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Detection of Kidney Stone Using Machine Learning

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ABSTRACT

As result of our current life style kidney stone has become a common health issue. There are inaccuracies in the classification of kidney stone due to the presence noise.

Also, quick and correct diagnosis of kidney stone is essential which is observed to be lacking in the currently followed practices.

Kidney-Urine-Belly computed tomography (KUB CT) analysis is an imaging modality that has the potential to enhance kidney stone screening and diagnosis. This study explored the development of a semi-automated program that used image processing techniques and geometry principles to define the boundary, and segmentation of the kidney area, and to enhance kidney stone detection. It marked detected kidney stones and provided an output that identifies the size and location of the kidney based on pixel count. It's difficult to obtain results for large dataset using human inspection, this is where an automated kidney stone classification is implemented. The automated system uses image processing and deep learning method. The MIR and CT scan images of the proposed methodology of nephrolithiasis is pre-processed. The extraction of the key features is done using gray level concurrent matrix. The conversion of RGB format of image into gray format is essential. The colour information of the image is now reduced and converted into a single dimensional from 3 dimensional with similar patterns.

Keywords :- Image Processing, Artificial Neural Network, Convolutions Neural Network, Deep Learning, Machine Learning, Java. CT scan, MATLAB

I. INTRODUCTION

The Kidney Stone issue can be seeing rising dramatically throughout the world. Shape of kidneys are like bean shaped. They are located on both side of spine behind bellies and below the ribs. Size of kidney is around size of a largest fist. Filtration of the blood is the primary function of kidneys. They maintain balance of bodily fluids by removing waste materials from it. Also, they keep electrolytes in their sufficient levels. Renal calculus, more commonly known as kidney stone formation, is characterized by the formation of crystals in the urine caused by substance concentration or genetic susceptibility. All persons are susceptible to kidney stones, even infants, and yet, the majority of kidney stone cases remain undetected except in cases where extreme abdominal pain is exhibited or abnormal urine color is observed. In addition, people with kidney stones exhibit common signs such as fever, pain and nausea that are easily associated to other conditions. Kidney stone detection is important particularly in its early stages to facilitate intervention or to receive proper medical treatment. The presence or the recurring presence of kidney stone decreases kidney functions and dilation of the kidney. It also has implications on the degrees of chronic kidney disease (CKD) or chronic renal failure (CRF) for people who have not been previously diagnosed with this condition. However, because of its asymptomatic nature, it is commonly diagnosed among patients who undergo medical examination for other diseases such as cardiovascular diseases (CVD), diabetes, and other medical conditions predispose to the urogenital apparatus [1]-[3]. Today, computer-assisted tools such as Manuscript received February 26, 2015; revised June 5, 2015. ultrasound imaging, computed tomography (CT), and Xrays that use intravenous pyelogram (IVP) provide the most accurate diagnostic tools for kidney stone screening and diagnosis. CT scans, which provide threedimensional views of the organ or region of interest is the most sought after kidney stone screening tool in hospitals. Its convenience and efficiency in kidney stone detection (including its pathology) for both asymptomatic and symptomatic patients make advances in CT technology extremely important for physicians and patients alike [4], [5]. Software programming, which has found current and potential applications in technological advancements in the field of medicine, recognizes the need to contribute to CT screening development particularly in enhancing diagnosis of the kidney-urine-belly (KUB) region for kidney stone detection. This study developed a semiautomatic kidney screening program that integrated digital image processing and image analysis techniques in KUB CT images. Specifically,the study (1) developed a method for defining the boundary of regions of interest in a digital KUB CT scan; 2) developed a method for segmenting the region and object of interest in a digital KUB CT scan; and, (3) developed a method for detecting the object of interest (kidney stones) including its size and location in a digital KUB CT scan images.

The prevalence of kidney stones is clearly on the rise across the globe. Kidneys are bean-shaped organs. They may be found on both sides of the spine, under the ribcage and below the belly button. The kidney is around the size of a human hand. The kidneys' principal job is to filter blood. They keep physiological fluids from being too acidic or alkaline by filtering out trash. They also maintain adequate amounts of electrolytes. Once blood enters the kidneys, the organs begin performing functions such as filtering out waste and regulating the body's salt, water, and mineral levels. After being purified, the blood is reabsorbed into the body via the kidneys, while the waste products are sent through the pelvis and out of the body through the ureters. Almost 10% of the total volume of every kidney stone is composed of these small filters. Nephrons are the cells responsible for filtering blood. Kidney failure may occur if the kidney's blood supply is suddenly cut off.

