ANALYSIS AND IMPLEMENTATION OF KIDNEY STONE DETECTION USING ARTIFICIAL NEURAL NETWORKS

*A Project report submitted in partial fulfillment of the requirements for
the award of the degree of*

BACHELOR OF TECHNOLOGY

IN

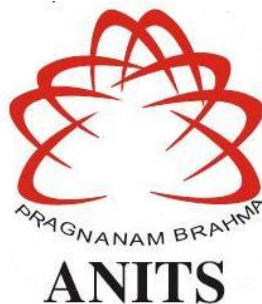**ELECTRONICS AND COMMUNICATION ENGINEERING**

Submitted by

P.V.N.Srihyma(317126512046)   CH.NagaSaiKiran(317126512012)

M.SankarPavanKumar(317126512039)   K. NaveenKumar(317126512024)

Under the guidance of

Mr.V.Vijay Kumar Raju

(Assistant Professor)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY AND SCIENCES
(UGC AUTONOMOUS)
(*Permanently Affiliated to AU, Approved by AICTE and Accredited by NBA & NAAC with 'A' Grade*)
Sangivalasa, bheemilimandal, visakhapatnamdist.(A.P)
2020-2021
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

ANIL NEERUKONDA INSTITUTE OF TECHNOLOGY AND
SCIENCES (UGC AUTONOMOUS)

*(Permanently Affiliated to AU, Approved by AICTE and Accredited by NBA &
NAAC with 'A' Grade)*

Sangivalasa, Bheemilimandal, Visakhapatnam dist.(A.P)

ANITS

CERTIFICATE

This is to certify that the project report entitled **"ANALYSIS AND IMPLEMENTATION OF KIDNEY STONE DETECTION USING ARTIFICIAL NEURAL NETWORKS"** submitted by P.V.N.Srihyma (317126512046), M.Sankarpavankumar(317126512039), Ch.NagaSaikiran (317126512012), K.Naveenkumar (317126512024) in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology in Electronics & Communication Engineering** of Andhra University, Visakhapatnam is a record of bonafide work carried out under my guidance and supervision.

Project Guide

V.Vijay Kumar Raju
Assistant Professor
Department of E.C.E
ANITS

Assistant Professor
Department of E.C.E.
Anil Neerukonda
Institute of Technology & Sciences
Sangivalasa, Visakhapatnam-531 162

Head of the Department

Dr. V.Rajyalakshmi
Professor & HOD
Department of E.C.E
ANITS

Head of the Department
Department of E C E
Anil Neerukonda Institute of Technology & Science
Sangivalasa - 531 162

ii

ACKNOWLEDGEMENT

ABSTRACT

Kidney stone problem (nephrolithiasis) is a common type of urological disease with a high recurrence rate.This disease is a progressive disease that damaged the kidneys leading to be permanent and undone problem. Therefore, it is vital to identify kidney stone disease before the permanent damage is done. If the stone problem is caught in the early stage, kidney disease can be treated very effectively. So, stone diagnosis is vital not only treatment of kidney disease but also management of recurrent stone formation. Hence early detection of kidney stone is essential Ultrasound imaging is one of the available imaging techniques used for diagnosis of kidney abnormalities, which may be like change in shape and position and swelling of limb. During surgical processes it is vital to recognize the true and precise location of kidney 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 overcome by employing suitable image processing techniques. The ultrasound image is first preprocessed to get rid of speckle noise using the image restoration process. The restored image is smoothened using Gabor filter and the subsequent image is enhanced by histogram equalization. The preprocessed image is achieved with level set segmentation to detect the stone region. Segmentation process is employed twice for getting better results; first to segment kidney portion and then to segment the stone portion, respectively. The results are analyzed using MLP-BP ANN algorithms for classification and its type ofstone.

Key words : Ultrasound image, Image processing, Image segmentation, Artificial neural networks.

CONTENTS

LIST OF SYMBOLS

F   Force function

Dist(.)   Distance function

Db12   Daubechies filyter

Sym12   Symlets filter

Bio12   Biorthogonal filter

G   Gaussian filtering

Sigma   Standard deviation

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVATIONS

US	Ultrasound
LSM	Level set method
LSF	Level set function
SDF	Signed distance function
MLP	Multilayer perceptron
BP	Back propagation
ANN	Artificial neural networks
CCD	Charge coupled device
CMOS	Complementary metal oxide semiconductor
PSF	Focuses spreading capacity
MTF	Tweak move work

