GJR Publication
OPEN ACCESS

Global Journal of Research in Engineering & Computer Sciences
ISSN: 2583-2727 (Online)
Volume 05| Issue 03 | May-June | 2025
Journal homepage: https://gjrpublication.com/gjrecs/

Research Article

Navigating the Challenges of Artificial Intelligence in Healthcare: Overcoming Barriers in the 4th Industrial Revolution and Beyond

*Isa Ali Ibrahim[1], Abdurrahman Isa Ali[2], Muhammad Ahmad Baballe[3]

[1]School of Information and Communications Technology, Federal University of Technology Owerri, Imo State, Nigeria.
[2]Nigerian Communnications Commission (NCC), Maitama Abuja, Nigeria.
[3]Department of Mechatronics Engineering, Nigerian Defence Academy (NDA), Kaduna, Nigeria.
https://orcid.org/0000-0001-9441-7023

DOI: 10.5281/zenodo.15538505 **Submission Date: 23 April 2025 | Published Date: 28 April 2025**

Corresponding author:** ***Isa Ali Ibrahim
School of Information and Communications Technology, Federal University of Technology Owerri, Imo State, Nigeria.
https://orcid.org/0000-0002-1418-9911

Abstract
Any behavior exhibited by a machine or system that mimics human behavior is generally referred to as artificial intelligence (AI). A form of artificial intelligence known as "machine learning" enables computers to learn from data without the need for explicit human programming. The application of artificial intelligence (AI) technologies in medicine is one of the most important recent advancements in global healthcare. Artificial intelligence-based technologies are transforming the global healthcare system because they allow for a major revamp of the medical diagnostics system and a corresponding decrease in healthcare expenditures. Before therapy can begin, a disease must be classified into the proper class of disorders. The feature space of the disease can be used to classify the disease sort. Machine learning algorithms can help with this problem. The Fourth Industrial Revolution (4IR), which is defined by developments in automation, digital technology, and interconnection, is mostly driven by artificial intelligence. AI is helping the 4IR by improving operations, spurring innovation, and changing a number of industries. This paper examines the impacts, drawbacks, and challenges of implementing artificial intelligence (AI) in the healthcare sector.

Keywords: *4th Industrial Revolution, Challenges, Goals, Machine Learning, Healthcare, Artificial Intelligence (AI).*

I. INTRODUCTION
Because traditional programming techniques offer less flexibility, it is becoming more difficult to arrange, analyze, and respond to the daily increase in data production. Systems that can learn from data by identifying patterns and connections across data sets to improve predictions are becoming more and more in demand today. Artificial intelligence's machine learning subfield enables computers to learn from data without explicit human programming (S. Brown, 2021). In a broad sense, artificial intelligence (AI) refers to any computer or system behavior that resembles human behavior. The most basic kind of artificial intelligence is the "imitation" of human behavior by computers, which is based on considerable data on previous instances of the same behavior. The same task of utilizing computers to understand human intelligence is connected to artificial intelligence (AI), which is not always restricted to biologically logical approaches. In the twenty-first century, the field of AI has grown steadily. With dramatic revolutions influenced by both ideas and tactics, the evolution of AI has improved the development of human society in our own time (Liu et al., 2018). Deep learning, machine learning, and artificial intelligence are all areas of active research. And it appears that it may soon be able to fully replace human intelligence. The study of artificial intelligence, or AI, is a branch of computer science that focuses on creating intelligent computer systems, or systems that possess the skills that are typically associated with the human mind, such as language comprehension, learning, the capacity for reasoning, problem-solving, etc. Later, a variety of software programs and algorithms started to be referred to as AI; its defining characteristic is that they have the ability to answer some issues in the same way that a human would. For instance, AI is just starting to permeate medicine