Congenital kidney defects like kidney stones prevent urine from draining properly. Renal calculi stone, struvite stone, and stage horn kidney stones were all studied. The Kidney Stone issue can be seeing rising dramatically throughout the world. Shape of kidneys are like bean shaped. They are located on both side of spine behind bellies and below the ribs. Size of kidney is around size of a largest fist. Filtration of the blood is the primary function of kidneys. They maintain balance of bodily fluids by removing waste materials from it. Also, they keep electrolytes in their sufficient levels.

II. LITERATURE REVIEW

Many research papers have been published and many researchers have work upon it, in order to design Kidney stone detection using image processing and deep learning few of the following are discussed here. Literature survey is an information review. Which will help us in understanding and exploring concept of basis learnings So it will help us in better understanding the topics based on early information available. Literature survey is often done to connect our work with the relation of existing data [1].

It is impossible to treat and maintain health without first obtaining an accurate diagnosis of the ailment. Several imaging techniques are proposed as potential ways for detecting kidney stones. In this study, the authors present a system that can automatically identify kidney stones by using deep learning models. Computed Tomography (CT) images from a publicly available dataset are used in the research. These data sets were designed specifically for use with deep learning algorithms. When investigating the effectiveness of several deep learning models, it was discovered that the VGG series was the most advantageous. Using the VGG16 architecture, we were able to achieve a 99% detection rate for kidney stones. Moreover, the stratification K-fold cross validation technique was used to assess the model's efficacy. Moreover, Gradient-weighted Class Activation Mapping (or Grad-CAM) is used to identify the kidney stone's location. To summarise, in this setup, author first run the CT image via a VGG model server to be classified, then they use Grad-Cam to locate the region of interest, and lastly, an expert verifies the outcome [2].

Merve Karaman et al. [3] Kidney cysts, lesions, and stones may all be more easily identified with more precise identification of renal areas in abdomen CT imaging. In this research, automated kidney identification is achieved by the application of the machine learning algorithm Aggregate Channel Features (ACF).

During the training phase, negative picture samples are extracted automatically. The AdaBoost classifier is used to generatethe ACF in an alternating fashion over the course of N iterations. Negative samples are discarded at each stage and collected alongside the positive ones. Effectiveness of the research is evaluated using the confusion matrix and k-fold cross-correlation techniques. The ACF is used to train the k-fold-split data set based on the positions of the labelled items.

The confusion matrix may be used to calculate recall, precision, and F1 scores, all of which are useful in evaluating performance. The obtained data demonstrates that the suggested approach is capable of identifying specific locations inside the kidneys.

Suresh M B et al [4] Stones in the kidneys are a hard accumulation of salt and minerals, most often calcium and uric acid. Most people with kidney stones don't realise they have them until it's too late, hastening the decline of their kidneys and other organs. The correct localization of a kidney stone is essential for surgical removal. Most ultrasound pictures will include speckle noise that cannot be manually eliminated. This study discusses the difficulties associated with kidney stones, as well as methods for detecting them via the use of image processing methods. Processes such as pre-processing, segmentation, and Morphology Analysis. The effectiveness of procedures

is determined when their output parameters are studied and assessed.

Harsh Dave et al [5] The ultrasound area of interest presents difficulties because to the wide variety of textures and sounds present. Ultrasound scans are the gold standard for diagnosing kidney problems, especially stones. The current research effort in automatic ultrasonic object identification follows this similar line of inquiry. A programme has been developed that can identify the ultrasound image's stone location for the doctor. The recommended stone presence evaluation technique will help the practitioner choose the optimal site. Locations where stones are possible quarry targets for the extraction function. A wide variety of indicators, including dissimilarity, angular momenta, entropy, and correlation, are used. For the purpose of training image dataset classification, the KNN classification is utilised. About 91% accuracy may be expected from the classification system as a whole. Furthermore, the confusion matrix will evaluate the proposed system's complexity and precision

Sandhya, S et al. [6] proposed a method of enhancing the visual quality in medical images. The feature of medicinal representations is should be better clarity and carries particular information that is obtained from patients by the observed general practitioner. The goal of the representation quality can be produced from the imaging organism using the processing method. Siegenthaler, Lea et al. [26] explained the impact of soft tissue layers on kidney images. The creators figured a higher request spleen insertion after up-inspecting of appropriated organize division plans to accomplish limit for any kidney class.

