International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 06 | June - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

A Review on Automated Medical Diagnosis

Likith Kumar[1], Abhineethi PS[2], Advitha CR[3], Snehal[4] , Uday J[5] , Renita Pinto[6]

Students, Dept. of E&CE, Mangalore Institute of Technology & Engineering, Moodabidri, Mangalore, India[1,2,3]
Student, Dept. of ISE, Mangalore Institute of Technology & Engineering, Moodabidri, Mangalore, India[4]
Senior Assistant Professor, Dept. of E&CE, Mangalore Institute of Technology & Engineering, Moodabidri, Mangalore, India[5]
Assistant Professor, Dept. of ISE, Mangalore Institute of Technology & Engineering, Moodabidri, Mangalore, India[6]

Abstract: The technology uses robotics, artificial intelligence (AI), and machine learning (ML) to automate the process of medical surgery with a focus on treating bone fractures. These technological advancements could enhance surgical accuracy, effectiveness, and safety. Bone fractures are common in humans. They can happen as a result of high pressure being applied to the bone, an accident, osteoporosis, or bone cancer. Consequently, getting an accurate diagnosis of a bone fracture is an important aspect in the medical field. X-ray and CT images were used to analyze bone fractures. This project aims to create a productive system based on image processing By utilizing AI and ML algorithms, the system can analyze medical imaging data, track tissue movement, and assist in surgical planning. Images of the fractured bone are obtained from the hospital and processing techniques including edge detection, segmentation, and pre-processing approaches for feature extraction are used. The enhanced images will be further divided into bone that has been broken and bone that has not been fractured, and the accuracy of different projects is fully employed using MATLAB the software for loading images and processing images The ultimate objective of the project is to develop an automated medical surgery system that enhances patient safety, decreases human error, and improves surgical outcomes. This technology can potentially transform the practice of surgery by utilizing the capabilities of AI, ML, and robotics.

Keywords: Artificial Intelligence, Machine Learning, Matlab, Image Processing

I. INTRODUCTION

AI-powered surgical automation is still in the early stages of development, but it can potentially revolutionize healthcare. AI-powered surgical automation is a system that uses artificial intelligence (AI) to improve the accuracy, efficiency, and safety of surgical procedures. In medical imaging and surgery, this breakthrough has the potential to greatly enhance surgical decision-making, streamline administrative procedures, increase patient care, and perform complex procedures with greater precision and efficiency. Our Project: “Automated Medical Diagnosis”- This aims to develop a system capable of swiftly and reliably identifying fractures within medical imaging, promoting quick medical diagnosis and suitable treatment to reduce surgical errors, and enhancing the overall efficiency using the power of AI & ML and robotics.

II. LITERATURE SURVEY

BACKGROUND RESEARCH

In the present world, despite advancements in medical imaging technology, the accurate and efficient detection of bone fractures remains a critical challenge. Bone fractures are a common injury, affecting millions of people each year. Manual analysis of medical images, such as X-rays and CT scans, for fracture detection is time-consuming, error-prone, and heavily reliant on the expertise of radiologists. Additionally, radiologists may miss subtle fractures, especially in complex cases. Early detection and treatment of bone fractures is essential for a good prognosis. The need for a reliable, automated, and fast bone fracture detection system is evident.

LITERATURE REVIEW

A literature survey shows the various analysis and research made in the field of interest and results already published, taking into account the various parameters of the project and the extent of the project. It includes researches made by various analysts-their methodology and the conclusion they have arrived at. It is the most important part of the report as it gives direction in the area of research.

[1] Survey On Various Techniques For Bone Fracture Analysis Using Image Processing Methods by M. Anita Indu and A. S. Professor Suvalakshmi, Research gate,2021.

Bone fractures are a serious problem brought on by pressure, accidents, or osteoporosis. Medical imaging is essential for identifying these injuries. Bone fractures must be quickly identified because they are crucial for supporting the body. Medical imaging is becoming important for this reason, which relieves some of the pressure on physicians. Recent research emphasizes several methods, such as picture segmentation, classification, and fracture identification, for bone fracture detection. The study examines different fracture kinds as well as strategies for detecting and categorizing them.