@ 2025 | PUBLISHED BY GJR PUBLICATION, INDIA

through speech processing (R. M. Fazliddinovich & B. U. Abdumurodovich, 2017), natural language text processing [M. Musaev, I. Khujayorov & M. Ochilov, 2020], object identification (M. Rakhimov, J. Elov, U. Khamdamov, S. Aminov & S. Javliev, 2021). voiceprint recognition (Khdier, Hajer & Jasim, Wesam & Aliesawi, Salah, 2021), robotics (Mihret, Estifanos., 2020), handwritten character recognition (M. Musaev & M. Rakhimov, 2020), expert systems (Brown, Carol & O'Leary, Daniel., 1995), and medical diagnostics (Kashyap, Abhishek., 2018). There have already been a lot of intriguing computer algorithms and inventions in this field, but they are still a long way from being widely used because they lack clinical evidence of their efficacy. However, it should be acknowledged that narrowly focused artificial intelligence will firmly take its position given how swiftly this subject has progressed over the past few years and the fact that computers are now outperforming people in solving specific medical problems, which will rise significantly. All areas of human activity—including medicine and healthcare—have been affected by AI technologies. The medical professional must stay current with the most recent developments in medical science. A doctor cannot treat patients, rest, update knowledge, and maintain it in his thoughts at the same time, hence they cannot perform this task as quickly as AI (M. A. Baballe, A. M. Gambale, A. S. Bari, A. S. Lawan, & R. J. Suleiman., 2022); (A. H. Muhammad, A. Y. Abdullahi, A. Abba, A. Isah, A. A Yako, M. A. Baballe, 2022); (M. A. Baballe, et al., 2022). AI can keep all the information gathered and regularly update research data. The adoption of such technology will simplify life for medical professionals. In fact, one of the most significant aspects of healthcare that AI technologies may aid with is the treatment of chronic diseases. Broadly speaking, chronic diseases are problems that last for a year or longer and necessitate continuing medical care, restrict daily activities, or both. The main causes of death and disability worldwide are chronic illnesses such renal disease, heart disease, cancer, and diabetes. The annual investment in AI had a modest decline in 2018, however it was only momentary. The majority of total corporate investments in AI are private. The amount invested in artificial intelligence initiatives for the healthcare industry worldwide in 2021 increased to $11.2 billion from $8 billion in 2020. The Stanford Institute for Human-Centered Artificial Intelligence released such statistics in March 2022. The study found that from 2017 to 2021, the "attractive" businesses for private investment in the artificial intelligence market were those related to medicine and healthcare. During this time, core projects received a total investment of more than $28.9 billion (Artificial Intelligence Index Report, 2022). Automation and increasing the precision of diagnostics are two crucial topics. The classification of diseases is one method for increasing the precision of diagnosis. AI in the form of machine learning (ML) (Ławrynowicz, Agnieszka & Tresp, Volker., 2014). enables the classification of illness kinds that are similar to one another in terms of a parametric factor. And one of the fundamental machine learning algorithms used for classification is K-Nearest Neighbor (KNN) (Cunningham, Padraig & Delany, Sarah., 2007). A neural network can also be used to tackle the categorization problem (M. Rakhimov, T. Boburkhon & T. Khurshid, 2021). High-performance hardware is needed for deep learning algorithms that use huge datasets, such as heterogeneous computing systems (M. Rakhimov & M. Ochilov, 2021) or parallel computing techniques. At the moment, parallel and distributed computing technologies (M. Musaev & M. Rakhimov, 2019); (M. Rakhimov, D. Mamadjanov and A. Mukhiddinov, 2020) can also be used to overcome this issue. The major goal of this study is to choose significant parametric variables from the gathered disease data that produce more F1-score outcomes. For classification, two forms of coronary heart disease were chosen. It is suggested to use the KNN algorithm for categorizing coronary heart disease. It can be viewed as an algorithm that, when used with the training dataset, generates predictions based on the characteristics of other data points that are present adjacent to it (M. Rakhimov, R. Akhmadjonov, S. Javliev, 2022). In medical data mining, hidden patterns in datasets are discovered. For the early diagnosis of cardiac disease, a supervised algorithm like KNN is employed. The most well-known, successful, and efficient algorithm for pattern recognition is KNN, a frequently used lazy classification algorithm. The distance measure and K value both affect how accurate KNN is. Cosine and Euclidean distance are two other methods for calculating the separation between two instances. KNN determines its closest neighbors and determines a class by majority vote in order to evaluate a fresh unknown sample (Ma, Jabbar., 2017). When the training sample is large, lazy learning techniques like the KNN classifier can be expensive to use because they need to store the whole training sample. In order to reduce storage and processing needs, the compressed closest neighbor classifier incrementally caches a portion of the sample (Alpaydin, E., 1997). Due to its ease of use and relatively quick convergence speed, KNN is growing in popularity (Jabbar MA, Deekshatulu BL, & Priti C., 2013). Medical information technology has advanced toward intelligence as a result of the quick growth of information technology. For the intellectualization of medical information, the classification of large data in health care is extremely important. The KNN classification technique is straightforward, which has led to its widespread application in numerous disciplines (W. Xing & Y. Bei, 2020). One area of healthcare that might be categorized is coronary heart disease (CHD). The Center for Specialized Cardiology's medical personnel and the CHD statistics were both discussed. The CHD dataset was collected from the National Center for Health Statistics (NCHS) (Huang, Nur & Ibrahim, Zaidah & Diah, Norizan., 2021). The main developments in machine learning will be discussed in this paper, including automated data analysis for patient health records and data-driven prediction. The advancements in computer-aided diagnosis, medication discovery, and personalized medicine will also be contrasted (T. M. Tassew, X. Nie, 2022). It is impossible to stress the importance of using big data analytics and machine learning to improve patient outcomes and healthcare performance. With the use of these technologies, healthcare professionals are now able to gain useful insights from big datasets that were previously unexplored, opening up a whole new world of opportunities. By utilizing these information, medical professionals can decide more intelligently about tailored medicine, treatment plans, and resource allocation, ultimately improving patient