Maniriho, et al. [7] proposed a method for elimination of noise levels in low contrast images. This method is used to differentiate the pictures have the ability of low contrast with neighboring conditions that are observe the variations between the representations in emission intensity and also display the variation of intensity values.

Kai-jian Xia et al. [8] proposed system division on kidney yet space-possessing wound locale based with respect to SCNN and ResNet designs joined including SIFT-stream change. By using this method, Renal segmentation is done in the effective manner.

Lee et al. [9] proposed a system for the important and texture features are finding the characteristics of a kidney and these features are used to calculate the mean and standard deviation.

Vasantha, M et al. [10] proposed a new method for extracting the features of kidney and classified them by using ANN. By using ANN classifier the obtained accuracy is 80%. Hasan, M et al. [32] proposed a coparative analysis of different classifiers by changing the weights of ANN. A major class of terrestrial biodiversity requires vegetation. Three classifiers are used. The obtained accuracy is by CNN, ANN and SVM is 99%, 94% and 91%, respectively.

Hence Zhao, Gang et al. [11] explains a semi-supervised machine learning model-the weakly labeled support vector machine (WELLSVM)-is used to determine urban flood susceptibility to classify flood-prone areas with small flood inventories.

III.Research Methodology

The identification of objects in an image and this process would probably start with image processing techniques such as noise removal, followed by (low-level) feature extraction to locate lines, regions, and possibly areas with certain textures. The clever bit is to interpret collections of these shapes as single objects, e.g. cars on a road, boxes on a conveyor belt, or cancerous cells on a microscope slide. One reason this is an AI problem is that an object can appear very different when viewed from different angles or under different lighting. Another problem is deciding what features belong to what object and which are background or shadows etc. The human visual system performs these tasks mostly unconsciously but a computer requires skillful programming and lots of processing power to approach human performance.

Manipulation of data in the form of an image through several possible techniques. An image is usually interpreted as a two-dimensional array of brightness values and is most familiarly represented by such patterns as those of a photographic print, slide, television screen, or movie screen. An image can be processed optically or digitally with a computer.
Image An image is a two-dimensional picture, which has a similar appearance to some subject usually a physical object or a person. Basically, the image contains 256 by 256 or it's a combination of horizontal and vertical lines.

Collection of pixels. Each pixel contains red, green, and blue. Image Types Red Green Blue: They are red, green and blue. A (digital) color image is a digital image that includes color information for each pixel. Each pixel has a particular value that determines its appearing color. This value is qualified by three numbers giving the decomposition of the color in the three primary colors Red, Green, and Blue. Any color visible to the human eye can be represented this way. The decomposition of color in the three primary colors is quantified by a number between 0 and 255. For example, white will be coded as R = 255, G = 255, B = 255; black will be known as (R, G, B) = (0,0,0); and say, bright pink will be: (255,0,255).

Gray image: A gray-scale image is a digital image is image in which the value of each pixel is a single sample, that is, it carries only intensity information. Images of this sort, also known as black-and-white, are composed exclusively of shades of gray(0-255), varying from black(0) at the weakest intensity to white(255) at the strongest. Binary Image: A binary image is a digital image that has only two possible values for each pixel. Typically, the two colors used for a binary image are black and white though any two colors can be used. The color used for the object(s) in the image is the foreground color while the rest of the image is the background color.Binary images are also called bi-level or two-level. This means that each pixel is stored as a single bit (0 or 1). The name black and white, monochrome or monochromatic are often used for this concept, but may also designate any images that have only one sample per pixel, such as grey-scale images. Representation of image extensions are .txt, .xlsx, .pdf, .csv, .png, gif, tiff, .jpg, jpeg
A subfield of machine learning, "deep learning" consists of what amounts to a three-layer neural network. Although these neural networks can "learn" from massive amounts of data, they still fall short of the capabilities of the human brain. More hidden layers may assist optimise and adjust for accuracy, whereas a single layer neural network may still generate approximative predictions.
CT, which stands for "computerised axial tomography scanner," is an electronic radioactivity image process in which a narrow beam of x-rays is focused on a patient and rapidly shifted around the frame, carrying signals that are processed by each machine's computing to encourage cross-divided countenances or "slices" of the body. These cross-sectional images, often known as tomographic figures, provide more information than conventional x-rays. Each slice is then digitally "shapely" pieced together to generate a three-dimensional representation of the patient's anatomy that may be used for precise labelling and sectioning of normal structures and abnormalities.
In contrast to conventional radiology, which utilises a robust and quick radioactivity tube, a CT scanner uses a power-driven radioactivity starting that rotates inside the circular gap of a donut-shaped form known as a base. A CT scan entails the patient lying on a bed that slowly moves around the stage, all the while a television set spins around them, emitting tiny x-ray photons via the screen. As a kind of corrective film, CT scanners make use of a variety of mathematical radiation detectors that are positioned in a direction perpendicular to the radioactivity source. Detectors collect the x-rays after they have left the subject and send them on to a computer. The patient's frame, methods, and tissues, as well as some abnormalities the doctor is worried to detect, may all be seen in a

3D exact copy of the patient created by spreading image slices independently or shapely together for a single piece.

