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PREDICTION OF KIDNEY STONES USING CNN

Mrs. B. Sailaja[1], Akkireddi Kusuma[2], Adusumilli Samatha[3], Gunturu Krishnaveni[4], Etha Lakshmi Prasanna[5]

[1]AssistantProfessor, Department of Computer Science and Engineering, Vignan's Institute of Engineering for Women, Visakhapatnam, India

[2-5]Department of Computer Science and Engineering, Vignan's Institute of Engineering for Women, Visakhapatnam, India

ABSTRACT

Nowadays, kidney stone has become a major problem and if not detected at a nearly stage then it may cause complications and sometimes surgery is also needed to remove the stone. So, detecting the stone precisely paves the way to image processing because through image processing there is a tendency to get the precise results and it is an automatic method of detecting the stone. 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 over come by employing suitable image processing techniques. The ultrasound image is first pre-processed to get rid of speckle noise using the image restoration process. There stored image is smoothened using one of the (gaussian) filtering technique. The preprocessed image is achieved with image segmentation to detect the stone region. Further these gmented image is processed withwavelettransformationandCNNclassification.

Key Words:
Kidney stone detection, CNN classification, wavelet processing, ultrasound images, Gaussian filter, cannyedge detection.

INTRODUCTION

Kidney stone, also known as a renal calculus is a solidpiece of material which is formed in the kidneys from mineralsin urine. Kidney stones typically leave the body in the urinestream, and a small stone may pass without causing symptoms. Kidney stone detection is challenging because of having low resolution image quality which is difficult to analysis by human as well as machine. As we all know that medical cannot afford low accuracy that is why we choose to improve classification technique in order to analyse best kidney stone detection. The proposed techniques start with image acquisition which is used to take image from the external source of system. After first step we move to the median filter which is actually used to remove noise for the image. Sharpening of the image is done with the help of un-sharp masking. Generally medical images are poor quality especially in contrast form. Therefore it is required to enhance the image. Digital Image Processing means processing digital image by means of a digital computer. We can also say that it is a use of computer algorithms, in order to get enhanced image either to extract some useful information. Digital image processing deals with manipulation of digital images through a digital computer. It is a subfield of signals and systems but focus particularly on images. DIP focuses on developing a computer system that is able toper form 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. Analyzing and manipulating the image.
3. Output in which result can be altered image or are port which is based on analyzing that image.

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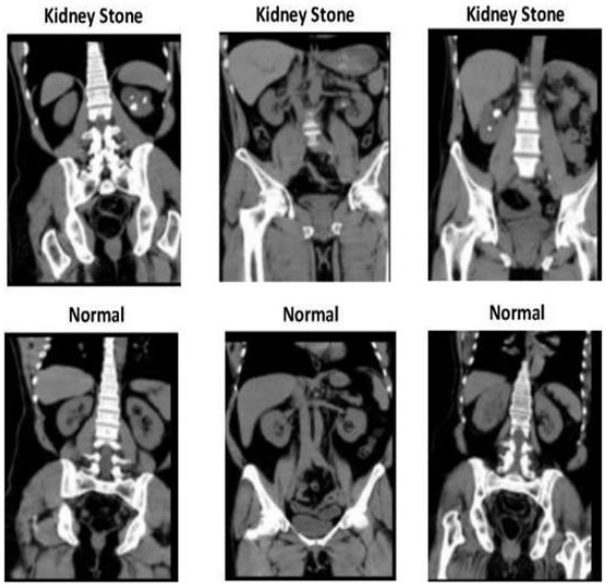

Fig1: Kidney stone Images

CONVOLUTION NUERAL NETWORK

Convolution Neural Network or CNN is a type of artificial neural network, which I swidely used for image/object recognition and classification. Deep Learning thus recognizes objects in an image by using a CNN. A typical neural network will have an input layer, hidden layers, and an output layer. CNNs are inspired by the architecture of the brain. Just like a neuron in the brain processes and transmits information throughout the body, artificial neurons or nodes in CNNs take inputs, processes them and sends the result as output. The image is fed as input. The input layer accepts the image pixels as input in the form of arrays. In CNNs, there could be multiple hidden layers, which perform feature extraction from the image by doing calculations. This could include convolution, pooling, rectified linear units, and fully connected layers. Convolution is the first layer that does feature extraction from an input image. The fully connected layer classifies the object and identifies it in the output layer. "CNNs are feed forward networks in that information flow takes place in one direction only, from their inputs to their outputs. Just as artificial neural networks (ANN) are biologically inspired, so are CNNs. The visual cortex in the brain, which consists of alternating layers of simple and complex cells, motivates their architecture. CNN architectures come in several variations; however, in general, they consist of convolutional and pooling (or subsampling) layers, which are grouped into modules.