@ 2025 | PUBLISHED BY GJR PUBLICATION, INDIA

outcomes and making the healthcare system more effective. Healthcare professionals may now more easily spot trends, correlations, and risk factors thanks to the ability to analyze enormous amounts of healthcare data. This information enables early disease detection, disease prevention, and patient-specific treatment approaches (F. DelGiorgio Solfa, & F. R. Simonato, 2023). In this opinion piece, we will examine AI's enormous influence on medicine while noting both its possible advantages and impending difficulties (Mehta V., 2023). The application of AI and ML in healthcare has grown in importance, creating new opportunities for innovation, precision medicine, and better decision-making. It is essential to investigate the potential, difficulties, and ethical ramifications of integrating AI and ML into healthcare as we set out on this transformative journey. The field of diagnostics is one of the primary areas where AI and ML have demonstrated tremendous promise. These technologies can swiftly and precisely find trends, spot anomalies, and help with disease diagnosis by analyzing enormous amounts of medical data. The early diagnosis of diseases like cancer and better patient outcomes are made possible by AI-powered algorithms' outstanding accuracy in analyzing medical images like X-rays and MRIs (A. Naveed, 2023). A general taxonomy of machine learning algorithms is presented in this overview, which is followed by a more in-depth explanation of each algorithm class, its function and capabilities, and examples of applications, particularly in geriatric medicine. Additional emphasis is placed on the implications for clinical practice, the difficulties associated with depending on devices with limited interpretability, and the advancements made in overcoming the latter through the creation of explainable machine learning (R. J. Woodman, A. A. Mangoni, 2023). Examining how machine learning technologies might enhance healthcare operations management is the goal of this study. To accomplish this research goal, a machine-learning-based model to address a specific medical issue is created. This study specifically uses the CNN (convolutional neural network) technique to propose an AI solution for diagnosing malaria infection. A total of 24,958 photos were used for deep learning training using malaria microscopy image data from the NIH National Library of Medicine, and 2600 images were chosen for final testing of the suggested diagnostic architecture. The empirical findings show that, with minimal misclassification and performance metrics of precision (0.97), recall (0.99), and f1-score (0.98) for parasite cells and precision (0.99), recall (0.97), and f1-score (0.98) for uninfected cells, the CNN diagnostic model correctly identified the majority of malaria-infected and non-infected cases. The CNN diagnostic solution processed a large number of cases quickly and with a 97.81% accuracy that could be relied upon. The k-fold cross-validation test was used to further validate the performance of this CNN model. These findings imply that machine learning-based diagnostic techniques have an edge over traditional manual diagnostic techniques when it comes to enhancing operational capacities in the healthcare sector in terms of diagnostic quality, processing expenses, lead times, and productivity. In addition, by lowering the probability of unneeded medical disputes connected to diagnostic errors, a machine-learning diagnosis system is more likely to improve the financial viability of healthcare operations. Propositions with a research framework are offered to examine the effects of machine learning on healthcare operations management for safety and quality of life in international communities as an extension for future research (Y.S Cho, P. C, Hong, 2023); (Muhammad A. B., & Mukhtar I. B., 2023).

