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# Renal Stone Detection and Analysis Using Image Processing

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**ABSTRACT:**Ultrasound imaging is one of the available imaging techniques used for the diagnosis of kidney abnormalities. The detection of kidney stones using ultrasound imaging is a highly challenging task as they are of low contrast and contain speckle noise. This challenge is overcome by employing suitable image processing techniques. This paper presents a technique for the detection of kidney stones through different steps of image processing. The first step is image pre-processing. Image enhancement is a part of pre-processing that is used to enhance the image. Next, image segmentation is performed on the pre-processed image using the thresholding technique. Finally, the segmented images are analysed to detect the location of the stone. Here we are investigating a novel technique that can be used for the detection of kidney stones and convert the detected kidney stones information text to speech which is audible in the speaker.

**KEYWORDS:** Ultrasound Imaging, Imaging Techniques, kidney stones, Image Processing.

## I. INTRODUCTION

Digital Image Processing means processing digital images through a digital computer. We can also say that it is a use of computer algorithms, to get an enhanced image or to extract some useful information. Digital image processing deals with the manipulation of digital images through a digital computer. It is a subfield of signals and systems but focuses particularly on images. DIP focuses on developing a computer system that can perform processing on an image. 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.

Almost in every field, digital image processing puts a live effect on things and is growing with time to time and with new technologies. This led us to think differently and made us to research in medical stream. By this we got to know about kidney stones and its effects when it is not cured in early stage it may lead to surgery. We all have a saying "Prevention is better than cure," when stones are identified we can cure them without further delay in process.

## II. RELATED WORK

Image acquisition in this paper, the 1300 images were taken in the experimental plot on the north campus of Northwest A&F University, May to July 2013; they were taken in different light conditions (sunny, cloudy), periods, and plots; they were collected by manual collection. Also, the camera was fixed on the console. The image size is 4208/3120 and the format is JPEG. The selection of colour space: Colour is an important characteristic of plant identification. Because the images in this paper were under different light conditions, which can be easily affected by many environmental factors, therefore, to identify crops and guarantee more accurately. The accuracy of the identification algorithm and appropriate colour feature vector selection are critical and a suitable colour space is a prerequisite.

The accuracy of the identification algorithm and appropriate colour feature vector selection is critical and a suitable colour space is a prerequisite. The model uses the coordinate system or subspace to describe colours. At present, the most used colour space models are RGB, HSI, and YCrCb. For the RGB colour space model, all sorts of colours are

gotten by R (red), G (green), and B (blue) three colour channels transformation and mutual superposition. All colours that humans can perceive can be expressed by the colour space model the three-color channels are highly correlated, and are more sensitive to changes in lightness. Identification of the centre line of crop rows at present, line detection algorithms mainly include Hough transform and perspective method. Hough transform uses the duality of point-line after transforming the line in the original images space coordinate system into the points in the parameter space and then accumulating and counting all the possible points that fall on the boundary line to finally complete the detection task.

By using the global feature of an image, the robustness of the Hough transformation is strong, but the statistical calculation is taken in its parameter space with larger calculations and longer processing time. Perspective mainly uses the character of crops in the images plane to converge a point to obtain a perspective point, which can be the access to the centre line of crop rows Although this method can be accurately positioned to images that contain incomplete crop rows when dealing with the edge of the farm images, it cannot accurately calculate the position of the crop rows because the length of the crop line is insufficient. Aiming at the shortcomings of above-line detection algorithms, this paper combined the vertical projection method and linear scanning method, firstly vertical projection method was used to obtain the number and scope of the crop rows, then the image's bottom and top pixels were taken as two endpoints of a line, by moving the location of the endpoint to obtain different lines, then selected the line which contains the whitest pixels as the centre line of crop rows.

#### Vertical projection method:

Projection is mainly detection based on projection distribution features in some direction, and the projection direction should be horizontal, vertical, diagonal, and so on. It is often used for binary. Image segmentation and image analysis. Provided binary image between  $(i, j)$ , the size of the image is  $H$ , where, denote the width of images, denote the height of images, let  $(i)$  denote all the non-zero pixels of the column in the horizontal projection direction; let  $(j)$  denote all the non-zero pixels of throw in the vertical projection direction.

Because of the shooting angle and distance in the processing of acquisition images, the crop rows often intersect at the top or outside of the top images, therefore, this method cannot be taken to Process images directly. Assuming that there is a horizontal rectangle area in the bottom and top images, crop rows, and horizontal rectangular area will intersect. Therefore, the distribution of crop rows at the top of images and the bottom of images could be obtained by using vertical projection in a horizontal rectangle area. In this paper, firstly  $W/50$  size of the horizontal rectangular area was selected at the top and bottom of the images respectively. Then vertical projection within the horizontal rectangle area was used to obtain the distribution scope of the crop rows. Horizontal rectangular area and vertical projection.