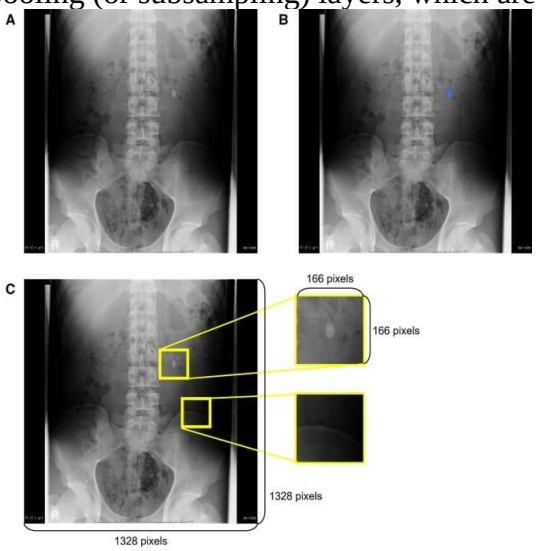

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Fig2: Convolution Neural Networks

Types of Kidney Stones:

Calcium stones- Calcium oxalate which is the prime content of Calcium stones. Oxalate is a naturally occurring substance found in food. Even found in metabolic activities by liver. Foods high in oxalate include nuts, chocolates, dark green vegetables and fruits like berries etc. Increase in the concentration of calcium or oxalate in urine can be caused because higher dosages of vitamin-D. Several metabolic disorders such as irregular intake of food can even cause these. Calcium phosphate is the main content of calcium stones. Renal tubular acidosis which is ametabolic reaction, is one of the major reason for the formation of these stones. Seizure medications, such as to piramate may even also produce these stones. Struvite stones-Frequent diagnosis with urinary tract infections usually cause this type of stones is found in recent studies. These stones are alarming situations as they grow larger with the time which may lead to removal by surgery. Uric acid stones- Humans who usually do not drink enough uids which are sufficient for the body and those who lose more fluids and high content of protein in their diet are more prone to this uric acid stones as they produce more uric acid. Recent studies show genetic dependency in the occurrence of uric acid stones. Cystine stones-A hereditary disorder that causes the kidneys to excrete too much of certain amino acids may cause these stones (cystinuria).

LITERATURE SURVEY

There has been many research carried in the fields of this image processing for kidney stone detection, researchers used many kinds of algorithms for finding the stone in a kidney. Ultrasound imaging is one of the imaging techniques used for diagnosis of kidney abnormalities. The kidney abnormalities such as formation of stones as shown. During surgery it is very hard to recognize the precise location of the kidney stone. Kidney stone disease is one of the most life threatening diseases in the worldwide. The main function of the kidney is to regulate the balance of electrolytes in the blood [1].

Ultrasound images are widely available, are generally safer as they donot involve radiation Moreover, in real setting, ultra sound images are collected and analyzed manually by physicians, and each examination may take several images of the kidney, uteri and bladder. This requires that an automatedsystemshouldhavetheabilitytodealwithnoisedataandselectappropriateimagesofthekidneyfro mastackofultrasounddata.Moreover, in real setting, ultrasound images are collected and analyzed manually by physicians, and each examination may take several images of the kidney , uteri and bladder. This requires that an automated system should have the ability to deal with noise data and select appropriate images of the kidney from a stack of ultra sound data[2].

In this stage it generates desired regions by segmentation and extracts the corresponding features, then undergoes classification. The efficiency of the model depends on segmentation and extracted features. Conventional model gives the better result. However,the intricate Characteristics of microscopic images of urine sediments make difficulty in pre-processing (segmentation) and feature extraction of conventional model. The use of deep learning based Convolutional Neural Network (CNN) Provides new way of classification and detection of urinary particles by learning desired features automatically and detect images[3] .