II. BENEFITS OF ARTIFICIAL INTELLIGENCE (AI) IN THE HEALTH SECTOR

AI is currently being extensively tested in hospitals for drug discovery as well as diagnosis and symptom prediction. Here are some of its most promising prospects:

1. Diagnostic Assessment
   Electronic health records (EHRs), radiography, CT scans, and magnetic resonance images all produce large volumes of data that AI can analyze. AI systems can assist with early symptom forecasts by analyzing data from patients, identifying trends, and identifying relationships.
2. Virtual Health Assistants
   Virtual health assistants are in charge of carrying out a range of duties, including returning normal patient calls and emails, monitoring medical records, safeguarding private patient information, setting up doctor appointments, and reminding patients to schedule follow-up appointments. Because it offers patients a personalized experience in managing their health and responding to their questions, it is one of the most beneficial AI applications in healthcare.
3. Treatment of Rare Diseases
   In order to speed up the discovery and development of cutting-edge breakthrough medications and vaccines and revolutionize the delivery of healthcare, BERG, an AI-based clinical-stage biotech platform, aims to map diseases. It combines interrogative biology with research and development (R&D) to enable medical professionals to create durable products for people battling rare diseases.
4. Targeted Treatment
   Benevolent AI, a prominent clinical-stage AI-enabled drug development business, was able to offer the proper treatment to the required patients at the correct time with the use of technologies like deep learning and AI, leading to tailored treatment of patients with helpful insights. The company is currently focused on developing portable remedies for uncommon diseases and securing licensing for its medications.
5. Drug Discovery
   Artificial intelligence uses neural networks to evaluate drug candidates' characteristics and bioactivity. With the aid of AI systems, researchers can determine the optimal therapeutic targets to investigate for specific diseases.

@ 2025 | PUBLISHED BY GJR PUBLICATION, INDIA

The healthcare sector has seen an increase in speed and a decrease in investment in drug discovery as a result. It has proven important in clinical trials in the selection of the correct candidates (https://emeritus.org/blog/healthcare-challenges-of-ai-in-healthcare/).

III. CHALLENGES OF USING ARTIFICIAL INTELLIGENCE (AI) IN THE HEALTHCARE SECTORS

Implementing AI in healthcare faces numerous challenges, including data quality and security, bias in algorithms, regulatory compliance, and integration with existing systems. Overcoming these hurdles requires a multidisciplinary approach, addressing technical, ethical, and practical considerations.

Here's a more detailed look at the challenges:

1. Data Quality and Security:

i. Data availability and quality:

Healthcare data can be incomplete, inconsistent, or fragmented across different systems, making it difficult to train AI models effectively.

ii. Data privacy and security:

Protecting sensitive patient information while enabling AI model development is crucial, requiring strong security measures and adherence to regulations like HIPAA.

iii. Data interoperability:

Different healthcare systems and devices may not easily communicate, hindering the flow of data needed for AI applications.

2. Algorithmic Bias and Fairness:

i. Bias in training data:

If AI models are trained on biased data, they may perpetuate existing inequalities in healthcare access and outcomes.

ii. Mitigating bias:

Developing fair and equitable AI systems requires careful consideration of potential biases and implementing strategies to mitigate them.

3. Regulatory and Ethical Considerations:

i. Compliance with regulations:

Adhering to healthcare-specific regulations like HIPAA and other data protection laws is essential for AI implementation.

ii. Ethical concerns:

Addressing ethical issues like transparency, accountability, and patient autonomy is crucial for building trust and ensuring responsible use of AI in healthcare.

4. Integration with Existing Systems and Workflows:

i. Implementation challenges:

Integrating AI tools into existing healthcare systems and workflows can be complex and disruptive.

ii. Physician acceptance:

Healthcare providers may be hesitant to adopt AI tools, requiring training and education to build confidence and trust.

iii. Capacity for change management:

Successfully implementing AI requires a strategic approach to managing organizational change, including training and education for healthcare professionals.

5. Other Challenges:

i. Lack of AI expertise:

A shortage of skilled professionals with expertise in AI and healthcare can hinder the development and implementation of AI solutions.

ii. Cost and investment:

The high cost of AI development and implementation can be a barrier, particularly for smaller healthcare facilities.

iii. Scalability and upgrades:

Ensuring that AI systems can scale to meet the needs of a growing population and adapt to new technologies is crucial for long-term success.