#### Linear scanning algorithm

Firstly, suppose the size of the image is  $W/H$ . Then, the number of crop rows and the scope of each crop row were got through the vertical projection method denoted the number of the crop rows,  $P_iTL$  denoted the left top boundary of  $I$  column of crop rows,  $P_iTR$  denoted the right top boundary of  $I$  column of crop rows,  $P_iBL$  denoted the left bottom boundary of  $I$  column of crop rows,

- $P_iBR$  denoted the right bottom boundary of the  $I$  column of crop rows.
- Linear scanning algorithm flow chart
- Extraction of Weeds Infestation Rate
- Division of grid cells

To further calculate weeds coverage area and crop coverage area within the cells, farmland images should be divided into cells. The vertical line of grid cells can be obtained. Namely, the farmland images can be divided into grid shape by centre lines of crop rows. Horizontal lines of the grid cells were divided according to the traveling speed of agricultural machinery. The speed of the tractor is about 18 Km/h, namely 5 m/s.

Calculation and modification of the classic Weed's Infestation Rate Some factors like sowing omitting, jitter, and centre-lined deviation often led to the heterogeneous spatial distribution of weeds in the farmland. What's more, the irregular distribution of the crops and the similar spectral signature (colour) between crops and weeds will make weed detection a difficult task. Domestic and foreign scholars had made a lot of research on the parameter of WIR, for instance, used corn farmland as a research object, and put forward the classic WIR, which uses a vector  $X!$  To represent two components;  $\sim X_1$  is weeds coverage;  $\sim X_2$  is weeds threat.

### III.LITERATURE REVIEW

[1] **A.Sohgaura and P.Bigoniya:** Renal calculi are crystalline structures of calcium oxalate with associated risk factors like dehydration, a high-fat diet, animal protein, high salt intake, and obesity. Crystals form in the distal tubule, nephron loop, and/or collecting tubule and have symptoms of severe pain and renal colic. Nephrolithiasis is a global problem affecting all geographical regions. This study compiles the epidemiology of renal calculi focusing on prevalence, occurrence, and re-occurrence rate from a global perspective. Literature on nephrolithiasis prevalence has been reviewed in Europe, Canada, America, East Asia, the Gulf region, Japan, China, and different parts of India. The etiology of nephrolithiasis was reviewed in detail for types, factors, symptoms, promoters, and inhibitors.

Renal calculi induction and progression mechanism were discussed with the pathophysiology involved. Understanding the pathophysiology of this disorder is necessary. chronic kidney dysfunction, bone loss, and fractures, increased risk of coronary artery disease, hypertension, type 2 diabetes mellitus, etc., and understanding the pathophysiology are necessary to develop highly effective drugs.

**Summary:** A Review on Epidemiology and Etiology of Renal Stone

Am.J. Drug Discov. Dev., vol. 7, no. 2, pp. 5462, 2017.

[2] **W. Wang et al.:** The data on the prevalence of kidney stones in mainland China are still lacking. We performed the present meta-analysis to assess the stone prevalence in mainland China from 1990 through 2016. A total of 18 articles were included. The pooled overall prevalence was 7.54% (95% CI, 5.94-9.15). The prevalence in age groups of <20 years, 20-29 years, 30-39 years, 40-49 years, 50-59 years, and 60 years and older was 0.27%, 3.15%, 5.96%, 8.18%, 9.14%, and 9.68%, respectively, showing that it increased with age. Moreover, the prevalence was 10.34% in males and 6.62% in females, with an odds ratio (OR) of 1.63 [95% CI: 1.51-1.76], indicating that males are more likely to suffer from this disease than females. However, urban areas (6.03%, 95% CI: 3.39-8.68) and rural areas (7.48%, 95% CI: 3.39-11.57) did not differ in the stone prevalence rate (OR = 0.84, 95% CI: 0.42-1.68).

The prevalence in the year groups of 1991-2000, 2001-2010, and 2011 to date was 5.95%, 8.86%, and 10.63%, respectively, which indicated an increasing trend. Further high-quality surveys throughout mainland China are needed to confirm these findings.

**Summary:** Prevalence of kidney stones in mainland China: A systematic review

, Sci. Rep., vol. 7, pp. 19, 2017.

[3] **W. Brisbane, M. R. Bailey, and M. D. Sorensen:** Kidney stone imaging is an important diagnostic tool and initial step in deciding which therapeutic options to use for the management of kidney stones. Guidelines provided by the American College of Radiology, American Urological Association, and European Association of Urology differ regarding the optimal initial imaging modality to use to evaluate patients with suspected obstructive nephrolithiasis. Noncontract CT of the abdomen and pelvis consistently provides the most accurate diagnosis but also exposes patients to ionizing radiation. Traditionally, ultrasonography has a lower sensitivity and specificity than CT but does not require the use of radiation. However, when these imaging modalities were compared in a randomized controlled trial, they were found to have equivalent diagnostic accuracy within the emergency department. Both modalities have advantages and disadvantages.

