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STONE DETECTION IN KIDNEY WITH IMAGE PROCESSING: CT IMAGES

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Abstract: Kidney stone has been a major health issue for many people across the countries. This investigation delves into the precise detection of stones in kidneys through the application of image processing techniques, particularly leveraging CT images. Detecting stones within the kidneys is a critical global concern, as these organs are pivotal in water purification and recycling within the human body. The study comprised four main stages: image preprocessing using a median filter, segmentation employing the k-means clustering algorithm, stone detection, and classification.

Data was gathered from approximately 40 patients who underwent CT scans at the hospital for the diagnosis of kidney stone diseases. The research endeavors to employ advanced methods for detecting boundaries, segmented areas, and accurately pinpointing stone locations within the kidney. By analyzing pixels, this investigation aids in precisely identifying the location of stones, as well as determining the number of patients afflicted by this condition.

Index Terms - Kidney, Stone detection, CT Image, Segmentation, K- mean clustering, Image Processing.

I. INTRODUCTION

It is important for A kidney stone is one of the important research studies in the world. In that the formulation of kidney stones, calcium is more common among them. Many people are suspect of kidney stone problems [1]. The majority of kidney stone patients are undetected. The patients are not aware of the problem because of internal damage except extreme pain abdominally or urine color changes are absorbed [2]. To receive the appropriate medical treatment it is very important to continuously monitor the issue and keep testing to avoid further damage to the body. If stone detected earlier it will help in preventing and recovering at an earlier stage. Kidney stones decrease the functioning and dilation of the human body [3]. For the chronic disease of the kidney, it has implications. Many people are facing difficulties over body purification and circulation. Healthy Kidney makes people happier and healthier. The patients those who have kidney stone faces regular pain and weakness over time [4]-[5] efficiency and convenience in stone location position for both symptomatic and asymptomatic patients based on advanced CT screening technology [7]-[8]. According to CT screening images, software-based technologies also play an important role in the detection of stone through the kidney [9]-[10]. Signs and symptoms of the human body with the presence of stone are intermittent pain (one of the highest and stronger pain is renal colic). It is caused by a stone in the kidney which is commonly highlighted restlessness, urinary urgency, sweating, hematuria, nausea, and vomit. Typically pain persists for 50- 60 mints for the effected patient [11]-[13]. For stone formation dehydration is the major factor which plays an important role in human health [14]-[15]. Intake of less quantity of water in high temperature and humidity may create dehydration in the human body because of those 80% chances of stone formation rate increases [16]. As of research high intake of sodium, honey including sugars, fructose based syrup, and consumption of fruit juices and tea increase the risk of stones in the kidney due to an increase in uric acid excretion and elevated urinary oxalate level [17]-[18]. Stones in the kidney can result in metabolic situations, such as tubular acidosis distal renal, hyperparathyroidism, dent's disease, primary hyperoxaluria, or sponge kidney [19]-[20].

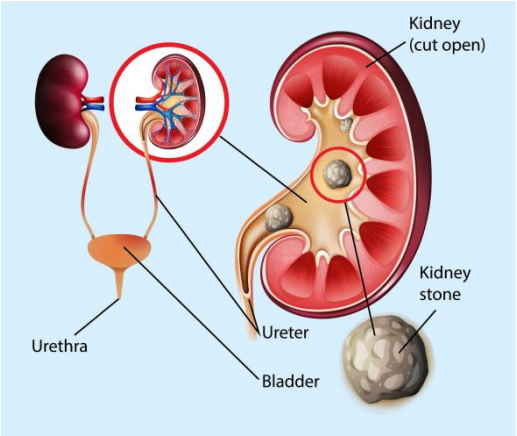

Fig 1: Stone in Kidney

LITERATURE REVIEW

In recent years, kidney stone have been gaining significant attention since they allow learners to navigate a wide range of educational resources that are available to them. In 2023 Kiran Kumar Patro et al.[1] propose a novel deep learning technique for automated detection of kidney stones with coronal CT images. It highlights the prevalence and severity okidney stone disease and the limitations of existing imaging methods, such as low resolution and false alarms. The proposed solution employs a Kronecker product-based convolution technique to reduce the redundancy in feature maps and extract abstract and in-depth features from the input images. The publicly available GitHub kidney stone CT scans are utilized to develop and evaluate the proposed architecture.

