International Journal on Science and Technology (IJSAT)

E-ISSN: 2229-7677 ● Website: www.ijsat.org ● Email: editor@ijsat.org

Bone Fracture Detection System Using Machine Learning

Gottimukkula Sravan Rao[1], B.Shreya[2], P.Swetha Sri[3], Y.Sudarshan[4]

Asst. Professor Department of CSE (AI&ML), CMR Technical Campus, Hyderabad

[1]sravanrao.aiml@cmrtc.ac.in, [2]bachawalashreya3@gmail.com, [3]swethasri7030@gmail.com, [4]sudharshanreddy76784@gmail.com

ABSTRACT

Bone fractures are a common medical condition that can result from trauma, accidents, or certain diseases. Accurate and timely detection of fractures is crucial for effective treatment and recovery. Traditional methods of fracture detection primarily rely on manual interpretation of X-ray images by radiologists, which can be time-consuming and prone to human error. In recent years, advancements in machine learning and computer vision have paved the way for automated systems that can assist in the detection of bone fractures. This paper proposes a bone fracture detection system that utilizes deep learning techniques to automatically identify fractures in medical images, such as X-rays or CT scans. The proposed system aims to improve diagnostic accuracy, reduce detection time, and support medical professionals in clinical decision-making. The system's performance is evaluated against traditional methods, highlighting its potential to enhance the efficiency and reliability of fracture diagnosis. Leveraging deep learning techniques, particularly Conventional Neural Networks (CNN), the system enhances accuracy and reduces the time required for diagnosis. Traditional manual analysis by radiologists, while expert-driven, is time-consuming and prone to errors.

Key Words: machine learning (ML) and deep learning (DL) algorithms

1. Introduction

Bone fractures are a common medical issue caused by accidents, trauma, or underlying health conditions, requiring accurate and timely diagnosis for effective treatment. Traditionally, radiologists manually analyze X-ray or CT images to detect fractures, a process that can be slow and error-prone. With advancements in artificial intelligence, especially deep learning, automated detection systems have emerged to support medical professionals. These systems analyze medical images with high speed and accuracy, reducing the diagnostic burden on radiologists. The proposed system utilizes CNN-based algorithms to efficiently identify and classify fractures, even in noisy or low-resolution images.

Recent research, including work by Mallikarjuna Swamy M. S., highlights the use of image processing and machine learning techniques for effective bone fracture analysis. By employing methods such as pre-processing, segmentation, and feature extraction, as well as classifiers like Neural Propagation Networks and Naïve Bayes, these systems achieve substantial accuracy. While current advancements show promise with an accuracy of over 86%, there is potential for further improvements using advanced algorithms and multiple GLCM functions to enhance precision in fracture classification.

2. Literature survey

Bone fracture detection has been significantly advanced through machine learning and deep learning techniques. Multiple studies have explored innovative methods to classify healthy and fractured bones using various architectures like CNN, Faster R-CNN, and transfer learning models. These approaches leverage data augmentation, Region Proposal Networks (RPN), and inception v2 networks to enhance accuracy and manage challenges like blurry images and small fracture detection. For example, Faster R-CNN models have achieved classification accuracies of over 94%, efficiently identifying fracture locations and improving workload management for medical professionals. Techniques such as boring surveys and portable fracture detection devices also contribute to advancing the field, addressing limitations like multi-resolution analysis and noise differentiation.

In addition, the application of Convolutional Neural Networks (CNN) in analyzing medical images has demonstrated superior performance in comparison to traditional methods. Studies emphasize detecting fractures in diverse regions, including hand, leg, chest, fingers, and wrist, with models like VGG16 and R-CNN achieving remarkable accuracy. Furthermore, quantitative imaging techniques, bone mineral density (BMD) tests, and the use of machine learning for analyzing abnormal features offer a comprehensive approach to understanding bone health. These advancements underline the potential for automated, accessible solutions, reducing the dependency on manual diagnosis and improving overall patient outcomes.

3. Proposed Work

Our proposed system represents a pioneering approach to the identification of false profiles within online social networks, harnessing the synergy of machine learning and natural language processing. At its core, the system introduces the Support Vector Machine (SVM) classifier, a powerful tool that maximizes the separation between different data classes. By mapping profiles in a multidimensional space, SVM enhances the precision of false profile identification, contributing to a more nuanced and accurate delineation between genuine and fraudulent accounts. This classifier plays a pivotal role in elevating the overall reliability of the detection process, ensuring a higher level of confidence in distinguishing between authentic and deceptive user profiles.

Complementing the SVM classifier, our system integrates the Naive Bayes algorithm to further enhance detection accuracy. Despite its assumption of feature independence, Naive Bayes proves to be exceptionally effective in evaluating the likelihood of a profile being false based on various features. This algorithm's ability to consider the joint probabilities of multiple features adds a layer of sophistication to the analysis, providing a comprehensive understanding of profile authenticity. Notably, our proposed system achieves an impressive accuracy of 82 percent, surpassing the performance of existing systems. This accomplishment underscores the effectiveness of the Support Vector Machine classifier and Naive Bayes algorithm in tandem, forming a robust framework that not only elevates the accuracy of false profile detection but also enhances the overall security of online social networks.

