International Journal of
INTELLIGENT SYSTEMS AND APPLICATIONS IN ENGINEERING
ISSN:2147-6799 www.ijisae.org Original Research Paper

Medical Imaging and Computer Vision for Artificial Intelligence in Diagnostic Healthcare

Dhananjay A. Kumbhar[1], Dr. Smita T. Kumbhar*[2], Pushpa D. Jadhav[3], Sushma S. Mule[4], Amol B. Chounde[5], Mayuri A. Jadhav[6], Akshay A. Jadhav[7]

Submitted: 26/01/2024 **Revised**: 04/03/2024 **Accepted**: 12/03/2024

Abstract: As AI's unique strategic analytic has increased in accuracy and expanded in applicability, the healthcare industry has become increasingly interested in it. It is proving more and more useful in a number of situations, such as helping to uncover previously unattainable insights into medical decision-making, establishing connections between resources and patients for improved management, and reaping benefits from previously inaccessible data assets. Although hospital imaging data might be difficult to analyze, it is a gold mine of patient information. No matter how talented they are, medical professionals find it extremely difficult to piece together high-resolution images from large data sets of MRI, CAT scans, X-rays, or other testing components. This work shows how a unique AI strategy may be thoroughly investigated across a range of dimensions, leading to exciting new directions for medical imaging research. This examination of the most useful current application demonstrates why it might have therapeutic applications. The potential of artificial intelligence (AI) in the detection of neurological disorders, bone fractures, cancer, and musculoskeletal issues is investigated in this study. The advantages and disadvantages of applying AI to healthcare have also been emphasised. Examining the specifics of AI's function in medical imaging has benefited from qualitative and statistical study of secondary data. Despite assurances to the contrary, a number of researchers have voiced scepticism over the utility of AI in the healthcare industry.

Keywords: *Deep learning, Artificial Intelligence, Image processing, Data, Information*

Artificial intelligence (AI) is the name given to a technology that imitates human intelligence but is produced artificially by computers as opposed to naturally. It has made a name for itself across many industries, including business, education, and health. Artificial intelligence has established itself as a crucial component of clinical practise within the healthcare industry due to its various benefits. An overview of five different applications of AI in the field of medical imaging is given in this article. This article examines not only how AI is being used in medicine, but also some potential future uses. This paper's main goal is to investigate potential uses of AI in the field of medical imaging. In this work, we also suggest a strategy for investigating the potential of AI to change the healthcare sector. Researchers are not overly afraid of AI; rather, they express the thoughts to embrace it. AI has a vast potential to study the many components of clinical research. The research discussed in this article has revealed a novel AI method and explores the potential future applications for the medical industry, including the implementation of such a method with potential staff [1, 2].

Image processing is widely used in a wide range of other fields, including web mining, medical imaging, scientific visualisation, and image mining. Content-Based Mir Image Retrieval (CBMIR) technologies are essential to the operation of medical databases because they enable quick searching and retrieval of medical images. The potential applications of deep learning techniques for image segmentation are thoroughly covered in this paper. The numerous possible applications of deep learning in medical imaging, including image mining, are explained in this article as a primer. Additionally, techniques for flaw detection in medical images and content-based picture retrieval are discussed. The methods stated above are all instances of de-generative models; the literature also emphasises

[1]*Department of Electronics and Telecommunication, MIT College of Railway Engineering and Research, Barshi, India. dhananjay.kumbhar@gmail.com*
[2]*Department of Pharmaceutical Chemistry, DSTS Mandal's College of Pharmacy, Solapur, India. smitakumbhar@gmail.com*
[3]*Department of Computer Science and Engineering, Walchand Institute of Technology, Solapur, India. jadhavpushpa75@gmail.com*
[4]*Department of Computer Science and Engineering, MIT College of Railway Engineering and Research, Barshi, India. sushma.mule@mitcorer.edu.in*
[5]*Department of Electronics and Telecommunication, SVERI's College of Engineering, Pandharpur, India. abchounde@coe.sveri.ac.in*
[6]*Department of Electronics and Telecommunication, MIT College of Railway Engineering and Research, Barshi, India. mayuaj1527@gmail.com*
[7]*Department of Electronics and Telecommunication, MIT College of Railway Engineering and Research, Barshi, India. akshayjadhav19910304@gmail.com*
Corresponding Author: *Dr. Smita Kumbhar*
Department of Pharmaceutical Analysis, DSTS Mandal's College of Pharmacy, Solapur, Maharashtra, India. ORCID ID: https://orcid.org/0000-0002-3030-9477
Telephone no. 0217-2343760, Mobile no. +91 8888824137
E-mail- smitakumbhar@gmail.com

