BONE FRACTURE DETECTION USING K-NEAREST NEIGHBOR CLASSIFIER

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ABSTRACT

Detecting bone fractures through digital image processing is an innovative approach that leverages the power of technology to enhance medical diagnostics. It is an application of image segmentation, is to extract anatomical structure from medical images. Segmentation, feature extraction and classification is to be done to improve the performance of the process. The proposed model takes the input from the dataset. The images from dataset are get resize then the segmentation is implemented by means of K-means Clustering, feature extraction is based on the Texture features and classification is based on k-nearest neighbor classifier. The efficiency and the accuracy of the proposed method are evaluated through testing images from the dataset Fracture Atlas.

Keyword: - *Segmentation, K-means Clustering, feature extraction, Classification, K-nearest neighbor classifier*

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1. INTRODUCTION

Detecting bone fractures through image processing is a fascinating intersection of medicine and technology. In this innovative approach, advanced imaging techniques, such as X-rays, are utilized to capture detailed images of the affected area. These digital images are then subjected to sophisticated image processing algorithms.
The process begins with the acquisition of high-resolution X-ray images, which serve as the input for the detection system.
Image processing techniques, including edge detection, segmentation, and pattern recognition, are applied to identify potential fractures. These algorithms can highlight abnormalities, allowing healthcare professionals to pinpoint the exact location and extent of the fracture.

2.EXISTING METHOD

General medical image segmentation methods can be classified into the following categories: thresholding, edge-based, region-based, classification-based, graph-based and deformable model.
In this process, threshold based segmentation is carried out to segment the bone region.

Thresholding is one of the basic segmentation techniques. Given an image I, thresholding method tries to find a threshold t such that pixels with intensity values greater than or equal to t are categorized into group 1, and the rest of the pixels into group 2.
Thresholding requires that the intensity of the image has a bimodal distribution. The algorithm can perform well on simple images with bimodal intensity distribution.
However, most of the medical images do not have bimodal distribution of intensity.

2.1 Disadvantages of Existing method

The major disadvantages of using The major disadvantages of using this segmentation is the accuracy of the process becomes reduced because due to the hard thresholding. In this system it doesn't provide particular information present in the image. As the data present in the image get reduced then the segmentation results will become degraded. It also provide poor classification results due to the reduction of data present in the image during segmentation.

3. PROPOSED METHOD

The proposed system in the passage aims to address the challenge of detecting fractures in bone X-ray images, which are not always easily discernible to the naked eye. The system employs digital image processing techniques, specifically segmentation using K-means clustering, to isolate and identify regions of potential fractures within the X-ray images.

3.1 Fracture Detection using Segmentation:

Segmentation is a fundamental technique in image processing that partitions an image into meaningful regions. In this system, the segmentation process is utilized to separate the bone structure from the background and identify potential fracture regions. K-means clustering, a popular unsupervised learning algorithm, is employed for this task. K-means clustering iteratively assigns pixels to clusters based on their similarity in feature space, thereby enabling the identification of distinct regions within the X-ray image.

3.2 Feature Extraction and Classification:

Once the potential fracture regions are identified through segmentation, the system extracts relevant features from these regions. Texture extraction techniques are employed to capture subtle patterns and characteristics indicative of fractures. Texture features could include measures such as co-occurrence matrices, local binary patterns, or Gabor filters, which capture variations in intensity and spatial distribution within the fracture region.

3.3 Classification using KNN Classifier:

After feature extraction, a classification algorithm is employed to distinguish between fractured and non-fractured regions. The K-nearest neighbors (KNN) classifier is proposed for this task. KNN is a simple yet effective algorithm that classifies an unknown instance based on the majority class of its nearest neighbors in the feature space. In this context, the KNN classifier utilizes the extracted texture features to classify each region within the X-ray image as either indicative of a fracture or not.

3.4 Efficiency and Accuracy:

The proposed algorithm aims to achieve both efficiency and accuracy in fracture detection. By leveraging segmentation and feature-based classification techniques, the system aims to accurately identify fracture regions while minimizing false positives. The efficiency of the algorithm is crucial for practical application in medical imaging systems, ensuring timely diagnosis and treatment of fractures.

