جامعة الجلالة
GALALA UNIVERSITY

Kidney Stone Detection

Advanced Image & Video Processing Pipeline for Medical Analysis

CSE281 || Digital Image Processing

Under supervision of: ***Prof. Gamal Fahmy***

Project Team members

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➢ Introduction and related work:

Detecting the presence of stone in a kidney using image processing techniques;

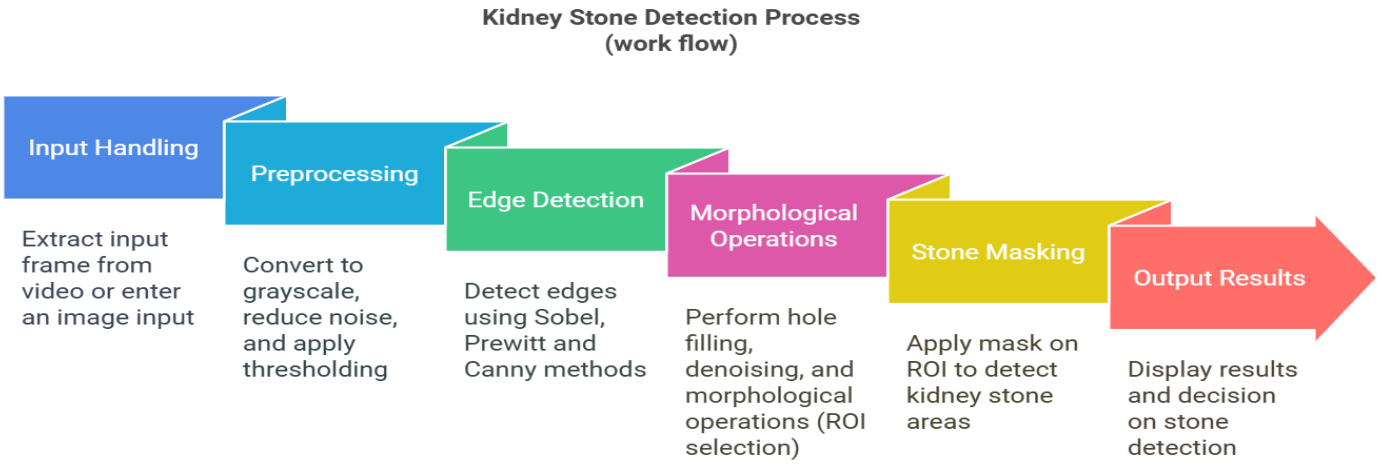
- Kidney stones are one of the most common urological disorders affecting millions worldwide. Early detection of kidney stones is crucial for effective treatment and prevention of complications. Traditionally, medical imaging techniques such as ultrasound, CT scans, and X-rays are used by radiologists to identify kidney stones. However, manual analysis of these images can be time-consuming and prone to human error.
- Recent developments in digital image processing have facilitated automated techniques for the detection of kidney stones. This can lead to better accuracy, efficiency and workflow automation, with the use of techniques like image segmentation, noise reduction, edge detection and morphological operations. Extract from Introduction of this paper shows that machine learning and image enhancement methods have previously been utilized to enhance detection algorithms predicted sensitivity and specificity.

➢ Proposal:

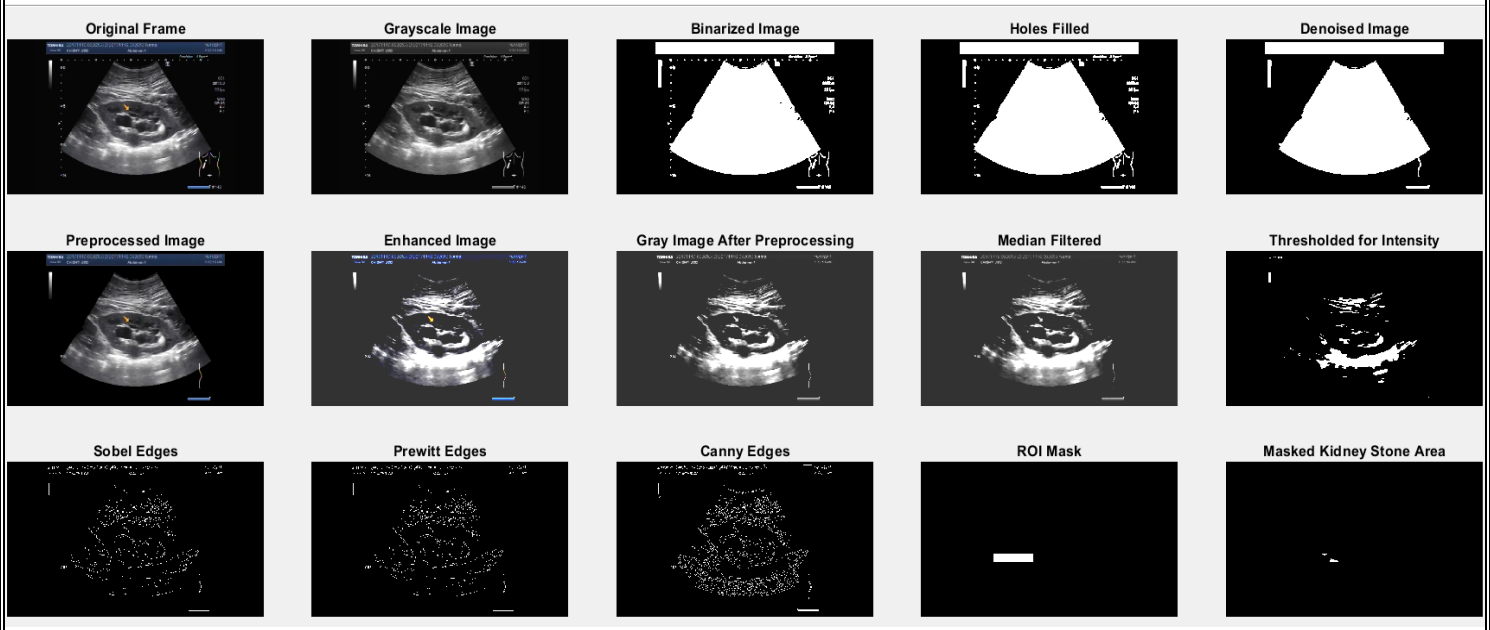
The proposed system is designed to automatically detect kidney stones in medical ultrasound images or video frames. The system employs a structured image processing pipeline that includes the following steps:

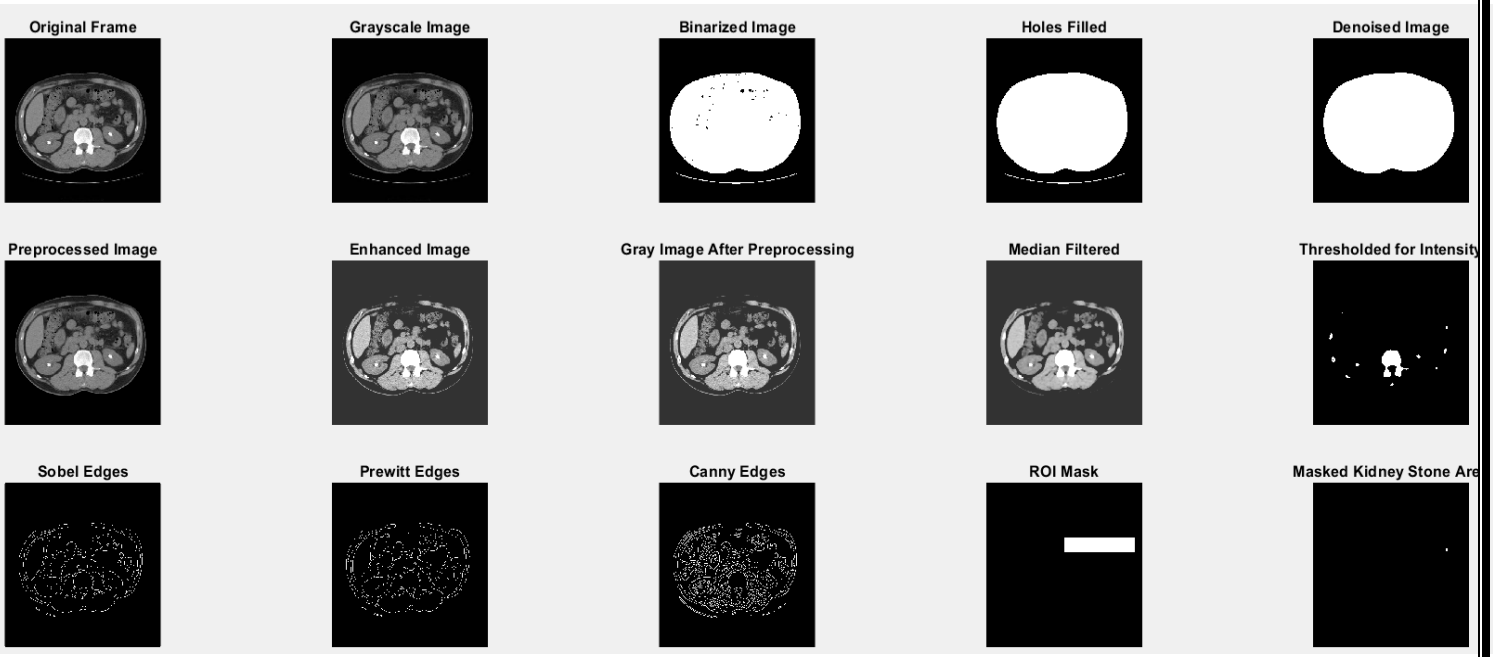
1. **Input Handling:** Support for both static images and video files, enabling real-time frame extraction and processing.
2. **Preprocessing:** Conversion to grayscale, noise reduction using median filtering, and intensity-based thresholding.
3. **Edge Detection:** Application of Sobel, Prewitt, and Canny edge detection methods to enhance boundaries of the stones.
4. **Morphological Operations:** Filling holes, removing unwanted noise, and identifying regions of interest (ROIs).
5. **Kidney Stone Masking:** Segmentation of the kidney stone area using ROI selection and masking techniques.
6. **Output Results:** Displaying intermediate processing steps and indicating the presence or absence of stones.
7. **Contrast Enhancement:** Applying custom enhancement techniques to improve visibility in various intensity ranges.

➢ System Analysis and Design (Kidney-Stone-Detection Process):



➢ ***Results and Output:***





Command Window

```
Stone is Detected in the kidney
>>
```

Command Window

```
No Stone is detected in the kidney
>>
```

➢ Conclusion:

An automated kidney stone detection system using MATLAB enhances diagnostic accuracy, reduces radiologist workload, and improves patient outcomes. Its adaptability and research value contribute significantly to medical image analysis.

➢ References:

1. International Journal of Advanced Research: IJARCCE.2023.12577.pdf
2. Kidney-Stone-Detection system: GitHub – Srilekha 09/Kidney_stone_detection_using_matlab
3. Dougherty, G. (2009). Digital Image Processing for Medical Applications. Cambridge University Press.
4. Gonzalez, R. C., & Woods, R. E. (2018). Digital Image Processing. Pearson.
5. Current Trends in Kidney Stone Detection Using Image Processing Techniques: A Comprehensive Survey. Journal of Medical Imaging and Health Informatics, 2021.
6. MATLAB Documentation. (n.d.). Image Processing Toolbox. Retrieved from: MathWorks - Solutions - MATLAB & Simulink