other models, such as pattern-based methods, future-oriented methods, in-depth methodologies, and model-based approaches. However, model-based methods or generative approaches are frequently given credit for success since in these cases, analysis is dependent on an estimate of the parameters and the full analysis is conditional on these estimates. Deep learning techniques, for example, have been developed as a result of recent advances in machine learning. This methodology has the potential to enhance analysis, particularly of medicinal tissues. In this study, we present the findings of a thorough analysis of the subset of image-processing tasks that lend themselves to deep learning methods.

- **Artificial intelligence's function in medical imaging**

Artificial intelligence may be useful to pathologists and radiologists; it is used in medical imaging to diagnose a wide variety of disorders. There are several signs that the work of accurately and quickly identifying the qualities in medical photos can be accomplished by AI tools and components. Here are five ways artificial intelligence is being used in the field of medical imaging, as well as how this technology is changing the workforce by making it more capable of spotting potentially fatal illnesses [3].

- **Recognising alterations in the cardiovascular system**

Measurements of heart architecture may be used to determine the likelihood of developing cardiovascular disease and the presence of problems requiring surgical or pharmaceutical intervention. It may be possible to make treatment decisions more quickly by monitoring and regulating the process of identifying different disorders using simple ordered image detection technologies, such X-rays. Nothing will make things clearer if an example is not provided. A chest x-ray could be the first image noticed once a patient who is complaining of dyspnea enters the emergency room. Cardiomegaly may be used as part of a preliminary screening procedure because it may be a sign of significant heart disease. The radiologist can make inaccurate findings if they placed an excessive amount of reliance on a cursory visual examination. Bigger pulmonary nodules on chest x-rays may signal additional, more significant pulmonary or cardiac issues that need to be ruled out, and artificial intelligence may make it easier for doctors to identify these issues. In a similar vein, automation of measurement tasks like determining the aortic valve, the carina angle, and the diameter of the pulmonary artery may be facilitated by artificial intelligence [4-6].

- **Recognising additional fractures and musculoskeletal wounds**

If not addressed right away, musculoskeletal injuries and fractures can cause persistent pain and disability. Hip fractures in the elderly are another concern that needs to be handled as soon as is practical. AI is especially useful for pinpointing the smallest but most critical fractures, which may be hidden. Surgeons are able to more confidently treat soft tissue injuries and dislocations because to the application of artificial intelligence. This specific type of fracture is seen to be of small relevance following the event and requires a speedier recovery. The results of the numerous previous tests must be compared in order to establish how the abnormality has changed over time because they cannot be clearly seen on the x-ray. In this situation, the medical professionals identify the best uses for AI, which enables them to quickly decide what to buy.

- **Identification of neurological conditions**

A disastrous diagnosis (ALS) may be given to patients with degenerative neurological conditions like amyotrophic lateral sclerosis. The diagnosis of ALS is greatly and critically impacted by artificial intelligence. Imaging tests are necessary to distinguish between primary lateral sclerosis (PLS) and amyotrophic lateral sclerosis (ALS) and to diagnose each condition separately. Recent studies on the detection of ALS and the use of AI to it show how crucial accuracy and speed are in this process.

- **Finding Thoracic Complications**

Due to the fact that AI algorithms can access images and x-rays, they are able to identify opacities that may indicate pneumonia and to notify users to potential diagnoses. Rapider patient observation and treatment are made possible by AI. Artificial intelligence may be able to prioritise problems based on their severity and nature in this regard, which could help people make decisions with a sense of urgency [7, 8].