[2] Contrast Enhancement of Medical X-Ray Image Using Morphological Operators with Optimal Structuring Element by R. Kushol, Md. N. Raihan, M. S. Salekin, and A. B. M. A. Rahman,arXiv,May-2019.

In every modern healthcare facility and hospital, doctors have employed X- ray images to direct surgical and medical procedures. The X-ray imaging approach helps doctors evaluate patients and identify diseases in the skeletal system more quickly and effectively since it can painlessly show bone structure. Using morphological operators, this research describes an effective contrast enhancement strategy that will improve the visualization of key soft tissue and bone segments. The image is improved using the top-hat and bottom-hat transforms, and the gradient magnitude value is determined to determine the structural element (SE) size automatically. Experimental testing on several x-ray imaging datasets demonstrates the efficiency of our technology, which also generates output that is comparably superior to some existing.

[3] Detection of lung cancer using image processing techniques by P. Gawade and R. P. Chauhan, International Journal of Advanced Technology and Engineering Exploration, vol. 3, no. 25, pp. 217–222, Nov. 2016.

A timely detection of lung cancer is essential to increasing survival rates. PET and CT scans are advised by international screening programs, especially for high-risk patients. Early detection is hampered by late-stage symptoms, which lowers survival rates. More than 85% of cases are influenced by tobacco smoking, genetics, and environmental factors. This work employs MATLAB for analysis and focuses on applying sophisticated computational methods and image processing to identify lung cancer early using CT images.

[4] Communication & Signal Processing by Adhiparasakthi Engineering College, Institute of Electrical and Electronics Engineers. Madras Section., and Institute of Electrical and Electronics Engineers, IEEE sponsored International Conference,2nd-4th April 2015.

Image segmentation is crucial in medical image diagnosis, simplifying disease identification. This study proposes an automated medical image identification model using fractal texture segmentation, focusing on detecting diseased image areas. A novel segmentation metric is introduced, streamlining the automated system, saving time in processing and transmission. The approach is anticipated to enhance disease diagnosis reliability, making it valuable for healthcare applications and broader use in medical science.

[5] Detection of Bone Fracture using Image Processing Methods by Anu. T. C and R. Raman,2015.

In the medical field, a correct bone fracture diagnosis is essential. In this effort, bone fractures are quickly and precisely classified using X- ray/automated medical Diagnosis scans and image processing algorithms. The pre-processing, segmentation, edge detection, and feature extraction steps are used to process images of fractured bones. The accuracy of various approaches is then evaluated by classifying the processed images into bones that are broken and those that are not fractured. For image processing and user interface creation, MATLAB 7.8.0 is used. Although there are some restrictions, the method shows a good accuracy of 85% in bone fracture identification.

[6] International Conference on Image Processing by Institute of Electrical and Electronics Engineers and IEEE Signal Processing Society, 2015 IEEE: proceedings : ICIP 2015 : 27-30 September 2015, Québec City, Canada Segmenting.

X-ray bone images are challenging due to varying brightness, posing difficulty in distinguishing bones from the background and soft tissue. Existing segmentation methods like active contour and region growing, while effective for some images, lack completeness due to diverse bone structures and lighting conditions. This paper introduces a novel bone segmentation method involving pre-processing steps like noise cancellation and edge detection. Analyzing intensity fluctuations in image rows yields more accurate bone segmentation. Visual evaluation demonstrates the algorithm's superior performance compared to conventional and recent bone segmentation approaches.

[7] X-ray image analysis for osteoporosis diagnosis: From shallow to deep analysis by M. Mebarkia, A. Meraoumia, L. Houam, and S. Khemaissia, Displays, vol. 76, Jan. 2023.

This study improves osteoporosis diagnosis using advanced texture analysis in medical images. By combining handcrafted methods (HOG, LPQ) with deep analysis via Gabor's filter bank, the system achieves an outstanding 89.66% accuracy in osteoporosis diagnosis.

[8] Automated diagnosis of bone metastasis based on multi-view bone scans using attention-augmented deep neural networks by Y. Pi, Z. Zhao, Y. Xiang, Y. Li, H. Cai, and Z. Yi, Med Image Anal, vol. 65, Oct. 2020.