The Mua'ad M Abu-Faraj et.al [2] presents an analysis and implementation of kidney stones detection by applying segmentation techniques on computerized tomography scans. It reviews the various imaging techniques and image processing methods for diagnosing kidney abnormalities, such as stone disease, kidney cysts, and urinary tract tumors. It explores the deployment of three segmentation techniques using matlab to examine the kidney area and to enhance kidney stone detection. The segmentation techniques under investigation are: threshold based segmentation, watershed based segmentation, and edge based segmentation. Shahina M k et al. [3] proposes a contour based algorithm to detect and analyze renal stones in ultrasound images. It discusses the benefits of ultrasound imaging for nephrolithiasis, a painful kidney disease. It describes the steps of the algorithm, from preprocessing to classification. The paper asserts that the algorithm can identify stones accurately and quickly.Prema T. Akkasaligar et al. [4] proposes a method for kidney stone detection in CT images using level set segmentation and fuzzy c-means clustering. It discusses the benefits of CT imaging for kidney stone diagnosis and describes the steps of the method. The paper shows that the method achieves high accuracy and efficiency in detecting kidney stones.In This paper presents an automated kidney stone classification method using image processing and neural networks. The authors use the Gray Level Co-occurrence Matrix (GLCM) and the Fuzzy C-Mean (FCM) clustering algorithm to extract features and segment computed tomography images of kidneys. The features are then classified using the Back Propagation Network (BPN), a type of artificial neural network. The article claims that this method can detect kidney stones in their early stages and reduce the inaccuracies caused by noise.r it presents a project that aims to predict and detect kidney stones using deep learning and computed tomography (CT) images. The authors use a convolutional neural network (CNN) model pre-trained on the ImageNet database to classify CT images as having or not having kidney stones. The article also reviews some related works and methods in the field of medical image processing and diagnosis. The article claims that the proposed system can reduce the doctor's mental fatigue and provide accurate and early detection of kidney stones.an optimized Doppler imaging sequence for improved detection of kidney stones, leveraging the "twinkling artifact" (TA). It suggests that TA is caused by micron-sized bubbles in the stones' crevices, and proposes enhancing bubble activity within FDA limits to increase TA sensitivity. Clinical trials with optimized settings showed promising results, indicating a potential for better kidney stone detection using ultrasound, which is safer than CT or X-ray diagnostics. Further research will focus on refining parameters and filtering methods. Tanay Kulkarni et al. The proposed system aims to monitor the learning process of students based on available resources, in order to identify their areas of interest and provide applicable recommendations. With the vast amount of information accessible on the web, it is determining to bring out only the most applicable information that fulfills the user's searching criteria. To address this concern, the

model first develops to enhance search accuracy and efficiency, a web crawler that prioritizes keywords is utilized to extract URLs that contain the user's searched keywords. These relevant web pages are then selected for further processing. The system will analyze on ensuring precise recommendations by implementing effective user profiling and content fetching techniques. Specifically, it covers the URLs pertaining to user activity and how they can aid in recommending content to other users. [13]

III.METHODS

This project is a machine learning-driven kidney stone detection system These studies investigate four stages, image preprocessing, segmentation of image using k-mean clustering, detection of stone location through the kidney, and classification. Data collected around 40 patients from the hospital using a CT scanning machine, which diagnosis kidney stone diseases and help in identifying the number of patients facing problems of stone in the kidney. The main objective of image segmentation is to find out region-based interest over the image. Segmentation steps involve split methods which help the image to split into the equal region or called as a unit. For iteration, it involves a split and merges process.Firstly, iteration split the region into different parts of the region then it followed by the merging process. In segmentation, the threshold value is set to 0.1