- **Cancer screening and Prevention**

In hospitals, imaging methods are frequently used to check patients for common malignancies. For instance, it could be difficult to identify breast tissue flaws connected to breast cancer, such as microcalcification. The worst outcome possible is that an incorrect diagnosis, frequently referred to as a false positive, may lead to diseases that kill people needlessly. Artificial intelligence (AI) may help with accuracy and the best use of imaging features to identify microcalcifications based on a suspicion for "ductal carcinoma in situ" (DCIS), which may lessen the likelihood of conducting needless benign biopsies.

Similar to this, head and neck cancer, colorectal cancer, prostate cancer, and cervical cancer may all be detected using AI.

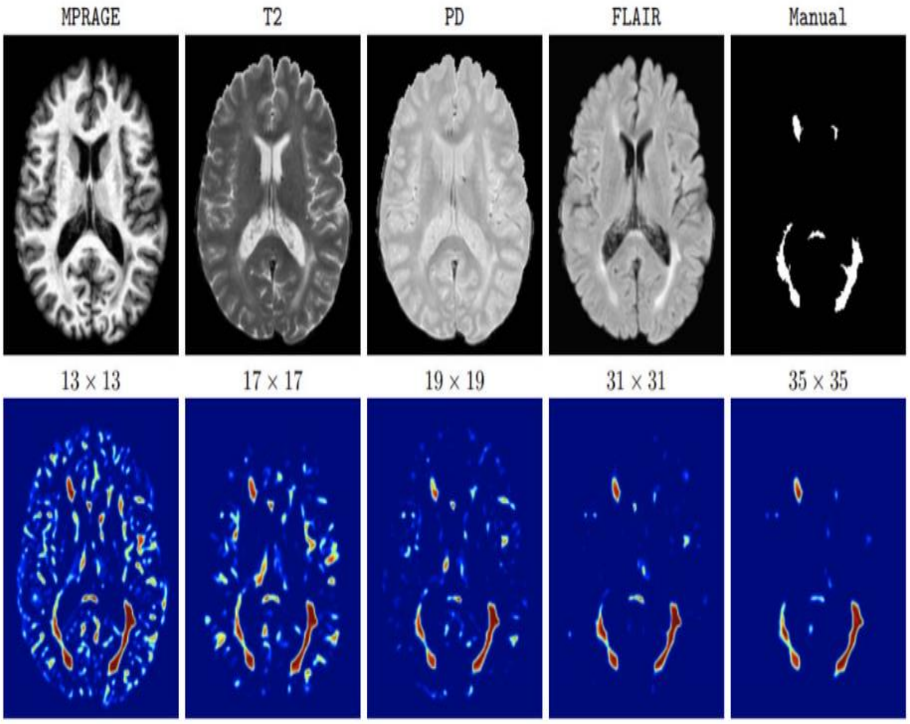

Fig 1. Medical image processing using artificial intelligence

Potential applications of AI in diagnostic imaging in the future

Human eyes are more adept at spotting problems since they have training and experience, but machine learning cannot identify problems with medical image annotation unless symptoms or concerns are expressed. The only way to identify the issue and make a well-informed prediction based on the pattern that may be seen is by employing it. There are many who disagree with the experts' consensus that the precision of the AI application greatly exceeds that of human sight, but on the other hand, many academics think the AI application is less useful.

- ***Training of AI models for use in medical imaging***

Experts employ key approaches integration into MI as a type of image marking to pinpoint an issue's position and use computer vision to create a picture of it. Image labelling is another name for image annotation. Image annotation is another name for image labelling. After the MI has been annotated with the issue, the AI model may undergo extensive training. Big data is driven by AI and machine learning, which provides appropriate data for analysing medical images and producing predictions about what kind of ailment may likely develop in patients. This aids in gathering pertinent information for the analysis of medical imaging. Artificial intelligence may be useful for disease diagnosis [9-11].