To better detect kidney injuries and illnesses, CT scans of the kidneys may give more accurate information than standard kidney, ureter, and bladder (KUB) X-rays. Examining one or both kidneys using a CT scan is an excellent way to spot abnormalities like tumours or other lesions, obstructive disorders such kidney stones, congenital deformities, polycystic uropathy, and fluid collection around the kidneys (and hence the site of abscesses).

Categories of Images They come in shades of red, green, and blue, thus their name. Each each pixel in a digital picture may be assigned a specific colour, making such an image a "colour" image. The colour shown by a pixel is determined by a numerical value assigned to it. This number is qualified by three additional digits that specify the colour's breakdown into its component red, green, and blue. This method may be used to represent any hue that can be seen by the naked eye. One may express the degree to which a colour has been broken down into its component hue, value, and intensity by using a number between zero and 255. Example colour codes for common colours include: white (R = 255, G = 255, B = 255), black ((R, G, B) = (0,0, 0), and hot pink (R = 0, G = 0, B = 1). (255,0,255).

Image in grey The value of each pixel in a grayscale digital picture is a single sample; that is, the image conveys just intensity information.

Pictures of this kind, commonly known as black and white, consist entirely of grayscale values (from 0-255), with black (0) representing the lowest intensity and white (255) representing the highest. A computer picture with just two potential values for each pixel is called a binary image. Any two colours may be used to create a binary picture; however, black and white are the most common. Foreground colour refers to the hue used for the image's foreground elements, whereas background colour describes the hue used for the image's background elements. You may also hear binary pictures referred to as bi-level or two-level images. This indicates that there is just one bit for each pixel (0 or 1). Black and white, monochrome, and monochromatic are common terms for this idea, although they may also be used to refer to any picture with a single sample per pixel, including grayscale. Formats like.txt,.xlsx,.pdf,.csv,.png,.gif,.tiff,.jpg,.jpeg, and.jpeg are used to represent images

Kidney stones are on rise throughout the globe and majority of individuals with concretion disease don't notice the disease because it damages the organs slowly before showing symptoms. Kidney could be a bean shaped organ and present on either side of the spine. the most function of kidney is to manage the balance of electrolytes within the blood. Formation of stones in kidneys is thanks to blockage of urine congenital anomalies, cysts. differing types of kidney stones namely struvite stones, stag horn stones and renal calculi stones were analysed. concretion may be a solid concretion or crystal formed in kidneys from dietary minerals in urine. so as to urge obviate this painful disorder the urinary calculus is diagnosed through CT images so removed through surgical processes like ending of stone into smaller pieces, which then passthrough tract. If the dimensions of the stone grow to a minimum of 3 millimetres, then they'll block the ureter. This causes lots of pain mostly within the back lower and it should radiate to groin. Classification of urinary stone is completed based upon their location within the kidney (nephrolithiasis), ureter (ureterolithiasis), or bladder (cystolithiasis), or by their chemical composition. The stone could even be present inside minor and major calyces of the kidney or within the ureter. In medical imaging modalities, computed axial tomography is used because it's low noise, when put next to other modalities and thus provide results with maximum accuracy. The kidney malfunctioning could also be life intimidating. Hence early detection of calculus is crucial. Precise identification of urinary calculus is vital so on ensure surgical operations success. Thus, to supply the efficient stone detection system, image

filtering is one amongst the foremost and important steps within the automated detection. this will reduce the erroneous detection which can occur because of knowledge variation of judging specialist pre-processing is then followed by segmentation and morphological analysis to detect the stone automatically. Many researchers have contributed within the field of nephrolith detection by presenting various algorithms to detect the stone within the kidney from MRI images. Some researchers emphasize on strong and efficient segmentation. Some emphasized on strong and effective segmentation for accurate detection of stone. Once the image enhancement and noise reduction of the CT image is finished then the region of interest is obtained from the image. Kidney stones are hard collection of salt and minerals often made of calcium and acid. Majority of individuals with stones in kidney at initial stage don't notice and it damages the organs slowly