Addressing these challenges requires a multifaceted approach, including investing in data infrastructure, developing robust ethical guidelines, and fostering collaboration between healthcare professionals, AI researchers, and policymakers (https://www.google.com/search?q=challenges+of+using+AI+IN+HEALTHCARE+SECTORS).

@ 2025 | PUBLISHED BY GJR PUBLICATION, INDIA

IV. Applying AI in the Healthcare Sector: Difficulties

1. Data Privacy and Security: Large volumes of patient data are needed for the application of AI in healthcare, which presents issues with data security and privacy. Ensuring that patient data is safeguarded against unauthorized access and that patients have authority over its usage is crucial.
2. Bias in the Data: If the training data for AI systems is not representative of the people they will be used to assist, then the systems may become prejudiced. This could provide unfair or erroneous results, especially for underrepresented communities.
3. Lack of Transparency: Because it might be challenging to decipher how an AI system arrived at a given choice, many of them are referred to as "black boxes". Physicians and other medical experts may find it challenging to trust the outcomes of an AI system due to this lack of transparency.
4. Regulation and Governance: At the moment, there aren't many precise laws and policies governing the application of AI in healthcare. Patients may find it challenging to know what to anticipate when interacting with an AI system, and healthcare institutions may find it challenging to employ the technology appropriately.
5. Lack of Understanding: It's possible that many patients and healthcare professionals are unaware of AI's limitations and how it functions. This may result in irrational expectations and misplaced faith in technology (https://www.forbes.com/sites/forbesbusinesscouncil/2023/02/07/top-five-opportunities-and-challenges-of-ai-inhealthcare/?sh=e1fb69d28056).

V. CONCLUSION/RECOMMENDATIONS

This article discusses the application of machine learning techniques in the healthcare industry to manage enormous volumes of patient data and lower the time, expense, and resources needed for its analysis. These technologies are currently in high demand since they have been demonstrated to be more accurate than licensed doctors' diagnosis and to enhance patients' hospital experiences. It was also emphasized that as these tools are designed to work in conjunction with doctors, training is required before they can be used for their primary purpose. The benefits of AI in the realm of medicine are emphasized (M.A. Baballe, S. H. Ayagi, & U. F. Musa., 2023). The difficulties of applying AI are also well covered (A. Garba, M. B. Ahmad, M. I. Bello, 2023).

AI offers significant potential to revolutionize healthcare, from improving diagnostics and treatment to streamlining administrative tasks and personalizing care. Here's a breakdown of AI's potential and recommendations for its implementation.

AI's Potential in Healthcare:

i. **Improved Diagnosis:**
   AI can analyze medical images (X-rays, MRIs) with high accuracy, assisting in early disease detection and potentially reducing the need for more invasive procedures, says BMC Medical Education.
ii. **Personalized Treatment:**
   AI can analyze patient data to develop tailored treatment plans, optimizing effectiveness and reducing risks, says the European Commission.
iii. **Drug Discovery and Development:**
   AI can accelerate the drug discovery process by analyzing large datasets of molecules and identifying potential drug targets.
iv. **Predictive Analytics:**
   AI can analyze patient data to predict potential health risks and identify patients who may benefit from proactive interventions, reports Consensus.
v. **Administrative Task Automation:**
   AI can automate tasks like patient scheduling, billing, and electronic health record management, freeing up healthcare professionals to focus on patient care, says the European Commission.
vi. **Robotics in Surgery and Rehabilitation:**
   AI-powered robots can assist surgeons with complex procedures and support patients during rehabilitation, improving accuracy and efficiency.
   Recommendations for Implementing AI in Healthcare:
vii. **Focus on Explain ability and Transparency:**
   Ensure that AI algorithms are understandable and verifiable, building trust and confidence in their use.
viii. **Prioritize Data Quality and Integrity:**
   High-quality data is essential for accurate AI predictions and diagnoses, emphasizing the importance of data collection and storage.
ix. **Develop Robust Ethical and Legal Frameworks:**
   Establish clear guidelines for AI use in healthcare, addressing issues like bias, privacy, and accountability.
x. **Promote Human-AI Collaboration:**
   Integrate AI tools into existing healthcare workflows, allowing clinicians to leverage AI's capabilities while maintaining control and oversight.
xi. **Invest in Training and Education:**

@ 2025 | PUBLISHED BY GJR PUBLICATION, INDIA

Equip healthcare professionals with the knowledge and skills to effectively use and interpret AI-driven insights.

xii. **Ensure Safety and Validation:**
Rigorously test and validate AI algorithms before deployment, ensuring they meet safety standards and regulatory requirements.

xiii. **Consider the Patient Experience:**
Design AI tools that are user-friendly and accessible to patients, improving their overall experience with healthcare.

