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Kidney Stone Detection Using Machine Learning

Naveen and Sandeep Kumar
M.Tech Scholar, Department of CSE
Assistant Professor, Department of CSE
CBS Group of Institutions, Village Fatehpuri, Jhajjar
raonaveen566@gmail.com

Abstract: *Ultrasound Imaging is a widely used non-invasive diagnostic technique for visualizing internal body structures such as kidneys, muscles, blood vessels, joints, and other organs. In kidney examination, ultrasound imaging plays a crucial role in determining kidney size, position, and structural abnormalities including the presence of stones, cysts, and infections. Early detection of kidney stones is highly beneficial for effective treatment planning and improved patient outcomes, reducing the need for invasive procedures and enhancing survival rates. Common treatment methods for kidney stones include surgical removal as well as ultrasound and laser lithotripsy.This study proposes an effective approach for removing speckle noise from kidney ultrasound images to enhance image clarity and improve diagnostic accuracy. The presence of speckle noise often reduces image quality and affects proper interpretation by radiologists. To overcome this issue, various preprocessing techniques such as spatial domain filtering and wavelet domain filtering are applied to both normal and abnormal kidney stone ultrasound images. The proposed method significantly improves image quality, making it easier to identify kidney stones and related abnormalities. The experimental results demonstrate a high classification and detection accuracy of up to 97.86%, indicating the effectiveness of the proposed approach in improving kidney stone diagnosis through enhanced ultrasound image processing*

Keywords: Kidney Stone, IDS, GA, Fuzzy Logic System

I. INTRODUCTION

The Urolithiasis is a standout amongst the most widely recognized scatters of the urinary tract. Such issue happens as a typical issue to each man & lady in Malaysia, because of nature of living. This stone named as renal calculi is a strong bit of material that frames in a kidney when pee turn out to be very thought. The extent of stone fluctuated from littler, medium & bigger size, according to determination, if in beginning times not analyzed, development is to higher. At point when extent of the stone is littler, it might pass alone, causing next to zero torment amid pee. A bigger stone may stall out along urinary tract (body seepage framework to remove the waste) and can obstruct the stream of pee, causing serious torment or dying. Urinary tract incorporates 2 kidneys, 2 ureters, a bladder, and a urethra.

Extracorporeal stun wave lithotripsy (ESWL) is the most widely recognized treatment for Urolithiasis. It utilizes centered stun waves to break the stones into pieces that can pass normally. Little stone sections in the renal pelvis have a decent shot of passing normally, yet pieces situated in the lower calyces are bound to remain. The leftover stone parts go about as cores for future stones, which causes high retreatment and low sans stone rates for lower shaft stones.

Follow-up careful administration of stones is perplexing and individualized however depends fundamentally on the assets accessible at the clinical, causes extra uneasiness, and opens the patient to numerous X-beams. In the event that stones or stone sections could be moved out of the lower post to the renal pelvis for treatment or to pass naturally, it would drastically diminish the quantity of retreatments a patient would get. A few scientists have moved toward this remaining stone pieces issue by attempting to prescreen life structures where lower post parts won't pass. Others have endeavored to move the stone through ureteroscopy, understanding reversal, percussion, or citrate. Sadly, these methodologies have had blended outcomes and are not normally utilized. In this manner, new advancements that can

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furnish precise stone identification with nonionizing-radiation and can decrease the stone repeat rate are seriously required.

Presently day, kidney illnesses have turned out to be more typical than any other time in recent memory & emerging all through world, particularly because of confusion of hypertension & diabetic mellitus [1]. Illnesses in kidney may advance to End organize renal malady (ESRD) which prompts need of Renal substitution treatment (RRT) &Hemodialysis just as kidney transplants [1]. In India just, as per 19th report of Indian Dialysis & Transplant Registry, recently enlisted dialysis patients keep on expanding, from 2375 out of 2002 to 5153 out of 2010, & in any event 5201 out of 2011 [2]. Medicines of ailments are life sparing, however request long haul duty at significant expense. Accordingly, other than concentrating on treatment itself, early counteractive action & discovery including pee test, blood test & imaging trial of kidney sicknesses ought to turn into need. Early identification of kidney illnesses permits increasingly viable & appropriate treatment to patient [3]. Much of time patients with beginning time of kidney infection can get treatment that can postpone or even avoid kidney harm. Furthermore, early treatment can likewise anticipate considerable lot of heart & vascular conditions, which may confuse kidney ailment [4]. Other than that, early identification of kidney malady can maintain strategic distance from further pointless biopsy & treatment sessions [5, 6].Currently, there are few sorts of tests that can be utilized to analyze kidney illness. Kidney capacity can be surveyed by performing blood & pee tests. Blood test is performed to check degree of waste result of blood urea nitrogen (BUN) [7] & creatinine [8, 9] while pee tests is performed to gauge degree of specific substances in pee, for example, protein [10, 11], ketones, glucose, blood, & different substances. Unnecessary measure of waste item in blood & related substance in pee show that level of kidney capacity has decreased [7-11].