- ***Reliable automated management data***

It has been proposed in a number of articles that once a good AI framework has been built, it would be able to identify a variety of diseases in less time than a radiologist can, while also being more accurate and successful. After conducting a thorough secondary data analysis (both quantitative and qualitative), an essay on AI in medical imaging was prepared.

The many applications for AI have been categorised through the use of statistics and a secondary data analysis. Comparatively, qualitative study on AI development emphasises its precision and promise. The distorted use of statistical measurement in the basic analysis has been highlighted through table diagrams. In this qualitative follow-up, we talk about how AI might advance in the future. It has been possible to delve deeper into the topic at hand by incorporating publications by other researchers. The goal to improve the efficacy and efficiency of diagnosis and treatment is the main driver behind the expanding application of AI in medical imaging. This is so that AI can aid in the quicker and more precise diagnosis and treatment of medical disorders. Radioactivity-based imaging is growing significantly.

The effectiveness and efficiency of AI over the course of several years

The term "artificial intelligence" refers to a computer that mimics human cognitive functions, such as the capacity for problem-solving and skill acquisition. In a broader sense, we may argue that it is the process of systematic learning through the execution of tasks that rely on a particular algorithm or pattern in order to understand and recognise the notions. There are numerous automated processes, some of which even require human intelligence to be effective in some domains [12]. Deep learning, machine learning, and artificial intelligence all refer to various learning methodologies; they are all connected and have been in use for some time. This article examines the application of AI to medical imaging, and it makes note of the possibility of monitoring student use of this training material over a period of several years. The use of AI in clinical diagnostic imaging has been the subject of extensive research. It has demonstrated impressive accuracy in the medical profession over a period of years. However, with the slight modifications in detecting methods, the greater sensitivity has emerged as a significant drawback [13, 14].

Application of AI in the medical business

It is predicted that the worldwide healthcare AI market, based on clinical applications, will reach about $1.5 billion by 2024. According to market research and consulting, artificial intelligence is anticipated to play a significant role in the global medical industry as a result of its increased use. The covid pandemic subsidies in AIU-based medical treatment with high annual growth that is anticipated to increase by 44% by the year 2022 are projected to hasten the market's growth. Artificial intelligence is increasingly being used, particularly in the diagnosis of various diseases. Since approving the opportunity, it has taken a leading role in the treatment of diseases like lung cancer, breast cancer, neurological disorders, and cardiovascular diseases. Artificial intelligence has a wide range of possible applications in the healthcare industries of the future due to its dynamic nature.

The use of Artificial Intelligence in Medical Imaging

- **Increased health screenings**

AI-enhanced medical imaging enables doctors to diagnose and treat patients more quickly.

Researchers at Tulane University have demonstrated that AI is just as good as human pathologists at detecting colorectal cancer in tissue scans. This study was undertaken to see whether artificial intelligence could help pathologists meet the demand. The authors of the study claim that a cancer diagnosis necessitates the evaluation and interpretation of numerous histological images. Overworked doctors may commit more errors. In a news release announcing recent findings, Hong-Wen Deng, Ph.D., a professor and the director of the Centre for Biomedical Engineering and Genomics at Tulane University, asserted that pathologists are kept busy despite their monotonous work. Deng highlighted that there aren't enough pathologists in the globe, especially in developing countries. According to the researchers, "this study is innovative because we successfully exploited artificial intelligence to identify and diagnose colorectal cancer in a cost-effective method, which may one day lessen the workload of pathologists" [15, 16].

- **Improved precision medicine**

AI in medical imaging results in more precise therapy. Computer science has been used by Stanford University researchers to discriminate between two types of lung cancer. Machine learning helped pathologists' stage and grade tumours, which enhanced patient survival prediction. This accusation was made in a news release by Michael Snyder, Ph.D., the department's head and a professor. In this instance, the assessments of two experienced pathologists are congruent. This method, which substitutes complex quantitative data for subjectivity in 60% of cases, should enhance patient outcomes. AI eliminates morality. By determining the patient's cancer kind and the most effective treatment, precision medicine advances. The use of precision medicine enables individualised patient care.

