provide a comprehensive analysis of how AI can be integrated into Moldova's healthcare system, offering practical recommendations for its implementation. In doing so, this study seeks to demonstrate that AI is not just a tool for wealthy, technologically advanced countries, but a necessary innovation for improving healthcare in developing nations like Moldova.

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