REFERENCES

1. Garba, M. B. Ahmad, & M. I. Bello, (2023). Applying AI in the Healthcare Sector: Difficulties. Computer and Information Science, 16(4).
2. H. Muhammad, A. Y. Abdullahi, A. Abba, A. Isah, A. A Yako, & M. A. Baballe, (2022). The Benefits of Adopting a Wireless Nurse Call System. Global Journal of Research in Medical Sciences, 2(3). Retrieved from https://gjrpublication.com/gjrms/
3. Namoun, I. A. Ibrahim, E. Mustafa et al. "Generative artificial intelligence in education: an umbrella review of applications and challenges", available at Research Square https://doi.org/10.21203/rs.3.rs-4892155/v2
4. Naveed (2023). Transforming Healthcare through Arti cial Intelligence and Machine Learning. Pakistan Journal of Health Sciences, 4(5). https://doi.org/10.54393/pjhs.v4i05.844.
5. Alpaydin, E. (1997). Voting over Multiple Condensed Nearest Neighbors. Artificial Intelligence Review, 11, 115-132. https://doi.org/10.1023/A:1006563312922
6. Artificial Intelligence Index Report 2022. Chapter 4: The Economy and Education. 4.2 Investment. Retrieved from https://aiindex.stanford.edu/wpcontent/uploads/2022/03/2022-AI-Index-Report_Master.pdf
7. Brown, C., & O'Leary, D. (1995). Introduction to artificial intelligence and expert systems. Artificial Intelligence/Expert Systems Section of the American Accounting Association.
8. Cunningham, P., & Delany, S. (2007). k-Nearest neighbour classifiers. Mult Classif Syst, 54. https://doi.org/10.1145/3459665
9. F. Del Giorgio Solfa, & F. R. Simonato (2023). Big Data Analytics in Healthcare: Exploring the Role of Machine Learning in Predicting Patient Outcomes and Improving Healthcare Delivery. International Journal of Computations Information and Manufacturing (IJCIM). https://doi.org/10.54489/ijcim.v3i1.235
10. Fazliddinovich, R. M., & Abdumurodovich, B. U. (2017). Parallel processing capabilities in the process of speech recognition. 2017 International Conference on Information Science and Communications Technologies (ICISCT), pp. 1-3. https://doi.org/10.1109/ICISCT.2017.8188585.
11. https://emeritus.org/blog/healthcare-challenges-of-ai-in-healthcare/.
12. https://www.cdc.gov/nchs/fastats/heart-disease.htm
13. https://www.google.com/search?q=challenges+of+using+AI+IN+HEALTHCARE+SECTORS&rlz=1C1GCEU_enNG1161&oq=challenges+of+using+AI+IN+HEALTHCARE+SECTORS&gs_lcrp=EgZjaHJvbWUyBggAEEUYOTIICAEQABgWGB4yDQgCEAAYhgMYgAQYigUyDQgDEAAYhgMYgAQYigUyDQgEEAAYhgMYgAQYigUyDQgFEAAYhgMYgAQYigUyDQgGEAAYhgMYgAQYigUyBwgHEAAY7wUyCggIEAAYgAQYogQyCggJEAAYgAQYogTSAQozNjEyMmowajE1qAIMsAIB8QWtM5135F81EQ&sourceid=chrome&ie=UTF-8.
14. Huang, N., Ibrahim, Z., & Diah, N. (2021). Machine Learning Techniques for Heart Failure Prediction. Malaysian Journal of Computing, 6, 872. https://doi.org/10.24191/mjoc.v6i2.13708
15. I. A. Ibrahim, M. A. Baballe, (2024). Essential Elements Required for a Successful AI Application in the Healthcare Industry, In Global Journal of Research in Engineering & Computer Sciences, Vol. 4, Number 5, pp. 46–51, https://doi.org/10.5281/zenodo.13755067
16. A. Ibrahim, Abdurrahman I. A., & Muhammad A. B. (2025). Artificial intelligence-Enhanced Wireless Medical Alert Systems: Overcoming Challenges, Mitigating Effects, and Addressing Limitations, In Global Journal of Research in Engineering & Computer Sciences, Vol. 5, Number 3, pp. 53–58), https://doi.org/10.5281/zenodo.15521486
17. A. Ibrahim, M. A. Baballe, (2024). Developing a User-Friendly Smart Blind Stick for Visually Impaired Individuals in the Digital Era, JETIR, Volume 11, Issue 9.
18. A. Ibrahim, Abdurrahman I. A., & Muhammad A. B. (2025). Artificial intelligence-Enhanced Wireless Medical Alert Systems: Overcoming Challenges, Mitigating Effects, and Addressing Limitations. In Global Journal of Research in Engineering & Computer Sciences (Vol. 5, Number 3, pp. 53–58). https://doi.org/10.5281/zenodo.15521486
19. A. Ibrahim, M. A. Baballe, (2024). Heartbeat Sensors: Revolutionizing Cardiovascular Monitoring in the 4IR Era, JETIR, Volume 11, Issue 10, 37. I. A. Ibrahim, M. A. Baballe, (2024). Step-by-Step Guide to Building Wearable Health Devices, In Global Journal of Research in Engineering & Computer Sciences, Vol. 4, Number 5, pp. 52–59, 2024, https://doi.org/10.5281/zenodo.13759291.
20. Jabbar, M. A., Deekshatulu, B. L., & Priti, C. (2013). Heart disease classification using nearest neighbor classifier with feature subset selection. Annals Computer Science 2013.

