OPTIMIZING DATA PROCESSING IN MEDICAL INSTITUTIONS: AI-BASED OCR AND AUTOMATED VISUALIZATION TECHNOLOGIES

Turdimuratov Baxtiyor Kurbonovich
Teacher of the Department of Social and Humanitarian Sciences,
Termez Branch of Tashkent State Medical University
baxtiyor.turimuratov6691@gmail.com
Imomov Elmurod Xolboyevich
2nd-year student of the 2nd Faculty of Medicine,
Termez Branch of Tashkent State Medical University
elmurodimomov@gmail.com

Abstract: This thesis investigates the implementation of artificial intelligence (AI)-based optical character recognition (OCR) and automated data visualization technologies to optimize manual data entry processes in healthcare institutions. The study aims to develop models that save medical staff time, minimize mechanical errors caused by human factors, and accelerate the analysis of medical histories. Within the methodology, the operational principles of OCR systems based on Deep Learning and Natural Language Processing (NLP) algorithms were analyzed. The results indicate that integrating these technologies reduces manual data entry time by 70-80% and enables rapid monitoring of disease dynamics using automated dashboards. In conclusion, it is substantiated that training future medical professionals in digital technologies and AI tools is a crucial foundation for improving the quality of healthcare services.

Keywords: Artificial Intelligence (AI), OCR (Optical Character Recognition), medical information systems, digitalization, automated visualization, electronic polyclinic, Big Data.

Introduction (Relevance). In the process of digitalizing the modern healthcare

system, one of the most time-consuming tasks for doctors and medical staff is the manual entry of paper-based information into electronic databases. Converting various test results, old outpatient cards, and referrals into an electronic format not only requires significant time but also leads to mechanical errors due to the human factor. From this perspective, implementing AI-based OCR (Optical Character Recognition) technologies and automated data visualization tools into practice is considered an important factor in improving the quality of medical services.

Research Objective: To analyze models for enhancing the work efficiency of medical staff by automating document circulation in medical institutions using AI-based OCR technologies and automatically visualizing the generated databases.

Main Part and Methodology. Unlike traditional scanning, OCR technology converts text images (e.g., handwritten prescriptions, printed test sheets) into editable and searchable digital data. Modern OCR systems used in medicine are based on Deep Learning algorithms and are capable of recognizing doctors' complex handwriting and specific medical terminology with high accuracy.

The process is carried out in the following steps:

1. **Data entry and recognition:** Paper-based test results (e.g., a blood test sheet) are uploaded to the system. The OCR system clears lighting, contrast, and noise using neural networks and extracts the text into digital lines.

2. **Semantic analysis (NLP):** The system does not merely recognize letters; through Natural Language Processing (NLP), it identifies the data type (patient's full name, diagnosis, indicator values) and places them into appropriate cells.

3. **Automated visualization:** The digital indicators entered into the system are automatically converted into graphs, charts, and dashboards using BI (Business Intelligence) tools. For example, the dynamics of a patient's blood sugar level over the last 6 months are displayed as a graph on the screen in a second.

Results. The application of AI-based OCR and visualization technologies in medical practice yields the following results:

- **Time efficiency:** The time spent on manual data entry is reduced by 70-80%, leaving the doctor more time to interact directly with the patient.
- **Data accuracy:** Errors resulting from human fatigue or inattention (e.g., misplacing a comma) are minimized.
- **Decision-making speed:** Automated visualization allows the doctor to visually assess disease dynamics and make correct clinical decisions rapidly. Additionally, it creates an opportunity for polyclinic managers to monitor disease statistics and staff workload in real-time.

Conclusion. AI-based optical character recognition (OCR) and automated visualization technologies are not merely auxiliary tools but serve as the fundamental basis of the "E-Health" system. When teaching the subject "Information Technologies in Medicine" in higher medical education institutions, training future specialists to work with these AI systems and developing their digital literacy and creative thinking is a demand of the times. The widespread introduction of these technologies will elevate the speed and quality of medical care in our republic to a new level.

References:

1. Topol, E. J. (2019). High-performance medicine: the convergence of human and artificial intelligence. *Nature Medicine*, 25(1), 44-56. (A fundamental international article on the convergence of human and artificial intelligence in medicine).
2. Rajkomar, A., Dean, J., & Kohane, I. (2019). Machine learning in medicine. *The New England Journal of Medicine*, 380(14), 1347-1358. (On the role of machine learning algorithms in processing medical data).
3. World Health Organization. (2021). Ethics and governance of artificial

intelligence for health: WHO guidance. Geneva: WHO. (The official WHO manual on the use of AI in medicine).

4. Decrees of the President of the Republic of Uzbekistan. Regulatory and legal documents on the introduction of the new model of organizing the healthcare system and mechanisms for digitalizing the sector ("E-Health", "Electronic polyclinic").
5. Ghassemi, M., et al. (2020). A review of challenges and opportunities in machine learning for health. *BMJ Health & Care Informatics*, 27(1). (Analysis of opportunities in visualizing and analyzing clinical data).
6. Turdimuratov, B. K. (2026). Development of creative thinking of future specialists in higher education using digital technologies (on the example of TRIZ and SCAMPER algorithms). *[Name of Scopus-indexed journal, in press]*. (Pedagogical foundations of introducing innovative and creative approaches in medical education through digital technologies).
7. Kurbanovich T. B., Ulaboyevich K. S. (2022). Effective use of digital technologies in the medical education system.
8. Kurbonovich T. B. et al. (2025). Digital Technologies in Medicine. Telemedicine. *IMRAS*, Vol. 8, No. 12, pp. 39-41.
9. Kurbanovich T. B. et al. Development OF Creativity in Learning Laboratory Activities in Information TECHNOLOGY. *Repository Antis Publisher*, p. 714991.
10. Kurbonovich T. B., Uralovich S. F. OPPORTUNITIES OF MICROSOFT EXCEL IN VISUALIZING ELECTRONIC HEALTH RECORDS AND CALCULATING MEDICAL DATA CORRELATION IN CLINICAL PRACTICE.
11. Quvvatovich Q. N. (2026). THE LEGAL SIGNIFICANCE OF TEACHING THE NEW CONSTITUTION OF UZBEKISTAN. *Arabian journal of science*, Vol. 3, No. 6, pp. 2573-2576.