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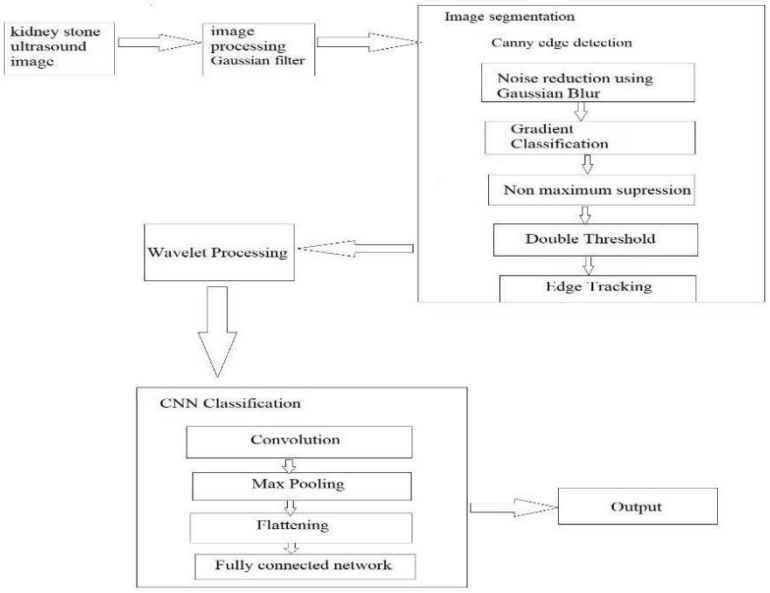

Fig 3: Architecture of CNN

IMAGE PRE-PROCESSING

Image preprocessing is the steps taken to format images before they are used by model training and inference. This includes, but is not limited to, resizing, orienting, and color corrections. Image preprocessing may also decrease model training time and increase model inference speed. If input images are particularly large, reducing the size of these images will dramatically improve model training time without significantly reducing Model performance.

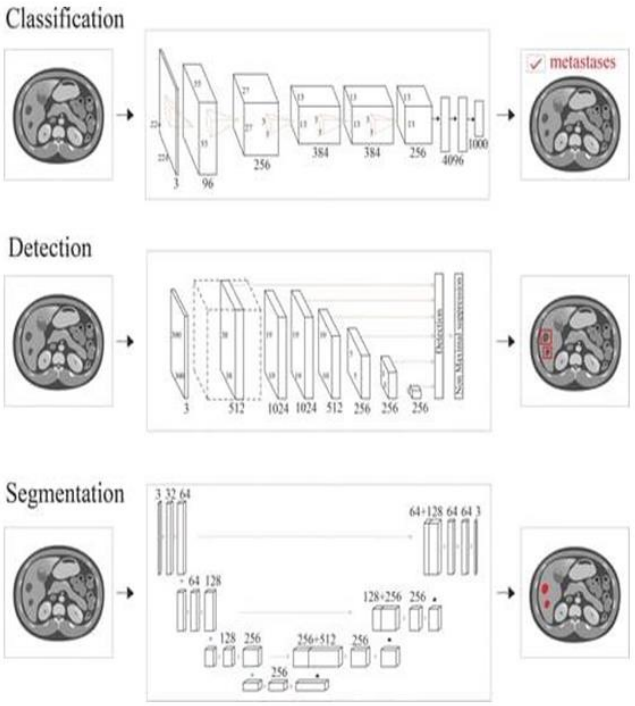

Fig4: image Preprocessing

IMAGE SEGMENTATION

Segmentation is an important and major aspect of medical imaging and digital image processing. It helps in visualizing the data available by providing diagnostics for various diseases depending on the given dataset. Canny edge detection, identifying and sharpening the edge of the kidney and the stone

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in the kidney are two major functionalities of it. It is one of the level set segmentation techniques. The process of dividing a digital image into multiple segments is termed as segmentation of the image. The lines, curves, boundaries are located in the process of image segmentation and even image objects. Assigning labels to every pixel of the image and segregating labels having same labels which have common characteristics and this process is termed as image segmentation. The result produced is image segmentation, a set of segments which cover the entire image or a set of contours of the image.