The fact that level set techniques require a great deal of thought to construct the appropriate velocities for advancing the level set function is one of the disadvantages we encountered as a result of our use of level set segmentation. Therefore, there must be a lot of data available to obtain the accuracy rate, which may not always be the case. The current kidney stone detection system includes level set segmentation and a smoothing Gabor filter. The fact that level set techniques require a lot of thought to construct appropriate velocities is one of the disadvantages we encountered as a result of using level set segmentation. After that, CNN classification and wavelet transformation are used to process the data. Prior to re-appropriation, the information has been scrambled using the merged encryption method. This framework officially addresses the problem of authorized information de-duplication to increase the likelihood of data security. In addition, copy check document name characteristic the information itself takes into consideration distinct filenames based on the distinct benefits of clients. It also shows some new developments in de-duplication that support approved copy. Cloud-based information management features a dynamic and unpredictable levelled administration chain. In typical circumstances, this is not the case. Web administrations are used for solicitation and responses in traditional web design

Pre-processing of Images: Pre-processing is required because the ultrasound has low contrast and speckle noise. Image restoration, smoothing and sharpening, and increasing contrast are all part of pre-processing. Operations with images at the lowest level of abstraction, where both the input and the output are intensity images, are referred to as pre-processing. An intensity image is typically represented by a matrix of image function values (brightness), and these iconic images are of the same kind as the original data that was captured by the sensor. Pre-processing aims to improve the image data by suppressing unintentional distortions or enhancing some important image features for subsequent processing, despite image geometric transformations. Pre-handling is required on the grounds that the ultrasound has low difference and spot calmer. Picture reclamation, smoothing and honing, and expanding contrast are all essential for pre-handling. Activities with pictures at the least degree of reflection, where both the info and the result are power pictures, are alluded to as pre-handling. A force picture is ordinarily addressed by a lattice of picture capability values (splendour), and these notorious pictures are of the very kind as the first information that was caught by the sensor. Albeit mathematical changes of pictures, like revolution, scaling, and interpretation, are delegated pre-handling strategies here because of the utilization of comparative techniques, the objective of pre-handling is an improvement of the picture information that smothers reluctant mutilations or upgrades some picture highlights significant for additional handling. This utilizations Gaussian separating, which is a technique for improving or changing a picture. You can, for example, channel a picture to either stress a few highlights or eliminate others. Smoothing, honing, and improving edges are only a couple of the picture

handling tasks that can performed with channel. The worth of some random pixel in the result not set in stone by applying a calculation to the upsides of the pixels nearby the comparing input pixel. Separating is a local activity.

3.2 Objective

->The primary goal of this work is to enhance the identification rate of kidney stone issues using imaging techniques by increasing their accuracy and sensitivity.

->To better detect kidney stones in ultrasound images using median filters to boost detection rates in terms of accuracy and sensitivity,

->This study compares and contrasts supervised, unsupervised, and semi-supervised learning methods and presents the results of existing research employing each strategy. Achieve a more efficient approach of data analysis by automating the model-building process.

->The primary goal is to use pre-existing models to sort data into meaningful categories; the secondary goal is to use those models to forecast future events.

->The goals of this research are:

->To examine and apply pre-existing learning algorithms, such as those for classification, regression, structured prediction, clustering, and representation learning;

->To draw conclusions about the efficacy of these algorithms.

IV. Problem Formulation

4.1 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. These iconic images are of the same kind as the original data captured by the sensor, with an intensity image usually represented by a matrix of image function values (brightness). The aim of pre-processing is an improvement of the image data that suppresses unwilling distortions or enhances some image features important for further processing, although geometric transformations of images (e.g. rotation, scaling, translation) are classified among pre-processing methods here since similar techniques are used. For this Gaussian Filtering is used Filtering is a technique for modifying or enhancing an image. For example, you can filter an image to emphasize certain features or remove other features. Image processing operations implemented with filtering include smoothing, sharpening, and edge enhancement. Filtering is a neighbourhood operation, in which the value of any given pixel in the output image is determined by applying some algorithm to the values of the pixels in the neighbourhood of the corresponding input pixel. A pixel's neighbourhood is some set of pixels, defined by their locations relative to that pixel. In image processing, a Gaussian blur (also known as Gaussian smoothing) is the result of blurring an image by a Gaussian function (named after mathematician and scientist Carl Friedrich Gauss). It is a widely used effect in graphics software, typically to reduce image noise and reduce detail. The visual effect of this blurring technique is a smooth blur resembling that of viewing the image through a translucent screen. Gaussian smoothing is also used as a pre-processing stage in computer vision algorithms in order to enhance image structures at different scales—see scale space representation and scale space implementation. Mathematically, applying a Gaussian blur to an image is the same as convolving the image with a Gaussian function. This is also known as a two-dimensional Weier strass transform. Since the Fourier transform of a Gaussian is another Gaussian, applying a Gaussian blur has the effect of reducing the image's high-frequency components; a Gaussian blur is thus a lowpass filter