Kidney, ureter, bladder (KUB) plain film radiography is most helpful in evaluating for interval stone growth in patients with the known stone disease and is less useful in the setting of acute stones. MRI provides the possibility of 3D imaging without radiation exposure, but it is costly, and currently, stones are difficult to visualize. Further developments are expected to enhance each imaging modality for the evaluation and treatment of kidney stones shortly. A proposed algorithm for imaging patients with acute stones in light of the current guidelines and a randomized controlled trial could aid clinicians.

**Summary:** An overview of kidney stone imaging techniques

Nat. Rev. Urol., vol. 13, no. 11, pp. 654662, 2016.

[4] **Y. Andrabi, M. Patino, C. J. Das, B. Eisner, D. V Sahani, and A. Kambadakone:** Urolithiasis is a common disease with increasing prevalence worldwide and a lifetime-estimated recurrence risk of over 50%. Imaging plays a critical role in the initial diagnosis, follow-up, and urological management of urinary tract stone disease. Unenhanced helical computed tomography (CT) is highly sensitive (>95%) and specific (>96%) in the diagnosis of urolithiasis and is the imaging investigation of choice for the initial assessment of patients with suspected urolithiasis. The emergence of multi-detector CT (MDCT) and technological innovations in CT such as dual-energy CT (DECT) has widened the

scope of MDCT in stone disease management from the initial diagnosis to encompass treatment planning and monitoring of treatment success. DECT has been shown to enhance pre-treatment characterization of stone composition in comparison with conventional MDCT and is being increasingly used.

Although CT-related radiation dose exposure remains a valid concern, the use of low-dose MDCT protocols and the integration of newer iterative reconstruction algorithms into routine CT practice has resulted in a substantial decrease in ionizing radiation exposure. In this review article, we intend to discuss the role of MDCT in the diagnosis and post-treatment evaluation of urolithiasis and review the impact of emerging CT technologies such as dual energy in clinical practice.

**Summary:** Advances in CT imaging for urolithiasis.  
, Indian J. Urol., vol. 31, no. 3, pp. 18593, 2015.

[5] **Scales CD, et al.:** The last nationally representative assessment of kidney stone prevalence in the United States occurred in 1994. After a 13-yr hiatus, the National Health and Nutrition Examination Survey (NHANES) reinitiated data collection regarding kidney stone history. Describe the current prevalence of stone disease in the United States, and identify factors associated with a history of kidney stones. Self-reported history of kidney stones. Percent prevalence was calculated and multivariable models were used to identify factors associated with a history of kidney stones.

**Summary:** Prevalence of kidney stones in the United States.

[6] **Stamatelou KK, Francis ME, Jones CA, Nyberg LM, Curhan GC:** A body of evidence establishes that the occurrence of kidney stone disease has increased in some communities of industrialized countries. Information on recent temporal trends in the United States is lacking and population-based data on epidemiologic patterns are limited. The study objective was to determine whether kidney stone disease prevalence increased in the United States over 20 years and the influence of region, race/ethnicity, and gender on stone disease risk.

**Summary:** Time trends in reported prevalence of kidney stones in the United States

[7] **Fwu CW, Eggers PW, Kimmel PL, Kusek JW, Kirkali Z:** The occurrence of urolithiasis in the United States has increased; however, information on long-term trends, including recurrence rates, is lacking. Here we describe national trends in rates of emergency department visits, use of imaging, and drug treatment, primarily using the National Hospital Ambulatory Medical Care Survey to describe trends and the National Health and Nutrition Examination Survey to determine the frequency of lifetime passage of kidney stones. Emergency department visit rates for urolithiasis increased from 178 to 340 visits per 100,000 individuals from 1992 to 2009. Increases in visit rates were greater in women, Caucasians, and in those aged 25-44 years.

The use of computed tomography in urolithiasis patients more than tripled, from 21 to 71%. Medical expulsive therapy was used in 14% of the patients with a urolithiasis diagnosis in 2007-2009. Among National Health and Nutrition Examination Survey participants who reported a history of kidney stones, 22.4% had passed three or more stones. Hence, emergency department urolithiasis visit rates have increased significantly, as has the use of computed tomography in the United States. Further research is necessary to determine whether recurrent stone formers receive unnecessary radiation exposure during diagnostic evaluation in the emergency department and allow the development of corresponding evidence-based guidelines.

**Summary:** Emergency department visits, use of imaging, and drugs for urolithiasis have increased in the United States.