- **Signaling and assessing danger**

AI can recognise and anticipate health issues using medical imaging. Physicians may be able to anticipate heart attacks with the use of AI imaging and clinical data. In a machine learning model, 18F-NaF uptake on PET and quantitative coronary plaque characteristics on CT angiography were revealed to be complementary and potent indicators of heart attack risk in people with known coronary artery disease. Both techniques have the potential to increase the accuracy of heart attack prediction using clinical data. This study used data from CT angiography and 18F-NaF PET to examine whether AI may help with heart attack prediction. The study's researchers discovered that by fusing clinical and multimodal imaging data, AI algorithms may be able to predict heart attacks with high accuracy. Health screenings, precision medicine, risk assessment, and doctor workloads may all benefit from AI and machine learning [17].

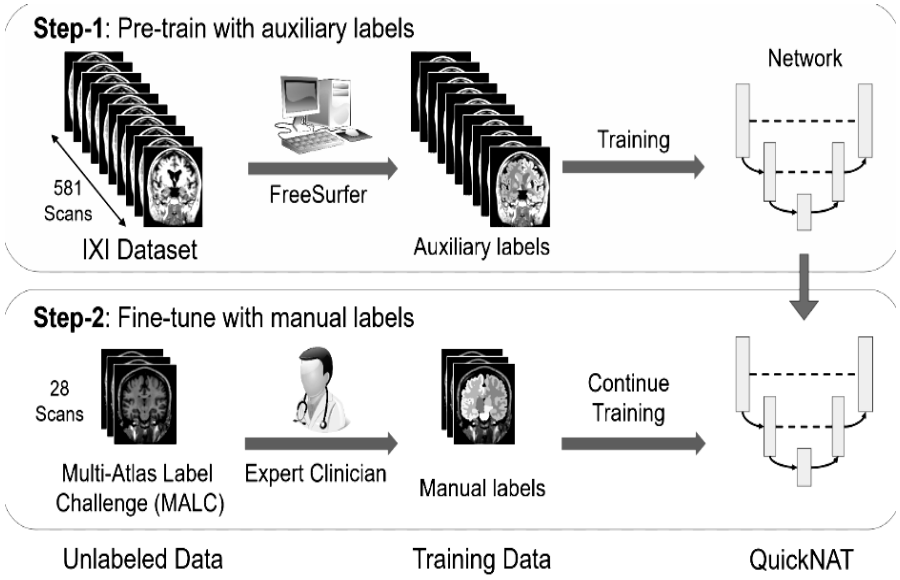

Fig 2: - AI in the Medical Imaging

After taking into account everything that has been discussed about AI in the medical field, one may come to the conclusion that there will be a wide variety of potential uses for AI in the future. Imaging in medicine is a crucial method in the clinical setting that helps doctors identify a wide range of disorders with accuracy. An X-ray, an MRI, a CT scan, and an ultrasound diagnostic are the most important medical images to have when diagnosing a condition. Because technology is made feasible by artificial intelligence, which also plays a bigger role in delivering accurate analysis of these photographs. In all honesty, the machine is trained using these images by the computerised vision programme, and the machine detection software then helps to analyse the images. Standard equipment won't be able to detect the illness as effectively as other testing techniques. As a result, a sizable number of medical images are used to train artificial intelligence models.

Ethics Approval: Ethics Committee has confirmed that no ethical approval is required.

Consent for publication: The authors have approved Consent for publication.

Data Availability: All data generated or analysed during this study are included in this published article and its supplementary information files.

Competing Interests: The authors have no competing interests to declare that are relevant to the content of this article.

Funding: No funds, grants, or other support was received.