Other than that, so as to analyze any clutters that influence particular veins of kidney, kidney biopsy, technique for examining little segment of kidney tissue, is performed. Furthermore, imaging tests including Ultrasound (US) [16-19], Intravenous Pyelogram (IVP), Computed Tomography (CT) [12-15] & Magnetic Resonance Imaging (MRI) [23] outputs are performed to get valuable data about kidney shape, size, & structure.

II. RESEARCH METHODOLOGY

2.1 Image Acquisition

In this stage, medical images are collected using various imaging modalities. Both invasive and non-invasive screening techniques are used for the detection and analysis of kidney-related diseases. These imaging methods are highly useful for identifying abnormalities and supporting clinical diagnosis. Invasive techniques may also be used for detailed examination and classification purposes in complex cases.

2.2 Pre-processing

Pre-processing focuses on improving image quality and enhancing the interpretability of acquired medical images by reducing noise, distortions, and unwanted artifacts. It includes image enhancement and smoothing techniques applied in both spatial and frequency domains. Common methods include histogram equalization for contrast enhancement, Gaussian filtering, median filtering, Gabor filtering, and disk filtering. Other techniques such as principal component analysis (PCA), background thresholding, isotropic resampling, erosion-dilation operations, and edge-preserving smoothing are also used. These methods help in improving image clarity and preparing data for further analysis by removing noise and enhancing important structural details.

2.3 Segmentation Phase

Image segmentation involves dividing the medical image into meaningful regions or objects of interest, separating kidney structures from surrounding tissues. This step is essential for identifying abnormalities and plays a key role in detecting kidney-related diseases. Segmentation assigns each pixel to a specific class, improving accuracy, reliability, and computational efficiency. Common methods include thresholding, fuzzy clustering, K-means clustering, watershed segmentation, region growing, deformable models, morphological operations, and edge-based techniques. These approaches help isolate kidney regions and detect possible abnormalities such as tumors or stones with higher precision.

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2.4 Post-processing

Post-processing techniques are applied after segmentation to enhance image quality and improve clarity. These methods may also be integrated with segmentation in some approaches. Techniques such as connected component labeling, morphological operations, PCA-based refinement, seed point detection, cluster merging, and Markov random field models are used. Additional methods like canny edge detection, appearance-based registration, and volume estimation help refine boundaries, remove noise, and recover missing or overlapping regions in kidney images.

2.5 Feature Extraction and Selection

Feature extraction involves identifying significant characteristics from segmented kidney images that represent specific disease patterns. These features are crucial for accurate classification and diagnosis. Common extracted features include shape-based parameters such as area, length, width, radius, and eccentricity, as well as texture-based features like energy, mean, and standard deviation. Morphological and spatial histogram features are also used. After extraction, relevant features with high discriminative power are selected, while irrelevant features are removed to improve classification accuracy and reduce computational complexity.

III. RESULT ANALYSIS

In this section, we have to discuss the result analysis of kidney stone as pre-processing and inverted kidney image. The fuzzy segment tumor images are analyzed in the same section.

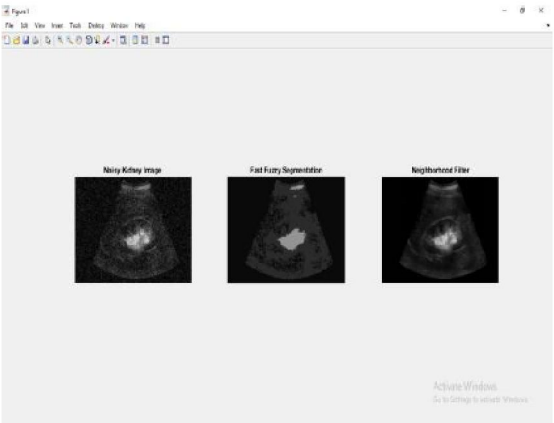

Fig 4 Comparative Analysis of Noisy Kidney Image, Fast Fuzzy Segmentation and Neighborhood Filter

Comparative Analysis of Noisy Kidney Image, Fast Fuzzy Segmentation and Neighborhood Filter is shown in figure 4. In this, preprocessing of image occur by the removal of noise from the image. Then image is segmented with fast fuzzy technique. In this process, segmentation is done using membership function. The removal of noise is done using neighborhood filter.