4. DESIGN METHODOLOGY

The proposed system design flow starts with giving the X-ray image as an input to the system. The input image goes to the preprocessed step. Here, the system Preprocess the X-ray images to enhance their quality and prepare them for further analysis. This may involve techniques such as noise reduction, contrast enhancement, and image normalization to ensure consistency across the dataset. Then the preprocessed image get segmented by using the K-means clustering algorithm to segment the bone structures in the X-ray images. This step aims to isolate the regions of interest (ROI) containing potential fractures from the background. Extract texture features from the segmented regions using appropriate techniques gray-level co-occurrence matrices (GLCM). These features capture the unique patterns and characteristics associated with fractures.

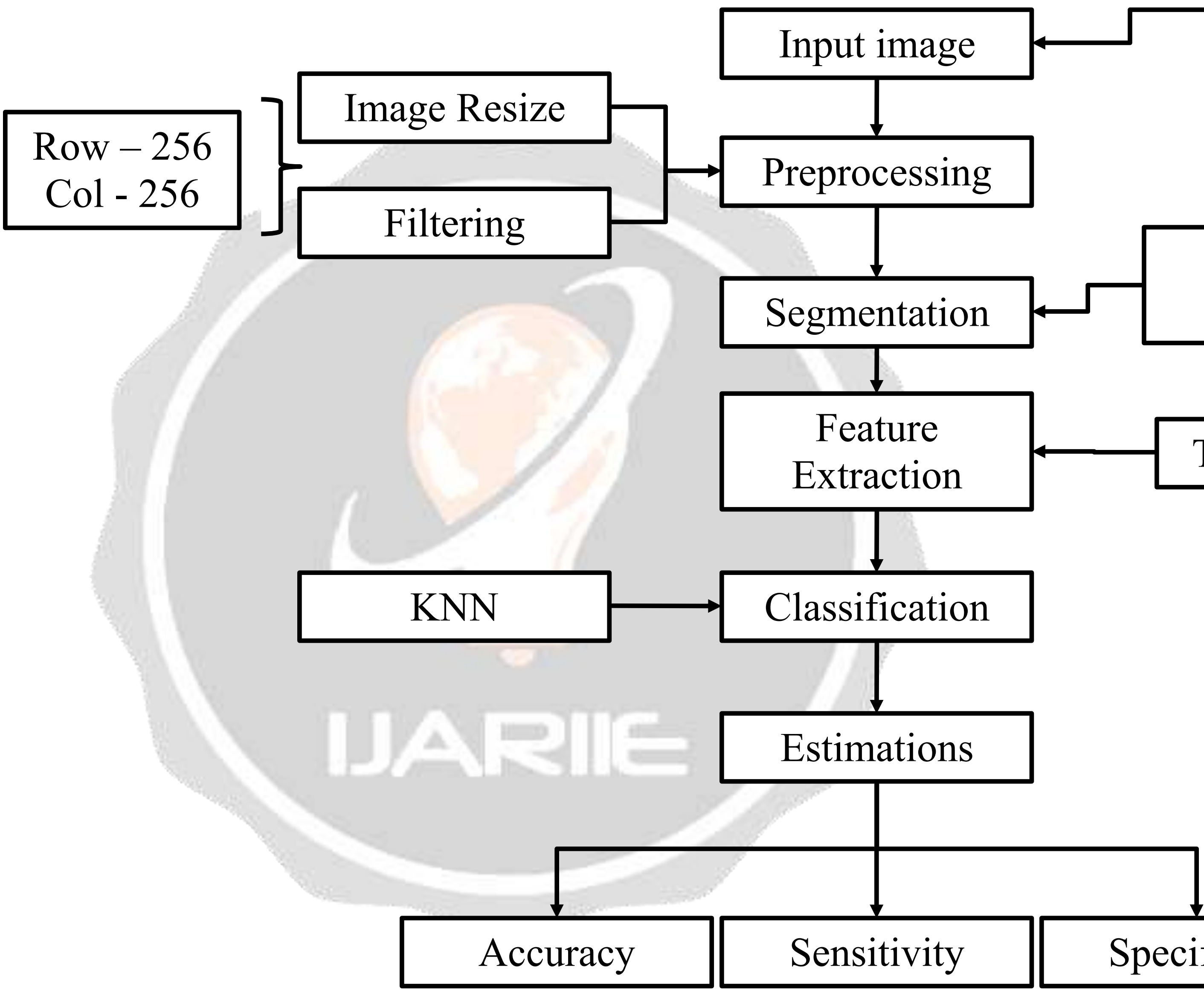


Fig 1: Flow diagram

5. Results

The input images which are holding for testing and training images with low resolution and noise. Previously the image is read and it undergoes preprocessing technique in which the RGB image is converted into grayscale to reduce the noise present in the image. Different image processing steps are involved in this proposed system which gives accurate results compared to the previous systems.