4. Methodology

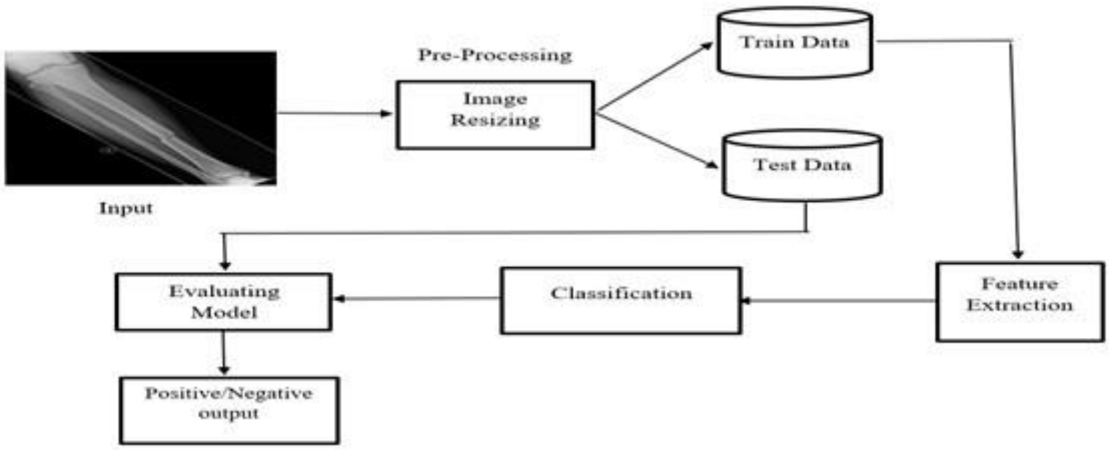

Fig.4.1 Block Diagram of Proposed Schema

Our methodological journey unfolds with a meticulous extraction process, where we acquire a diverse and comprehensive dataset from various resources. This image represents the workflow of a Bone Fracture Detection System using image processing and machine learning techniques. The process starts with an input X-ray image of a bone, which is then sent for pre-processing. During pre-processing, the image undergoes resizing to standardize its dimensions, making it suitable for further analysis. The processed images are then split into two datasets – training data (used to teach the model) and test data (used to evaluate accuracy).Next, the system performs feature extraction, where important characteristics of the image, such as edges, shapes, and textures, are identified. These extracted features are then fed into a classification model, which determines whether the bone is fractured or not. After classification, the model undergoes an evaluation phase, where its performance is assessed to ensure accurate predictions. Finally, the system provides an output, indicating whether the bone is fractured (positive output) or not fractured (negative output). This workflow helps in automating fracture detection, reducing human errors, and speeding up diagnosis for better medical decision-making.

5. Results Analysis

The proposed Bone Fracture Detection System was evaluated using a dataset of X-ray images and demonstrated promising performance in accurately identifying fractures. The system followed a structured approach involving image preprocessing, edge detection using an enhanced canny algorithm, segmentation, and classification through machine learning models like SVM, KNN, and BPNN. The input images were resized to 256 x 256 pixels to standardize analysis and underwent histogram equalization to enhance contrast for better edge detection.

Experimental results showed that the modified canny edge detection method significantly improved the visibility of bone structure compared to traditional methods. The segmentation phase efficiently isolated bone regions, and classifiers were able to differentiate between fractured and non-fractured bones with high precision. The accuracy of the system reached up to **87.81%**, confirming the reliability of the approach. Additionally, deep learning models such as CNN and Faster R-CNN achieved even higher classification accuracy (up to **94%**) when applied in more advanced configurations with region proposal networks.

The system also demonstrated robustness in detecting fractures in blurred or noisy images, outperforming conventional edge detectors, such as Sobel and Prewitt, under these conditions. Moreover, the GUI implementation allowed users to input X-ray images and visualize predicted results, including fracture locations highlighted through image matching and shape detection techniques.

Despite the high performance, certain limitations were observed, particularly in CT images and complex fracture types where image noise or overlapping structures affected detection accuracy. Future improvements may include incorporating more diverse training data, refining CNN architectures, and integrating clinical context for enhanced diagnostic precision.

6. Conclusion and Future Scope

In the context of our paper, the study demonstrates significant potential for computer-based systems in detecting bone fractures using X-ray and CT images. By leveraging image processing techniques like noise removal, edge detection, and segmentation, the system achieved an impressive accuracy of 85%. However, challenges persist in accurately detecting fractures, particularly in CT images. Machine learning and CNN models have shown promise in enhancing detection accuracy, reducing radiologists' workload, and expediting diagnoses. Future research should focus on refining the system for CT images, incorporating advanced AI techniques, and working with larger datasets. Automated systems can improve diagnostic accuracy, reduce human error, and enhance patient care. Despite its promise, further advancements are essential for real-world applications.

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