Preprocessing using Median Filtering: The technique of Median filtering is Preprocessing is a method for removing background noise from images. To remove noise from CT scan images the median filter is used. Median filters play an important role in removing noise from images. The median filter is a nonlinear statistical filter, which describes in spatial domain form. It is smoothing, CT scan images by utilizing the median value of the neighborhood pixels over the image. In the processed image median filter perform two tasks. Firstly all pixels in the neighborhood and the original image are sorted in ascending value orders. Secondly, the sorted median value computed and chosen as the pixel value for the processed image.

K-Means Cluster Algorithm: The K-Means algorithm is a method in machine learning it is also called an unsupervised classification method. It does not consist of any training data. K means clustering algorithm is an iterative method in which algorithm clusters pixels value iteratively by computing intensity of mean value for the given classes and segment the pixel by classifying its closest mean from each pixel value.

Segmentation: In machine learning, the segmentation method, it helps to detect the region of interest area for the particular image which needs to be examined. The main objective of image segmentation is to find out region-based interest over the image. Segmentation steps involve split methods which help the image to split into the equal region or called as a unit. For iteration, it involves a split and merges process. Firstly, iteration split the region into different parts of the region then it followed by the merging process. In segmentation, the threshold value is set to 0.1.

Linear Regression: Linear regression is a supervised machine learning technique used to predict a continuous target variable based on one or more input features. It assumes that there is a linear relationship between the input features and the target variable and uses the least squares method to determine the best-fitting line through the data points. Essentially, linear regression seeks to find the straight line that best represents the relationship between the input variables and the output variable.

IV. PROPOSED APPROACH

Collecting Data from Hospitals - The input for a learning platform consists of a spreadsheet that contains information about the reviews and likes that users have submitted. This spreadsheet serves as a source of data for the platform to process and analyze. It is necessary to extract the data of reviews and the number of enrolled individuals from this sheet. A set of coordinates for the starting point of each test are generated and returned to a function get Coordinates. It is then necessary to iterate through the sheet, extracting the reviews and enrolling counts from each set, and putting these into a file called Enrolled Count, which correlates the number of participants with the cognitive domain of each search falling under that domain.

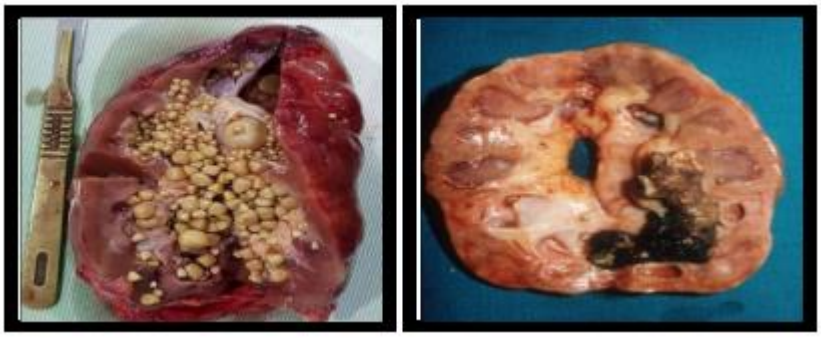

Fig.2 Presence of Kidney Stones

Classifying Image Based on Normal and Abnormal Stones –

Now use the KNN approach by considering the attributes that include what kind of courses are learned by the enrolled student, ratings given by the user, and how many hours the user spends, etc., and store this data as a historical activity set of the user. Fetch all available courses in the database and categorize these courses into groups by viewing the nature of the study. Import the student datasets and course datasets to prepare the data frames that have the common factor as the study stream and include what types of courses were learned by the user in the course dataset.[9]