4.2 Image Segmentation

Segmentation is a vital aspect of medical imaging. It aids in the visualization of medical data and

diagnostics of various diseases. Canny edge detection, one of the level set segmentation technique which is used for identifying and sharpening the edge of the kidney and the stone in the kidney. Image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as image objects). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyse. 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. The result of image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image (see edge detection). Each of the pixels in a region are similar with respect to some characteristic or computed property, such as colour, intensity or texture. Canny edge detection is a technique to extract useful structural information from different vision objects and dramatically reduce the amount of data to be processed. It has been widely applied in various computer vision systems. Canny has found that the requirements for the application of edge detection on diverse vision systems are relatively similar. Thus, an edge detection solution to address these requirements can be implemented in a wide range of situations. The general criteria for edge detection include:

• Detection of edge with low error rate, which means that the detection should accurately catch as many edges shown in the image as possible

• The edge point detected from the operator should accurately localize on the centre of the edge.

• A given edge in the image should only be marked once, and where possible, image noise should not create false edges.

4.3 Proposed System

In this project, we used canny edge detection methodology as it provides the presence of Gaussian filter which allows removing of noise in an image. This can be enhanced with respect to the noise ratio by non-maxima suppression method which results in one pixel wide ridges as the output. This also detects the edges in a noisy state by applying the thresholding method. The effectiveness can be adjusted by using parameters. It gives good localization, response and is immune to a noisy environment. Later CNN classification is introduced because more than ANN, CNN is suitable for image processing

4.4 Block Diagram

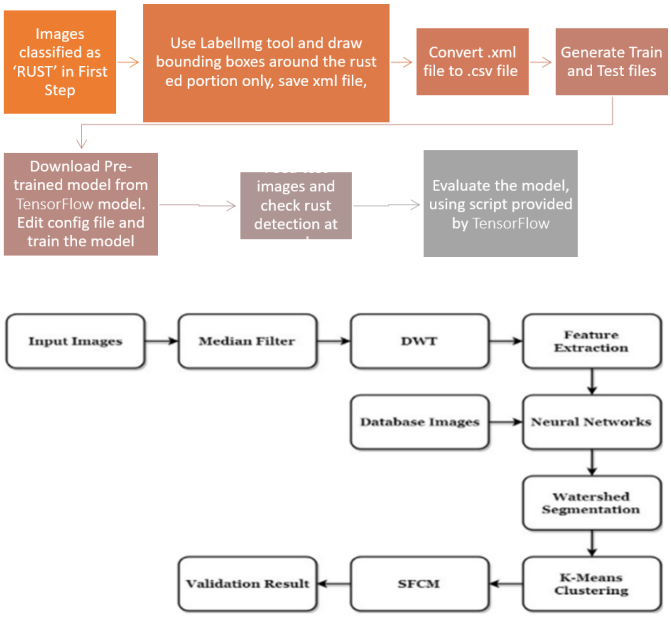

Fig 1. Block Diagram of Kidney Stone Detection System

In this architecture at first input is given, here we give ultrasound image of a kidney it may be normal or abnormal kidney present with stones. As ultrasound images contain lot of speckle noise it is difficult to deal with them, to overcome this image pre-processing is done i.e., Gaussian filter is applied to remove noise. The next step is image segmentation, canny edge detection is used and this contains five steps such as Noise reduction, Gradient classification, non maximum suppression, Double threshold and

Edge tracking at last we get an output with edges detected. This segmented image is given for wavelet processing. Later CNN is applied, in this we have Convolution layer, Max pooling layer, Activation layer and at last we find Fully connected layer.