Small Tumor Regions found in Image is shown in fig 5. Similarly, Fuzzy Segmented Tumors is shown in fig 6. Comparative Analysis of different methods are shown in the figure 5.7. In the previous method, PSO, GA and SVM are analyzed with accuracy 89.650 %. From last decade of years K-NN with GA and GC PSO technique is analyzed. Since the accuracy K-NN with and GC –PSO is 90 % and 95.81 % respectively. The accuracy of detection of kidney stone is 97.46 % using proposed fast fuzzy algorithm

IV. CONCLUSION

The proposed smart system detects and classifies multiple kidney disorders such as stones and tumors. This work can detect other abnormalities in different parts of the human body. In the future, CT, MRI, PET scans can be used with the existing US scans by forming a multi-modality imaging model with better diagnostic capabilities. The following observations of proposed algorithm that Mean square error of Image is 1.93. True positive rate and true negative rate of

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proposed fast fuzzy algorithm is 95.5 and 99.99 % respectively False positive rate and false negative rate of proposed fast fuzzy algorithm is 0.01 and 6.12 % respectively. The overall accuracy of proposed fast fuzzy algorithm is achieved upto 97.86 %.

REFERENCES

[1]. M K Shahina , Hema. S. Mahesh "Renal Stone Detection and Analysis by Contour Based Algorithm" 2019 International Conference on Recent Advances in Energy-efficient Computing and Communication (ICRAECC) , pp 147-158 , March 2019.
[2]. Nilar Thein , Kazuhiko Hamamoto, Hanung Adi Nugroho "A comparison of three preprocessing techniques for KS segmentation in CT scan images "11th Biomedical Engineering International Conference (BMEiCON) , pp 78-86 , July 2018.
[3]. Kaplan, Adam G., et al. "How Do I Set Up a Stone Clinic?." Practical Tips in Urology. Springer London, 2017. 333-339.
[4]. Morrison, Jeffrey C., et al. "Use of Ultrasound in Pediatric Renal Stone Diagnosis and Surgery." Current Urology Reports 18.3 (2017): 22.
[5]. Ibrahim, El-Sayed H., et al. "Detection of different kidney stone types: an ex vivo comparison of ultrashort echo time MRI to reference standard CT." Clinical imaging 40.1 (2016): 90-95.
[6]. Ganesan, Vishnu, et al. "Accuracy of ultrasonography for renal stone detection and size determination: is it good enough for management decisions?." Bju international (2016).
[7]. Viswanath, K., and R. Gunasundari. "VLSI Implementation and Analysis of Kidney Stone Detection from Ultrasound Image by Level Set Segmentation and MLP-BP ANN Classification." Artificial Intelligence and Evolutionary Computations in Engineering Systems. Springer India, 2016. 209-227.
[8]. Brisbane, Wayne, Michael R. Bailey, and Mathew D. Sorensen. "An overview of kidney stone imaging techniques." Nature Reviews Urology (2016).
[9]. Kaya, Coskun, et al. "Relationship between Twinkle Artefacts and in vivo Biochemical Composition of Kidney Stones." Urologiainternationalis 96.2 (2016): 212-216.
[10]. Navratnam, Sujata, Siti Fazilah Valliappan Raman, and Sundresan Perumal. "Proposed Seed Pixel Region Growing Segmentation and Artificial Neural Network Classifier for Detecting the Renal Calculi in Ultrasound Images for Urologist Decisions." International Journal of Computer Science Issues (IJCSI) 13.5 (2016): 62.
[11]. Bakin, Salinawati, et al. "Accuracy of ultrasound versus computed tomography urogram in detecting urinary tract calculi." Medical Journal of Malaysia 70.4 (2015): 238-242.
[12]. Andrabi, Yasir, et al. "Advances in CT imaging for urolithiasis." Indian journal of urology: IJU: journal of the Urological Society of India 31.3 (2015): 185.
[13]. Moore, Christopher L., et al. "Accuracy of reduced-dose computed tomography for ureteral stones in emergency department patients." Annals of emergency medicine 65.2 (2015): 189-198.
[14]. Mansouri, Mohammad, et al. "Dual-energy computed tomography characterization of urinary calculi: basic principles, applications and concerns." Current problems in diagnostic radiology 44.6 (2015): 496-500.
[15]. Viswanath, Kalannagari, and Ramalingam Gunasundari. "Design and analysis performance of kidney stone detection from ultrasound image by level set segmentation and ANN classification." Advances in Computing, Communications and Informatics (ICACCI, 2014 International Conference on. IEEE, 2014.
[16]. Cunitz, Bryan, et al. "Improved detection of kidney stones using an optimized Doppler imaging sequence." Ultrasonics Symposium (IUS), 2014 IEEE International. IEEE, 2014