Author contributions: All authors contributed to the study conception and design. Material preparation, data collection and analysis were performed by [**Smita Kumbhar**], [**Manish Bhatia**] [**Rajendra Dube]** and [**Dhananjay Kumbhar].** The first draft of the manuscript was written by [**Smita Kumbhar and Dhananjay Kumbhar**] and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

References

[1] Ayache N (2020) Medical Imaging in the age of Artificial Intelligence. Healthcare and Artificial Intelligence 89-91. https://doi.org/10.1007/978-3-030-32161-1_13

[2] Brag J (2020) Artificial Intelligence in medical imaging. Healthcare and Artificial Intelligence 93-103. https://doi.org/10.1007/978-3-030-32161-1_14

[3] Fromherz MR, Makary MS (2022) Artificial Intelligence: Advances and new frontiers in medical imaging. Artificial Intelligence in Medical Imaging 3(2):33-41. https://doi.org/10.35711/aimi.v3.i2.33

[4] Nadkarni P and Merchant SA (2022) Enhancing medical-imaging artificial intelligence through holistic use of time-tested key imaging and clinical parameters: Future insights. Artificial Intelligence in Medical Imaging 3(3):55-69. https://doi.org/10.35711/aimi.v3.i3.55

[5] Subasi A (2023) Introduction to artificial intelligence techniques for medical image analysis. Applications of Artificial Intelligence in Medical Imaging 1-49. https://doi.org/10.1016/b978-0-443-18450-5.00010-4

[6] Sureka CS (2021) Artificial Intelligence in medical imaging. Artificial Intelligence Theory, Models, and Applications 47-74. https://doi.org/10.1201/9781003175865-4

[7] Wolterink JM & Mukhopadhya A (2022) Demystifying Artificial Intelligence Technology in cardiothoracic imaging: The essentials. Artificial Intelligence in Cardiothoracic Imaging 15-25. https://doi.org/10.1007/978-3-030-92087-6-2

[8] Loh HW, Ooi CP, Seoni S, Barua PD, Molinari F & Acharya UR (2022) Application of explainable artificial intelligence for healthcare: A systematic review of the last decade (2011-2022). Computer methods and programs in biomedicine 226:107161. https://doi.org/10.1016/j.cmpb.2022.107161

[9] Sounderajah V & McCradden MD, Liu X (2022) Ethics methods are required as part of reporting guidelines for artificial intelligence in healthcare. Nat Mach Intell 4:316-317. https://doi.org/10.1038/s42256-022-00479-3

[10] Manickam P et. al. (2022). Artificial Intelligence (AI) and Internet of Medical Things (IoMT) Assisted Biomedical Systems for Intelligent Healthcare. Biosensors 12(8):562. https://doi.org/10.3390/bios12080562

[11] Chang V et. al. (2022) An artificial intelligence model for heart disease detection using machine learning algorithms. *Healthcar*e Analytics 2:100016. https://doi.org/10.1016/j.health.2022.100016.

[12] Hering A et. al. (2022) Learn2Reg: comprehensive multi-task medical image registration challenge, dataset and evaluation in the era of deep learning. IEEE Transactions on Medical Imaging. https://doi.org/10.48550/arXiv.2112.04489

[13] Dev S et. al. (2022). A predictive analytics approach for stroke prediction using machine learning and neural networks. *Healthcare Analytics* 2:100032. https://doi.org/10.1016/j.health.2022.100032.

[14] Pathan MS et. al. (2022) Analyzing the impact of feature selection on the accuracy of heart disease prediction. *Healthcare Analytics*, 2:100060. https://doi.org/10.1016/j.health.2022.100060.

[15] Loku L et. al. (2020) Using Python Programming for Assessing and Solving Health Management Issues. South East European Journal of Sustainable Development 4(1).

[16] Guleria P and Sood M (2020) Intelligent Learning Analytics in Healthcare Sector Using Machine Learning. In: Jain, V., Chatterjee, J. (eds) Machine Learning with Health Care Perspective. Learning and Analytics in Intelligent Systems 13. https://doi.org/10.1007/978-3-030-40850-3_3

[17] Khan ZF & Alotaibi SR (2020) Applications of Artificial Intelligence and Big Data Analytics in m-Health: A Healthcare System Perspective. Journal of healthcare engineering 2020:8894694. https://doi.org/10.1155/2020/8894694