The paper introduces a deep neural network for automated diagnosis of bone metastasis in scintigraphy images, addressing the limitations of manual analysis. The model utilizes three sub-networks and innovates by jointly analyzing anterior and posterior views for improved accuracy. A spatial attention feature aggregation operator enhances spatial information. Trained on a large dataset, the model outperforms human experts, showcasing its potential as a clinical decision-support tool for bone scintigraphy image diagnosis.

[9] Computer-Aided Fracture Detection System by C. M. A. K. Z. Basha, M. Padmaja, and G. N. Balaji," J Med Imaging Health Inform, vol. 8, no. 3, pp. 526–531, Mar. 2018.

Two techniques for effective fracture detection in digital X-ray pictures are presented in this research. GFBFD is a

supervised technique employing radial basis function neural network and gradient features, and HTBFD is an unsupervised approach using fuzzy c-means and Hough transform. With an identification rate of 88%, GFBFD surpasses both HTBFD and K-nearest neighbor, indicating its potential as an early fracture diagnosis and localization technique.

[10] BrainSuite: An automated cortical surface identification tool by D. W. Shattuck and R. M. Leahy, Elsevier,2002.

The paper presents a new MR image analysis tool for rapid generation of accurate cortical surface representations of the human brain. The tool minimizes user interaction and includes operations such as skull and scalp removal, image non-uniformity compensation, tissue classification, topological correction, rendering, and editing. The paper discusses the theoretical aspects of each stage and provides validation results using real and phantom data, along with an inter operator variability study. Published in 2002 by Elsevier Science B.V.

LIMITATIONS OF EXISTING SYSTEMS

In the current way of doing things, when someone might have a broken bone, doctors use X-rays and CT scans. A human, called a radiologist, looks at these pictures to find any fractures.

Some of the common flaws noticed in the application are:

- Time-consuming: Looking at these images takes a lot of time.
- Errors can happen: Sometimes, the person looking at the images might make mistakes.
- Depends on the person's expertise: It relies heavily on how good the person looking at the pictures is at their job.
- Hard to find subtle fractures: Small breaks in bones can be easily missed, especially if the case is complicated.

III. PROPOSED SYSTEM

Our proposed work centers on harnessing machine learning (ML) and artificial intelligence (AI) for advanced bone fracture detection, specifically within Digital Imaging and Communications in Medicine (DICOM) images. The comprehensive approach involves.

DICOM Image Processing:

- Importing and preprocessing DICOM images for clarity.
- Employing feature extraction, segmentation, and edge detection.

Advanced Analysis Techniques:

- Utilizing ML algorithms for classification.
- Analyzing image data for patterns, anomalies, and specific structures.

Diagnostic Insights:

- Enhancing interpretability through feature extraction and segmentation.
- Optimizing clinical decision-making with automated tools.

Semi-automatic Robotic Operating Arm:

- Robotic System that is capable of performing basic operational procedures.
- Employing semi-automatic helping hands for Medical surgery .

Our innovative methodology integrates AI and ML into the DICOM preprocessing pipeline, streamlining fracture identification. This approach promises faster, more accurate diagnostics, revolutionizing healthcare delivery and patient care outcomes.

ARCHITECTURAL BLOCK DIAGRAM

An architectural explanation is a formal description and illustration of a system organized in a manner that supports reason concerning the structure of the system which comprises system components, the externally detectable properties of individual components, the interaction among them, and provides a plan from which products can be procured, and systems developed, that will work mutually to implement the on the whole as a system.