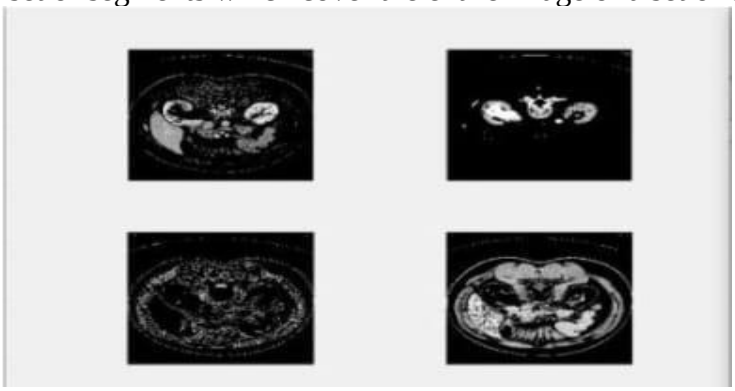

Fig 5: Image Segmentation

WAVELET PROCESSING

Wavelet transforms area mathematical procedure of performing signal analysis when signal frequency varies overtime.Wavelet Transform is particularly selected for this project as for certain classes and signals this provides better precise results. Wavelets are commonly used in image processing to detect and filter white Gaussian noise because of their high contrast of intensity values of the neighbouring pixel. The two-dimensional image in the form of the matrix is feed in to wavelet transform.The segmented image from the input opted to perform wavelet transform to get a compressed image. The image processed in this way can be cleaned without destroying the image quality such as blurring and muddling.

RESULT AND ANALYSIS

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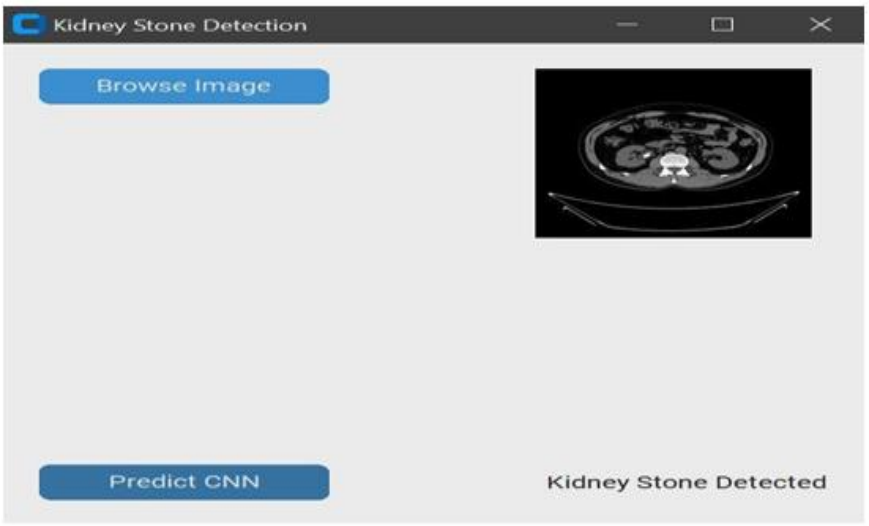

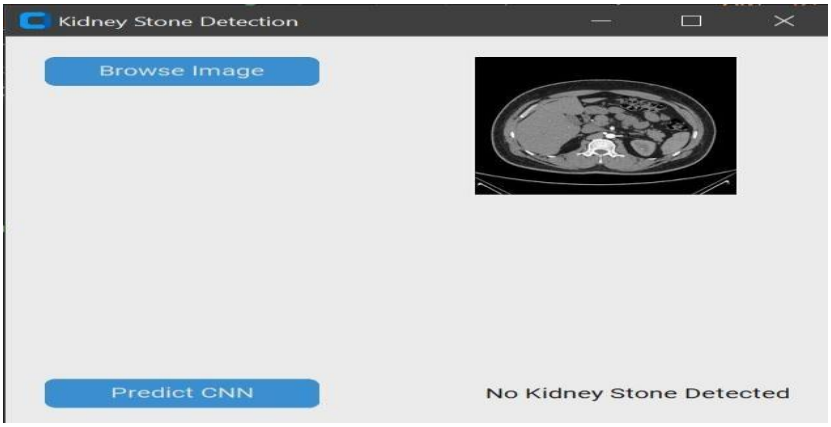

CONCLUSION AND FUTURE SCOPE

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

toaddressthelimitationssuchaslevelsettechniquesrequireconsiderable thought in order to construct velocities to get a perfect advanced level set function. This means there should be a huge data available to get the accuracy rate which is sometimes may not be possible. We planned to rectify these issues using CNN classification. The energy levels extracted from the wavelet sub bands i.e Gaussian filter gives the clear indication of difference in the energy levels compared to that of normal kidney image if there is stone. The CNN trained with normal kidney image and classified input into normal or abnormal by considering extracted energy levels from wavelet filters. By using CNN classification we obtained an accuracy in between 70-85%. We can also identify the size of a kidney stone by using SVM as a future scope of this project.

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