

**SUBMITTED by**:

**NAME**: Aarthi Nayak ULLAL

**USN**: ENG22EC0001

**CLASS**: ECE-A1

**COURSE**: Skill Enhancement COURSE-1

**TOPIC**: MATLAB MINI PROJECT:

KIDNEY STONE DETECTION USING MATLAB

**SUBMITTED to**:

DR.SHIRSENDU ROY

**ABSTRACT**

Nowadays, kidney stone has become a major problem and if not detected at an early Stage, then it may cause complications and sometimes surgery is also needed to remove the stone. This study presents an ultrasound speckle suppression method to detect the stones in the human kidney. An initial image is first improved using image enhancement techniques, which are used to change the image’s intensities. Next, median filters smooth the picture and eliminate noise. Pre-processed images are segmented using a thresholding technique. The suggested approach locates stones using location coordinates. The suggested scheme has been assessed by different performance measuring parameters. Physicians are likely to benefit from the research in terms of clinical diagnosis and educational training. Based on 30 test cases, the proposed plan was correct 96%

**INTRODUCTION**

Kidney stone disease is one of the major life-threatening ailments persisting worldwide. Kidney stone, also known as a renal calculus is a solid piece of material which is formed in the kidneys from minerals in urine. Kidney stones typically leave the body in the urine stream, and a small stone may pass without causing symptoms. The stone diseases remain unnoticed in the initial stage, which in turn damages the kidney as they develop. Since kidney malfunctioning can be menacing, diagnosis of the problem in the initial stages is advisable. Ultrasound image is one of the currently available methods with non-invasive low cost and widely used imaging techniques for analysing kidney diseases Digital Image Processing means processing digital image by means of a digital computer. Digital image processing deals with manipulation of digital images through a digital computer. The input of that system is a digital image and the system process that image using efficient algorithms, and gives an image as an output

Image processing mainly include the following steps:

1. Importing the image via image acquisition tools.

2. Analysing and manipulating the image.

3. Output in which result can be altered image or a report which is based on analysing that image

**I.TYPES OF KIDNEY STONE DETECTION**

These may include:

1. **Blood testing**: Blood tests may reveal too much calcium or uric acid in your blood. Blood test results help monitor the health of your kidney.

2. **Urine testing**: The 24-hour urine collection test may show that you're excreting too many stone-forming minerals or too few stone-preventing substances.

3. **Imaging**: Imaging tests may show kidney stones in your urinary tract. Options range from simple abdominal X Rays, which can miss small kidney stones.

4. **Analysis of passed stones**: You may be asked to urinate through a strainer to catch stones that you pass. Lab analysis will reveal the makeup of your kidney

**METHODOLOGY**

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It is divided into 4 modules namely

1. Image pre-processing

2. Image segmentation

3. Wavelet processing

4. Detection by morphological analysis

**1. IMAGE PRE-PROCESSING:**

As the ultrasound consists of speckle noise and is of low contrast pre-processing needs to be done. Pre-processing involves Image restoration, Smoothing & sharpening, Contrast enhancement. Pre-processing is a common name for operations with images at the lowest level of abstraction both input and output are intensity images [2]. The means associated with preprocessing of Ultrasound image, which are as follows:

a. Image restoration

b. Smoothing and sharpening

c. Contrast enhancement

**a. IMAGE RESTORATION**

Image restoration is intended to mitigate the debasement of the Ultrasound image. Corruption might be because of movement obscureness, commotion, and camera misfocus. The principal motivation behind picture rebuilding is to decrease the corruptions that are caused during securing of Ultrasound examining [3].

**b. SMOOTHENING AND SHARPENING**:

Smoothing and honing capacity utilize the pixels in a N x N neighbourhood about every pixel to adjust an image. For both smoothing and honing channels the bigger the N x N neighbourhood the more grounded the smoothing or honing impact. The entirety of the smoothing and honing channels can be utilized with layers, mix modes, darkness, and covers to build their helpfulness [4].

**c. CONTRAST ENHANCEMENT:**

The goal of image enhancement is to slow down the deterioration of the ultrasound image that occurs during scanning acquisition. Noise, blurring, and camera misfocus can all cause degradation. The level set function is employed in this system to ensure proper orientation. It is under the image preprocessing step. The average intensity in the small neighbourhood is f (m, n), and the median is ϑ (m, n), then the evolution between max, 0 (p) and min, 0 (p)



**SEGMENTATION**

In digital image processing and computer vision, image segmentation is the process of partitioning a digital image into multiple segments. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics .

**3. WAVELET PROCESSING**

Wavelet transforms are a mathematical means for performing signal analysis when signal frequency varies over time. Wavelets are commonly used in image processing to detect and filter white Gaussian noise, due to their high contrast of neighbouring pixel intensity values. Using these wavelets, a wavelet transformation is performed on the two-dimensional image. In this project, the segmented image from the input is made to undergo wavelet transform to get a compressed image .

**4. DETECTION BY MORPHOLOGICAL ANALYSIS**

Morphological procedures are used to process images based on their forms when organizing elements. It removes unnecessary information (pixels) from the outer part of the region of interest during processing. (MA) is a method for identifying, structuring and investing the total set of possible relationships contained in a given image .

**Materials and Methods**

Study setting of proposed work is done in our university. The number of groups identified for the study is 2. The group 1 is median filter and group 2 is rank filter. Matlab 2014a tool kit will be used to write the code and simulate. Using matlab accuracy and sensitivity has been calculated for the required algorithm and then results have been compared. Sample size per group is 114 (Kane, Phar, and BCPS n.d.). Median filter and rank filter are explained below. SPSS software has been used to compare the results and to find the graph. The pre-test analysis has done with p-value with 0.8 (gpower 80%).

**Median filter and Rank filter algorithm**

* Accuracy and sensitivity of the rank filter are analyzed by varying different ultrasound images
* in the MATLAB simulation tool. Matlab (2014a) will be used for simulation with required add-ons
* installed, these are predefined functions in the matlab for the image processing. Open matlab software
* and open a new m.file. Write the code for the rank filter and save the file in the desired location. Store
* the input images in the location using the rank filter algorithm. Then extract kidney images and find
* the stone in the ultrasound image. After processing the code the output image will be displayed in the
* command window and repeat the experiment for different kidney ultrasound images and get the
* output and find the detection rate using the formula. Kidney stone ultrasound images are taken as
* input images which are independent variables. Accuracy and sensitivity will be as output variables.
* By comparing the results a better algorithm has been decided. Detection rate of the algorithms will be
* calculated using the formula.
* Detection rate = (No. of output images/Total input images)\*100

**MATLAB CODE:**

clc

clear all

close all

warning off

[filename,pathname]=uigetfile('\*.\*','Pick a MATLAB code file');

filename=strcat(pathname,filename);

a=imread(filename);

imshow(a);

b=rgb2gray(a);

figure;

imshow(b);

impixelinfo;

c=b>20;

figure;

imshow(c);

d=imfill(c,'holes');

figure;

imshow(d);

e=bwareaopen(d,1000);

figure;

imshow(e);

PreprocessedImage=uint8(double(a).\*repmat(e,[1 1 3]));

figure;

imshow(PreprocessedImage);

PreprocessedImage=imadjust(PreprocessedImage,[0.3 0.7],[])+50;

figure;

imshow(PreprocessedImage);

uo=rgb2gray(PreprocessedImage);

figure;

imshow(uo);

mo=medfilt2(uo,[5 5]);

figure;

imshow(mo);

po=mo>250;

figure;

imshow(po);

[r c m]=size(po);

x1=r/2;

y1=c/3;

row=[x1 x1+200 x1+200 x1];

col=[y1 y1 y1+40 y1+40];

BW=roipoly(po,row,col);

figure;

imshow(BW);

k=po.\*double(BW);

figure;

imshow(k);

M=bwareaopen(k,4);

[ya number]=bwlabel(M);

if(number>=1)

disp('Stone is Detected');

else

disp('No Stone is detected');

end

**5. PROCESSED IMAGE**

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**Ultrasound Image Preprocessed Image**

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**Image Segmentation**

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**Wavelet Processing**

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**Final Output**

**III. RESULT**

To carry out the proposed analysis, the framework first examines images of ultrasound scans of patients with stones in MATLAB 2017b platform. After that, we create the organizing component before moving on to the rest of the procedure. The final outcomes of the suggested scheme are shown in figure 3, which are produced using the methodology mentioned earlier. In addition, the comparative analysis of the proposed work and three baseline schemes It has been observed that our scheme performs better compared to other existing schemes after 7th iteration. The final output shows the shape and location of the stone inside the kidney. Final output with possible two detected stones in image.

**IV. CONCLUSION**

In this project, the survey of different algorithms and classifications are analyzed followed by the detection of stone present in the kidney. From this implementation, the existing system limitations are inferred and a new design is proposed to address the limitations such as level set techniques require considerable thought in order to construct velocities to get a perfect advanced level set function. This means there should be a huge amount of data available to get the accuracy rate which is sometimes not possible. We planned to rectify these issues using Median filters that give a clear indication of difference in the energy levels compared to that of normal kidney image if there is stone. By using image Processing, we obtained an accuracy of 96%.

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