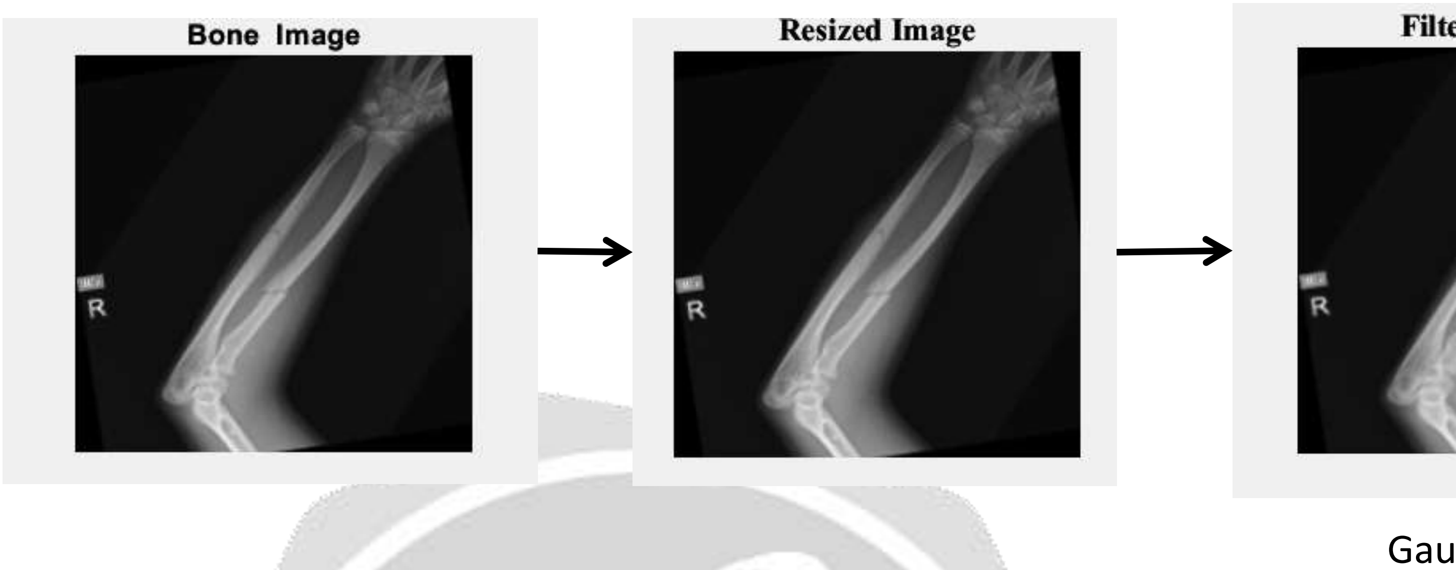


Fig 2: Preprocessed Result (image 1)