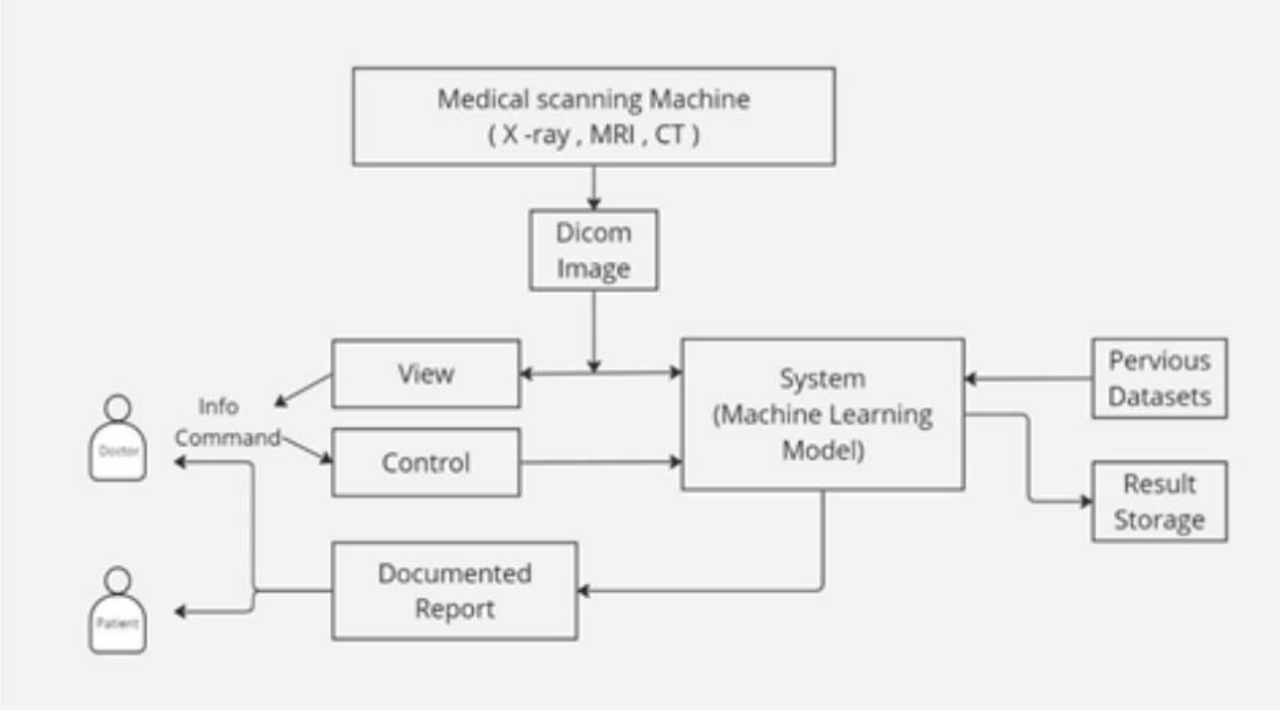

Figure 1.1 Architectural design for the system

Medical Scanning Machines (X-ray, MRI, CT): The core imaging devices in the system, responsible for capturing medical images such as X-rays, MRIs, and CT scans.

DICOM Image: Standard format for storing and transmitting medical images, ensuring compatibility and consistency.
Previous Datasets: Repository of historical patient data and images for reference and comparison.

Control System (Machine Learning Model): Central system employing machine learning for analysis, detection, and diagnosis based on medical images.

Result Storage: Repository for storing machine-generated diagnostic results and related information.

Documented Report: System-generated report detailing detected conditions, recommended treatments, and other relevant medical information.

IV. CONCLUSION

The main purpose of this project is to solve the issues in the medical sector related to the manual processing of Dicom images (Medical Scanning Output) and diagnosing based on those factors was a very tedious task and the accuracy is average and also the cost is quite high when the complexity increases. The project proposed is lined up to solve the above-mentioned problem by semi-automating the medical diagnosis with Artificial Intelligence and Robotics.

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[8] Y. Pi, Z. Zhao, Y. Xiang, Y. Li, H. Cai, and Z. Yi, "Automated diagnosis of bone metastasis based on multi-view bone scans using attention-augmented deep neural networks," Med Image Anal, vol. 65, Oct. 2020, doi: 10.1016/j.media.2020.101784.

[9] C. M. A. K. Z. Basha, M. Padmaja, and G. N. Balaji, "Computer Aided Fracture Detection System," J Med Imaging Health Inform, vol. 8, no. 3, pp. 526–531, Mar. 2018, doi: 10.1166/jmihi.2018.2324.

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