@ 2025 | PUBLISHED BY GJR PUBLICATION, INDIA

21. Kashyap, A. (2018). Artificial Intelligence & Medical Diagnosis, 6, 4982-4985.
22. Khdier, H., Jasim, W., & Aliesawi, S. (2021). Deep Learning Algorithms based Voiceprint Recognition System in Noisy Environment. Journal of Physics: Conference Series, 1804, 012042. https://doi.org/10.1088/1742-6596/1804/1/012042
23. Ławrynowicz, A., & Tresp, V. (2014). Introducing Machine Learning.
24. Liu, J. Y., Kong, X. J., Xia, F., Bai, X. M., Wang, L. Qing, Q., & Lee, I. (2018). Artificial Intelligence in the 21st Century. IEEE Access. PP. 1-1. https://doi.org/10.1109/ACCESS.2018.2819688
25. M. A. Baballe, A. M. Gambale, A. S. Bari, A. S. Lawan, & R. J. Suleiman. (2022). Issues with our hospitals queue management information systems. Global Journal of Research in Medical Sciences, 2(6), 102-106. https://doi.org/10.5281/zenodo.7330904
26. M. A. Baballe, A. S. Muhammad, J. Y. Abdullahi, Aminu Ya'u,, Ibrahim Idris Giwa, M. Habib Abubakar, & Z. Abdulkadir. (2022). The Impact of Hospital Queue Management Systems. Global Journal of Research in Medical Sciences, 2(5), 88-91. https://doi.org/10.5281/zenodo.7117651
27. M. Musaev & M. Rakhimov, (2019). "A Method of Mapping a Block of Main Memory to Cache in Parallel Processing of the Speech Signal" 2019 International Conference on Information Science and Communications Technologies (ICISCT), pp. 1-4. https://doi.org/10.1109/ICISCT47635.2019.9011946
28. M. Musaev & M. Rakhimov, (2020). Accelerated Training for Convolutional Neural Networks. 2020 International Conference on Information Science and Communications Technologies (ICISCT), pp. 1-5. https://doi.org/10.1109/ICISCT50599.2020.9351371
29. M. Musaev, I. Khujayorov & M. Ochilov (2020). "Development of integral model of speech recognition system for Uzbek language," 2020 IEEE 14th International Conference on Application of Information and Communication Technologies (AICT), pp. 1-6. https://doi.org/10.1109/AICT50176.2020.9368719
30. M. Rakhimov & M. Ochilov, (2021). Distribution of Operations in Heterogeneous Computing Systems for Processing Speech Signals. 2021 IEEE 15th International Conference on Application of Information and Communication Technologies (AICT), pp. 1-4. https://doi.org/10.1109/AICT52784.2021.9620451
31. M. Rakhimov, D. Mamadjanov & A. Mukhiddinov, (2020). A HighPerformance Parallel Approach to Image Processing in Distributed Computing. 2020 IEEE 14th International Conference on Application of Information and Communication Technologies (AICT), pp. 1-5. https://doi.org/10.1109/AICT50176.2020.9368840
32. M. Rakhimov, J. Elov, U. Khamdamov, S. Aminov & S. Javliev (2021). Parallel Implementation of Real-Time Object Detection using OpenMP. 2021 International Conference on Information Science and Communications Technologies (ICISCT), 2021, pp. 1-4. https://doi.org/10.1109/ICISCT52966.2021.9670146
33. M. Rakhimov, R. Akhmadjonov, & S. Javliev, (2020). Artificial Intelligence in Medicine for Chronic Disease Classification Using Machine Learning. Retrieved from https://www.researchgate.net/publication/367194708