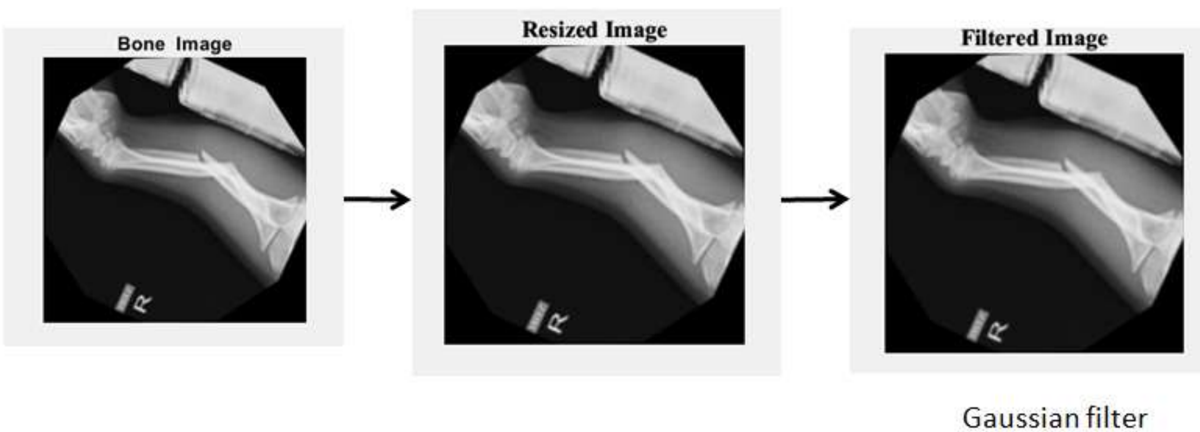


Fig 3: Preprocessed Result (image 2)

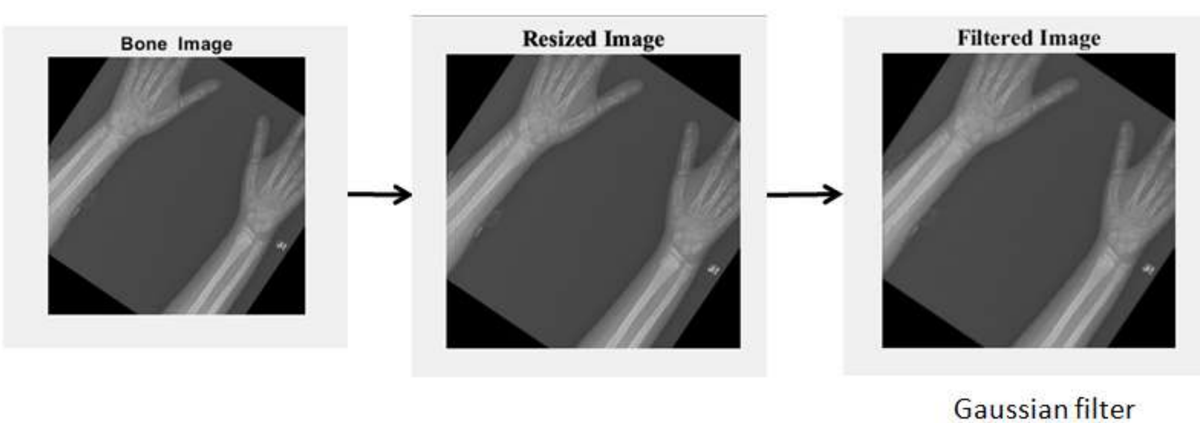


Fig 4: Preprocessed Result (image 3)