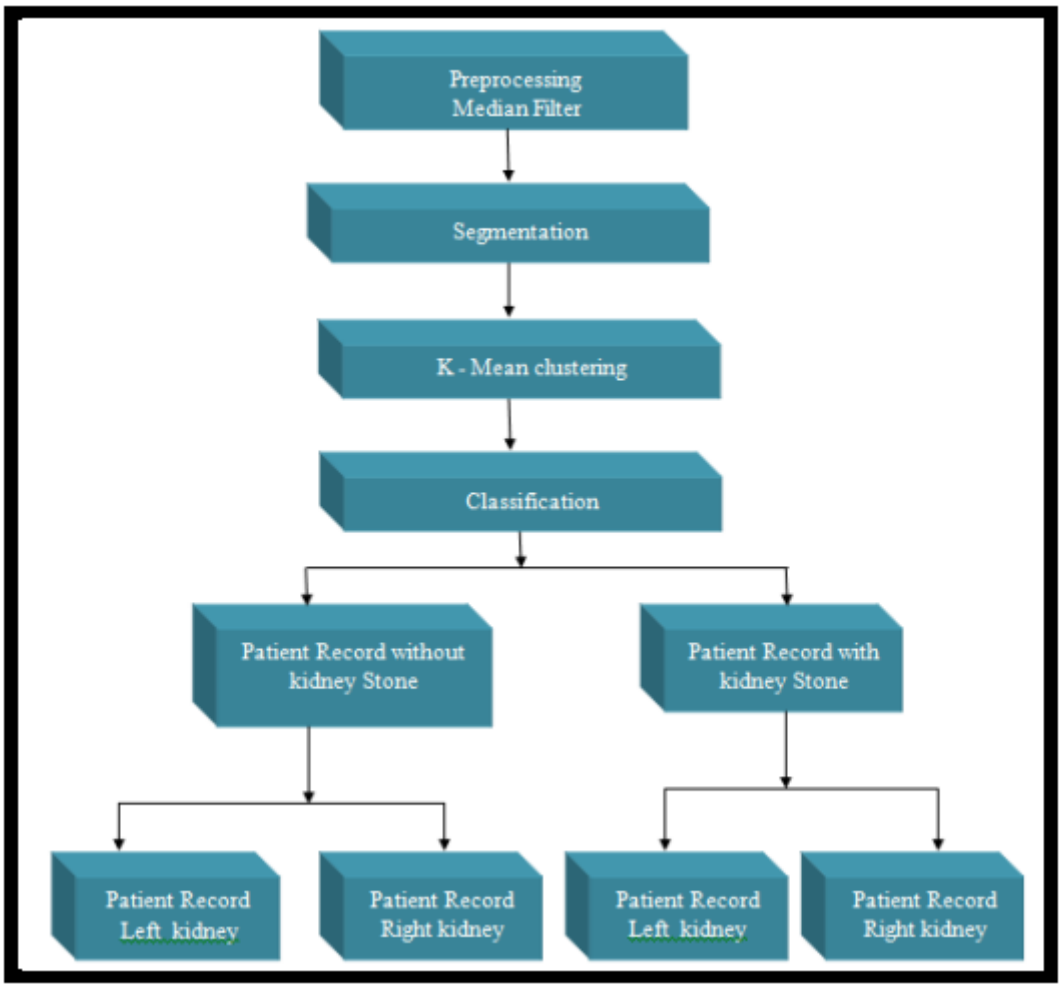

Fig 3. Methodology Flow Chart

Segmentation

In the segmentation method, it helps to detect the region of interest area for the particular image which needs to be examined. The main objective of image segmentation is to find out region-based interest over the image. Segmentation steps involve split methods which help the image to split into the equal region or called as a unit. For iteration, it involves a split and merges process. Firstly, iteration split the region into different parts of the region then it followed by the merging process. In segmentation, the threshold value is set to 0.1. In this matrix calculate the median value is 3 which is computed after steps 1 and 2. Then the original pixel values will be replaced and change to processed values.