Rectified linear unit is used to scale the parameters to non negative values. We get pixel values as negative values too. In this layer we make them as 0's. The purpose of applying the rectifier function is to increase the non-linearity in our images. The reason we want to do that is that images are naturally non-linear. The rectifier serves to break up the linearity even further in order to make up for the linearity that we might impose an image when we put it through the convolution operation. The pooling (POOL) layer reduces the height and width of the input. It helps reduce computation, as well as helps make feature detectors more invariant to its position in the input. The role of the artificial neural network is to take this data and combine the features into a wider variety of attributes that make the convolutional network more capable of classifying images, which is the whole purpose from creating a convolutional neural network. Here we used Relu activation function this process is repeated two times and at last sigmoid is used. Max pooling is done to get better image and flatten method is used. Dropout was used to avoid over fitting. For identifying kidney stone network is fully connected. We obtain output with labels yes or no which tells about the presence or absence of stone.

V. Experimental Setup& Results

5.1 EXPERIMENTAL SETUP & RESULTS

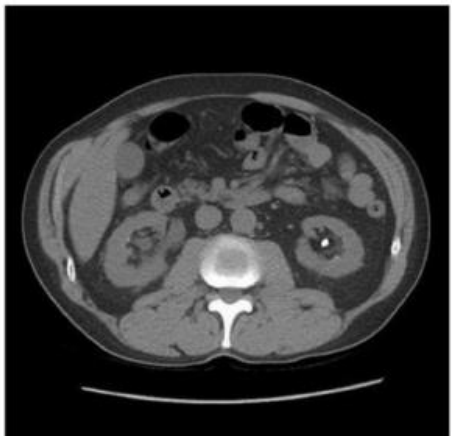

Figure 2: The Original Image

MATLAB is a high-performance language for education and research as it integrates computation, visualization and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation and also it has toolboxes for signal processing, neural network, image processing, database etc. MATLAB software was used to implement the algorithm, since MATLAB Image Processing Toolbox is a collection of functions that extend the capability of the MATLAB numeric-computing environment. The toolbox supports a wide range of image processing operations, such as Image analysis and enhancement. Region of interest operations, linear filtering and filter design. All the functions and equations used in this study are from MATLAB image processing toolbox. The CT scan images are taken from, the original image was segmented by threshold, edge-based segmentation, and watershed segmentation, the original image is shown in Fig.1. There are many segmentation techniques as shown in Fig.2. In this paper we have applied three segmentation techniques on the grey scale image after applied Gaussian filter twice on original image shown in Fig.3. These segmentation techniques are Edge based segmentation, Watershed segmentation, and Threshold based segmentation.

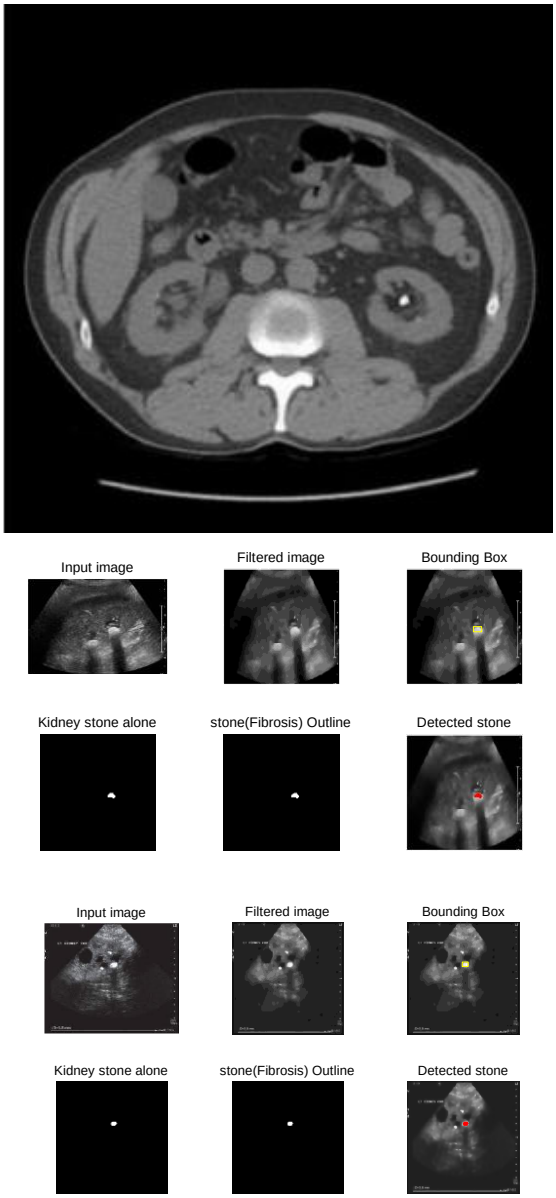

Figure 3: Grey Scale Image

VI. CONCLUSION AND FUTURE SCOPE

Conclusion

Detecting the presence of kidney stones using the proposed methodology has been done by pre-processing the ultrasound image. It was followed by segmentation and finally morphological analysis of the resulting image was performed.