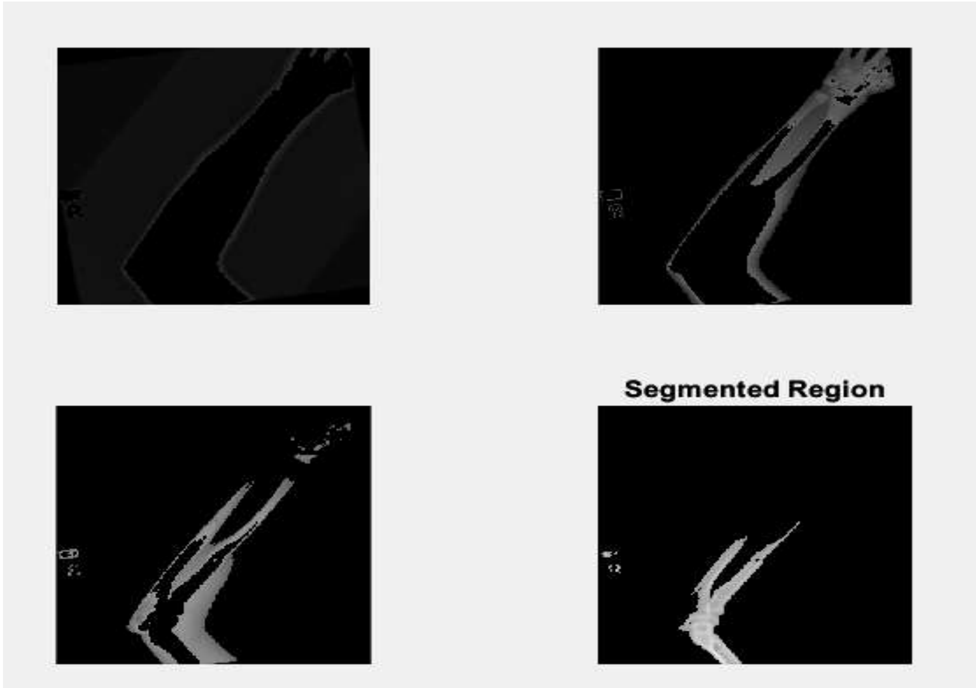


Fig 5: Segmentation Result (image 1)

Fig 6: Segmentation Result (image 2)

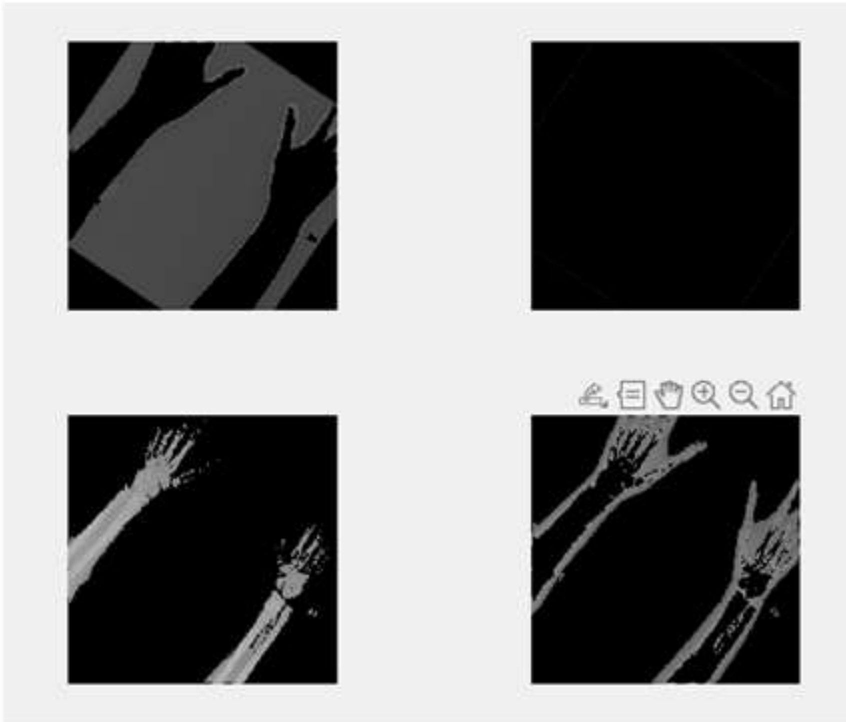
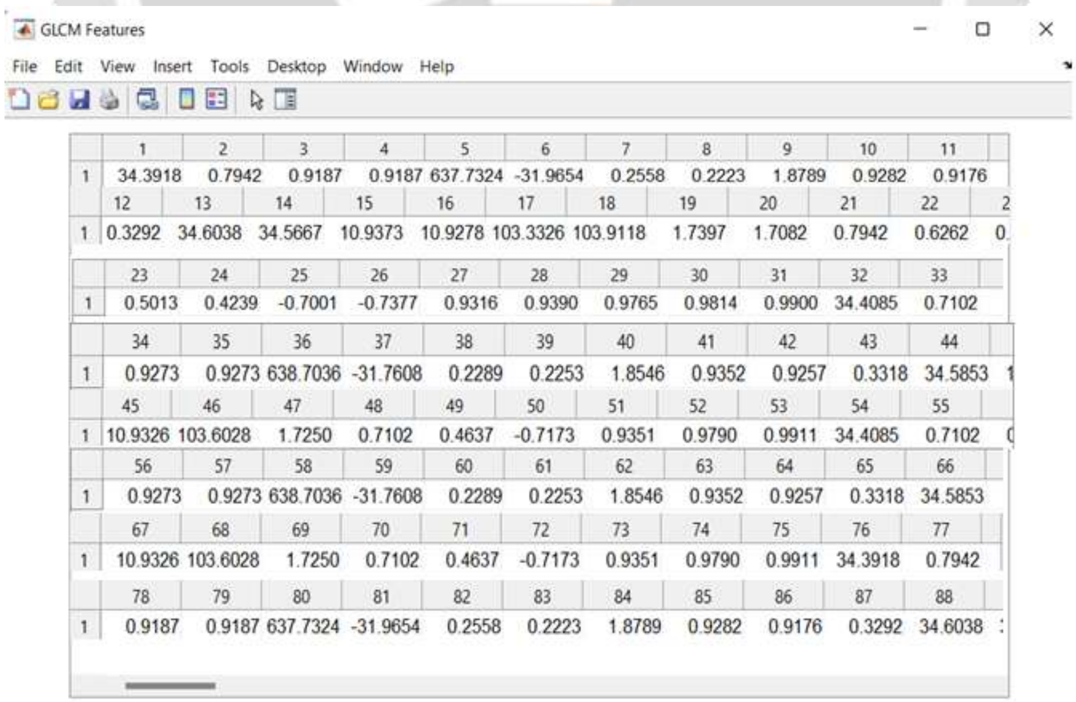