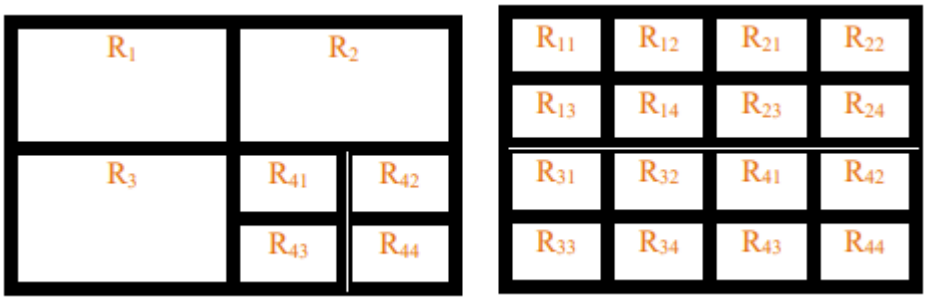

Fig 4. Splitting of the Image

Figure 5 represents a matrix of the spitting image. The matrix varies every subject domain by considering the number of stones in the Non-contrast CT of the abdominal area routinely delivers the best precise test but also exposes patients to ionizing radiation as a result of the procedure. Ultrasonography has traditionally had lesser sensitivity and accuracy than computed tomography (CT), but it does not involve radiation use. These imaging modalities, on the other hand, were shown to have equal diagnostic accuracy when compared to a randomized controlled experiment, which was conducted in an emergency department. Both modes of transportation have their pros as well as downsides. In patients with established stone illness, plain film radiography of the kidney, ureter, as well as bladder (KUB) is the most appropriate imaging technique for assessing interval stone development. It is less beneficial in the context of acute stones, however. Although magnetic resonance imaging (MRI) allows for 3D imaging without the use of radiation, it is both expensive and hard to see stones at this time. The examination of kidney disease is thus a critical aspect of the research into nephrolithiasis to better comprehend the function of trace components in the production of kidney stones as well as to develop future methods for management and prophylaxis of stone formation as well as recurrence. The purpose of this study is to examine methods and procedures that are routinely utilized in the evaluation of urinary calculi. And along with this, a cheap and non-radiation technology can be developed by improving the techniques, methods, and algorithms being used so far.

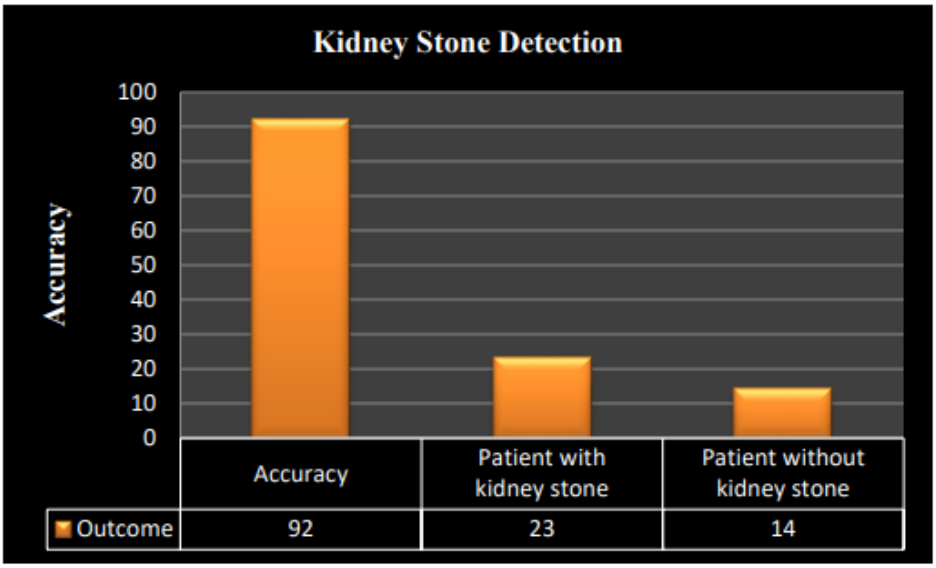

Fig 5. Represents the accuracy of kidney stone detection with overall outcomes, patients with kidney stone, and without kidney stone by using graphical mapping.