The final image helped in the detection of the exact location of the stone. Moving further the edge detection method was performed which identified the shape and structure of the formed stones.

Using the suggested technology, kidney stones have been detected by pre-processing the ultrasound picture. The generated picture underwent a morphological examination. The final picture was useful in pinpointing the precise spot where the stone was found. Then, the produced stones' shapes and structures were determined using an edge detection approach using round off technique.

Future Scope: - In future work, the proposed method might be designed for real time implementation via interfacing it with the scanning machines.

In future, the system will be designed for real time application by placing biomedical sensors in the abdomen region to capture kidney portion. The captured kidney image is to be proposed algorithm to process and detect stone on FPGA using hardware description language (HDL). The identified urinary calculus within the image is displayed with colour for straightforward identification and visibility of stone in monitor.

VII. REFERENCES

[1]. Anesh V. Madhikar,Apoorva Pramod Mohite,Aishwarya Arun Avatade,Meghana Deepak Galande"A Survey On Kidney Stone Detection Using Image Processing And Deep Learning" International Research Journal of Engineering and Technology (IRJET)Volume:09, Issue:05, May 2022 www.irjet.net|ISSN: 2395-0072

[2]. N. Thein, H. A. Nugroho, T. B. Adji and K. Hamamoto, "An image preprocessing method for kidney stone segmentation in CT scan images“,IEEE:2018

[3]. Nuhad A. Malalla, Pengfei Sun, Ying Chen, Michael E. Lipkin, Glenn M. Preminger and Jun Qin, “C-arm technique with distance driven for nephrothalisis and kidney stones detection: Preliminary Study”, EBMS International Conference on Biomedical and Health Informatics (BHI), IEEE 2016, pp. 164-167.

[4]. S. Hu et al., "Towards quantification of kidney stones using X-ray dark-field tomography," 2017 IEEE 14th International Symposium on Biomedical Imaging (ISBI 2017), Melbourne, VIC, 2017, pp. 1112-1115.

[5]. Bryan Cunitz, Barbrina Dunmire, Marla Paun, Oleg Sapozhnikov, John Kucewicz, Ryan His, Franklin Lee, Mathew Sorensen, Jonathan Harper and Michael Bailey, "Improved detection of kidney stones using an optimized Doppler imaging sequence", International Ultrasonics Symposium Proceedings, IEEE 2014, pp. 452-455.

[6]. Yung-Nien Sun, Jiann-Shu Lee, Jai-Chie Chang, and Wei-Jen Yao, "Three-dimensional reconstruction of kidney from ultrasonic images", Proceedings of the IEEE Workshop on Biomedical Image Analysis, IEEE 1994, pp. 43-49.

[7]. Marsousi, Konstantinos N. Plataniotis and Stergios Stergiopoulos, "Shape-based kidney detection and segmentation three-dimensional abdominal ultrasound images", 36th Annual International Conference of Engineering in Medicine and Biology Society, IEEE 2014, pp. 2890-2894.

[8]. Oleg A. Sapozhnikov, Michael R. Bailey, Lawrence A. Crum, Nathan A. Miller, Robin O. Cleveland, Yuri A. Pishchalnikov, Irina V. Pishalnikova, James A. McAteer, Bret A. Connors, Philip M. Blombgren and Andrew P. Evan, "Ultrasound-guided localized detection of cavitation during lithotripsy in pig kidney in vivo", Ultrasonics Symposium, IEEE 2001, pp. 1347-1350.

[9]. V. R. Singh and Suresh Singh, "Ultrasonic parameters of renal calculi", Proceedings of the 20th Annual International Conference on Engineering in Medicine and Biology Society, IEEE 1998, pp. 862-865.

[10]. K. Viswanath, R. Gunasundari, "Design and analysis performance of kidney stone detection from ultrasound image by level set segmentation and ANN classification", International Conference on Advances in Computing, Communications and Informatics (ICACCI), IEEE 2014, pp.407-414

[11]. K. Sharma et al., "Automatic Segmentation of Kidneys using Deep Learning for Total Kidney Volume Quantification in Autosomal Dominant Polycystic Kidney Disease", Sci Rep, vol. 7, no. 1, pp. 2049, May 2017.

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