Fig 7: Segmentation Result (image 3)



GLCM Features

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	1	2	3	4	5	6	7	8	9	10	11
1	34.3918	0.7942	0.9187	0.9187	637.7324	-31.9654	0.2558	0.2223	1.8789	0.9282	0.9176

	12	13	14	15	16	17	18	19	20	21	22
1	0.3292	34.6038	34.5667	10.9373	10.9278	103.3326	103.9118	1.7397	1.7082	0.7942	0.6262

	23	24	25	26	27	28	29	30	31	32	33
1	0.5013	0.4239	-0.7001	-0.7377	0.9316	0.9390	0.9765	0.9814	0.9900	34.4085	0.7102

	34	35	36	37	38	39	40	41	42	43	44
1	0.9273	0.9273	638.7036	-31.7608	0.2289	0.2253	1.8546	0.9352	0.9257	0.3318	34.5853

	45	46	47	48	49	50	51	52	53	54	55
1	10.9326	103.6028	1.7250	0.7102	0.4637	-0.7173	0.9351	0.9790	0.9911	34.4085	0.7102

	56	57	58	59	60	61	62	63	64	65	66
1	0.9273	0.9273	638.7036	-31.7608	0.2289	0.2253	1.8546	0.9352	0.9257	0.3318	34.5853

	67	68	69	70	71	72	73	74	75	76	77
1	10.9326	103.6028	1.7250	0.7102	0.4637	-0.7173	0.9351	0.9790	0.9911	34.3918	0.7942

	78	79	80	81	82	83	84	85	86	87	88
1	0.9187	0.9187	637.7324	-31.9654	0.2558	0.2223	1.8789	0.9282	0.9176	0.3292	34.6038

Fig 8: Feature Extraction Result (GLCM features)

	Image 1	Image 2	Image 3
Accuracy	95.91	95.89	95.86
Sensitivity	91.75	90.72	90.60
Specificity	98.41	99.40	99.38
Jaccard coefficient	83.65	84.59	83.25
Fscore	90.89	91.44	90.69
Missed classification	4.08	4.08	4.13
precision	90.83	92.66	91.16
PI	95.12	95.11	95.03
FPVF	0.54	0.59	0.62
FNVF	8.24	9.27	9.39

Fig 9: Classification performance (Comparision between three images)

	Proposed
Accuracy	95.9630
Sensitivity	91.0066
Specificity	99.4341
Jaccard Coeff.	84.6565
Fscore	91.4303
MissedClassification	4.0370
precision	92.5000
Performance index	95.1963
FPVF	0.5659
FNVF	8.9934
Fractured/ Not Fractured	**Bone Fracture id detected**

Fig 10: Classification result

6. Conclusion

The study successfully demonstrates the potential of advanced image processing techniques, particularly K-means clustering and texture-based classification, in improving the accuracy of bone fracture detection in X-ray images. The high performance metrics indicate the reliability of the proposed algorithm, showcasing its potential as a valuable tool for healthcare professionals in diagnosing and assessing various types of bone fractures with a high degree of precision. This innovative intersection of medicine and technology holds promise for enhancing patient care and facilitating more effective treatment planning in the field orthopedics.

7. References

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