V. RESULTS

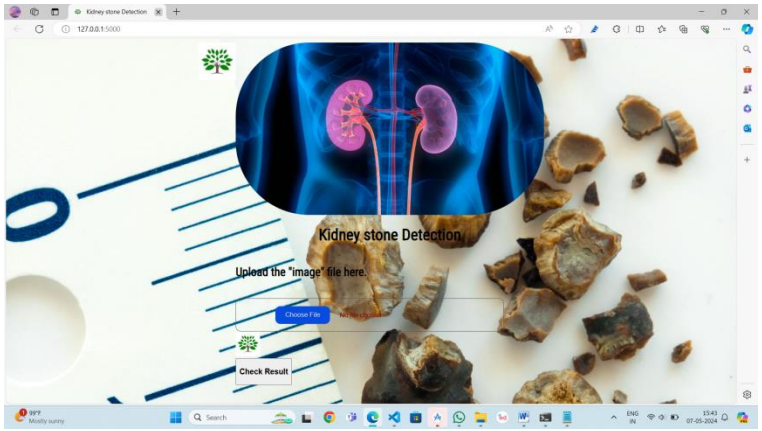

Fig 6. Starting Page

Figure 6 shows the web interface of the proposed system. The proposed system web interface is a user-friendly interface, it consists of an input for selecting the CT images and a check result button. The user drops the image in the selecting field and clicks the check result button then the system analyzes the input title with all the titles in the dataset. Match the input title with all available titles and list the matched titles in a separate dataset. Now the result is shown in the next webpage whether the kidney as stone or not in the kidney.

Fig 7. Result Page

Figure 7 is an example of the kidney stone showed in the kidney where it say the crystal or normal of the stone in the kidney also, this show the doctor where the stone is present in the kidney. around 40 patients from the hospital using a CT scanning machine, which diagnosis kidney stone diseases. This research explores the advanced technique to detect boundary, segmented area, and enhance detection of stone location from the kidney. This investigation helps in identifying the location of stone based on pixels. It also identifies the number of patients facing problems with the stone.

VI. DISCUSSION

One of the main benefits of a kidney stone detection is that it can assist doctors to save time and effort when searching for stones in the kidney that are the result display stone detection in kidneys with image processing techniques using CT images. Four stages were examined image preprocessing using median filter, segmentation with k- mean clustering algorithm, detection of kidney stone, and classification. Data collected for testing around 40 patients from the hospital using a CT scanning machine, which diagnosis kidney stone problems. Accuracy is calculated using a confusion matrix which helps in determining values of false positive, true positive, false negative, and true negative results. For testing 40 CT scan patient report collected. Initially, the images are clustered into two groups. Group 1 without kidney stone and group 2 with kidney stone analysis. In which group 1 contains 10 patients which are healthy in position by examining both sides of kidney _left and kidney _right and group 2 contains 30 patients which are unhealthy in

position by examining both sides of kidney _left and kidney _right using classification method. Group 2 also classifies several stones present by mean of count to kidney _left and kidney _right.

VII. CONCLUSION

In conclusion, the work with deep analysis of stone detection in kidneys with image processing techniques using CT images was examined. This is one of the important issues over the world to detect the proper location of stone throughout the kidney. In this research, four stages were examined image preprocessing using median filter, segmentation with k- mean clustering, kidney stone detection with location type using classification technique. A total number of data collected around 40 patients from the hospital to diagnosis kidney stone problems. This research explores the advanced technique to detect boundary, segmented area, and enhance detection of stone from the kidney with present locations left or right. The investigation ensures this research has 92.5% accuracy with an effective stone detection technique using image processing..

VIII. REFERENCE

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