34. M. Rakhimov, T. Boburkhon & T. Khurshid, (2021). Speaker Separation: Use Neural Networks. 2021 International Conference on Information Science and Communications Technologies (ICISCT), pp. 01-03. https://doi.org/10.1109/ICISCT52966.2021.9670322.
35. M.A. Baballe, S. H. Ayagi, & U. F. Musa. (2023). Using artificial intelligence (AI) technology in the health sector has several goals. Global Journal of Research in Engineering & Computer Sciences, 3(5), 31-35. https://doi.org/10.5281/zenodo.10048487.
36. Ma, J. (2017). Prediction of heart disease using k-nearest neighbor and particle swarm optimization. Biomedical Research-tokyo, 28, 4154-4158.
37. Mehta, V. (2023). Artificial Intelligence in Medicine: Revolutionizing Healthcare for Improved Patient Outcomes. J Med Res Innov. 2023, 7(2). https://doi.org/10.32892/jmri.292
38. Mihret, E. (2020). Robotics and Artificial Intelligence. International Journal of Artificial Intelligence and Machine Learning. https://doi.org/10.4018/IJAIML.2020070104
39. Muhammad, A. B., & Mukhtar, I. B. (2023). Artificial Intelligence in the Healthcare Sector. Global Journal of Research in Engineering & Computer Sciences, 3(5), 10-13). https://doi.org/10.5281/zenodo.10001767.
40. R. J. Woodman, & A. A. Mangoni. (2023). A comprehensive review of machine learning algorithms and their application in geriatric medicine: present and future. Aging Clinical and Experimental Research, 2023, https://doi.org/10.1007/s40520-023-02552-2
41. S. Brown (2021). Machine learning, explained. MIT Sloan School of Management, 21(04). Retrieved from https://mitsloan.mit.edu/ideas-made-to-matter/machine
42. T. M. Tassew, X. Nie, (2022). A Comprehensive Review of the Application of Machine Learning in Medicine and Health Care. A Comprehensive Review of the Application of Machine Learning in Medicine and Health Care. TechRxiv. Preprint. https://doi.org/10.36227/techrxiv.21204779.v1
43. W. Xing & Y. Bei, (2020). Medical Health Big Data Classification Based on KNN Classification Algorithm.IEEE Access, 8, 28808- 28819. https://doi.org/10.1109/ACCESS.2019.2955754
44. Y.S Cho, & P. C, Hong, (2023). Applying Machine Learning to Healthcare Operations Management: CNN-Based Model for Malaria Diagnosis. Healthcare (MDPI), 11, 1779. https://doi.org/10.3390/healthcare11121779.

@ 2025 | PUBLISHED BY GJR PUBLICATION, INDIA

CITATION
I. A. Ibrahim, Abdurrahman I. A., & Muhammad A. B. (2025). Navigating the Challenges of Artificial Intelligence in Healthcare: Overcoming Barriers in the 4th Industrial Revolution and Beyond. In Global Journal of Research in Engineering & Computer Sciences (Vol. 5, Number 3, pp. 81–87). https://doi.org/10.5281/zenodo.15538505

Global Journal of Research in Engineering & Computer Sciences

Assets of Publishing with Us

- **Immediate, unrestricted online access**
- **Peer Review Process**
- **Author's Retain Copyright**
- **DOI for all articles**

Copyright © 2025 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC 4.0) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.