#### IV. METHODOLOGY

The first step is to collect the ultrasound images and organize a dataset. After dataset collection, the next step follows, Image pre-processing, Image Segmentation, and Morphological Analysis

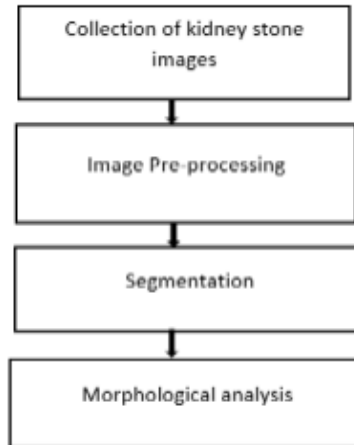


Figure (a). Proposed Block Diagram

### Image pre-processing

The purpose of pre-processing is to improve image data, remove unwanted distortions and improve some image features. Noise reduction through a filter operation helps to increase or decrease certain image details and makes image evaluation easier and faster. It involves specific filtering, Image enhancement, and edge filtering. Ultrasound images consist of a lot of fleck noises. The presence of the noise disturbs the ultrasonic image. Owing to this disturbance we can get inaccurate detection of the stone which causes damage at the time of surgery. So de-speckling of noise is a very crucial step of image pre-processing which improves the quality of the image and enhances the information of required content.

### Image Segmentation

Image segmentation is the process of dividing a digital image into sets of pixels which are also known as super pixels. The ROI model is usually used to identify the abnormal region based on clusters and centroids



Figure 4.3 Image Segmentation

The present step involves a clustering algorithm, which categorizes the input data points into different categories depending on their inherent distance from each other. The main task is to remove the distortion in the source image. It removes the undesired noise and enhances the features of the image. The images are pre-processed using DWT. Image enhancement is done because of removing noise and brightening the image. Wavelets are designed to transform an input image into a sequence of wavelets that can be processed more efficiently than pixel blocks. The entire image is converted into high and low pass filters. Image is divided into 4 sub-bands like Low-Low, Low-High, High-High, and High-Low. The LL sub band is considered both horizontal and vertical versions of an image. The other three subgroups LH, HH, and HL are groups with higher frequency data.

### Morphological Analysis

Morphing is the process of transforming object shapes from one form to other. Morphological operations are used to smooth the field of interest. At the time of the morphological operations process the images depend on the shape. During processing, it removes unwanted data called pixels from the outer region of the region of interest. It includes dilation and erosion.

### V.EXPERIMENTAL RESULTS

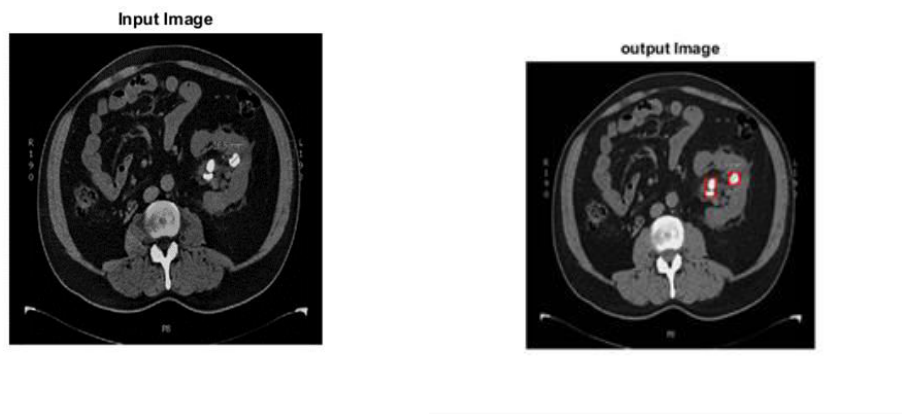


Fig:Input Image

Fig: output image



Fig: parameters

Fig:Precaution table

### VI.CONCLUSION

Here we are classifying the images of kidneys in which the dataset contains both kidneys with and without stones. While we test an image and the image is classified as a kidney with a stone and then segmentation of that image detects a stone. Otherwise classified the image a kidney without stones. Classified output kidneys with stones or kidneys without stones will be spoken out through the speaker. Hence, the classified out is kidney with stones then we get segmented output results by using the following steps given: The first step is the image pre-processing, Image enhancement is a part of preprocessing which is used to enhance the image. Next, image segmentation is performed on the preprocessed image using the thresholding technique. Finally, the segmented images are analyzed to detect the location of the stones. Then we calculated the parameter values like Area, Threshold, Contrast Etc.

### FUTURE SCOPE

The work can be extended by identifying the region of kidney stone and also predicting the size of the stone. The same can be utilized in an efficient way a possible victim can get worried or just cautious depending on the results, contradicting to waiting for prolonged periods without any closure

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