CHAPTER 1 INTRODUCTION

1.INTRODUCTION

Kidney stone disease is one of the major Life threatening ailments persisting Since kidney malfunctioning can be menacing, diagnosis of the problem in the initial stages is advisable. Ultrasound (US) image is one of the currently available methods with noninvasive low cost and widely used imaging techniques for analyzing kidney diseases.The ultrasound image is first preprocessed to get rid of speckle noise using the image restoration process. The restored image is smoothened using Gabor filter and the subsequent image is enhanced by histogram equalization. The preprocessed image is achieved with level set segmentation to detect the stone region. Segmentation process is employed twice for getting better results; first to segment kidney portion and then to segment the stone portion, respectively. Kidney Stones: Kidney stone has the chance of happening in half of people and in about portion of them gets clinically critical manifestations, which incorporates impeding simple stream of urine, swellings inside the kidney, torment in back or flank side of the low back, even queasiness, retching, and perspiring. The clinical name of the arrangement of kidney stone is NephrolithiasisIt is the collection of salts and certain minerals primarily comprised of calcium and uric corrosive in urine. It is caused because of deficient admission of water. Kidney stone fundamentally happens when our body needs liquid however collects a ton of wasteDiabetes, high circulatory strain and corpulence may expand the danger of kidney stone in a person.Ultrasound (US) picture is one of the as of now accessible strategies with noninvasive minimal expense and generally utilized imaging procedures for breaking down kidney infections.We present our strategy in the execution of US imaging for the assessment of kidney stone go and recognize that different conventions work similarly well. It is normal that these conventions will be altered over time as new hardware opens up**.** Rahman and Uddin have proposed lessening of dot commotion and division from US picture. It not just distinguishes

issue in the kidney area yet in addition gives picture quality improvement.The fundamental goal of this undertaking is to identify the kidney stone from an advanced ultrasound picture of the kidney by performing the

different picture handling strategies. In any case, the picture delivered by the ultrasound procedures isn't appropriate for additional preparing because of low differentiation and the presence of noise called speckle noise.These methods fundamentally assist the specialist with promoting treat the patient dependent on the size and area of thestone.

1.1 Project Objective

The kidney malfunctioning can be life intimidating. Hence early detection of kidney stone is essential. Precise identification of kidney stone is vital in order to ensure surgical operations success. The ultrasound images of kidney comprise speckle noise and are of low contrast which makes the identification of kidney abnormalities a difficult task. As a result, the doctors may find identification of small stones and the type is difficult and challenging for identify the small kidney stones and their type appropriately. To address this issue, a reaction diffusion level set segmentation is proposed to identify location of the stone. Kidney stone has the possibility of occurring in 50% of men and women and in about half of them gets clinically significant symptoms, which includes blocking easy flow of urine, swellings within the kidney, pain in back or flank side of the low back, even nausea, vomiting, and sweating. The medical name of the formation of kidney stone is Nephrolithiasis.The five common types of stones are calcium oxalate, calcium phosphate, uric acid, struvite, and cystine. Calcium oxalate and calcium phosphate is the mostly occurred type of kidney stones. Computerized Tomography (CT scan), Intravenous Pyealogram. Magnetic Resonance Imaging, Ultrasound imaging and Urine test was the method of identification of kidney stones. The intravenous

1.2 Project Outline

To detect the kidney stone, we used the following approach:

The kidney stone produces an acoustic shadow in the ultrasound image. An acoustic shadow or sound shadow is an area through which the sound waves fail to propagate due to topographical obstructions. In this case, the kidney stone is the barrier that disrupts the sound waves. Once we detect the shadow, the stone can be located just above it in the image.The ultrasound images contain speckle noise. To process the image and detect the location of the stone in the image, we need to remove the noise. Thus, the first step is to enhance the image by using various sharpening and smoothing filters.

After the image is enhanced, image segmentation is used to differentiate between the shadow and the stone by separating the foreground and the background.It comprises of the accompanying squares by means of kidney image data set, image preprocessing, image division, wavelet preparing, and ANN arrangement.

The kidney malfunctioning can be life intimidating. Hence early detection of kidney stone is essential. Precise identification of kidney stone is vital in order to ensure surgical operations success. The ultrasound images of kidney com prise speckle noise and are of low contrast which makes the identification of kidney abnormalities a difficult task. As a result, the doctors may find identification of small stones and the type is difficult and challenging for identify the small kidney stones and their type appropriately. To address this issue, a reaction diffusion level set segmentation .

CHAPTER 2   ULTRASOUND IMAGING

2.ULTRASOUND IMAGING

2.1 Introduction

Ultrasound imaging (sonography) uses high-frequency sound waves to view inside the body. Because ultrasound images are captured in real-time, they can also show movement of the body's internal organs as well as blood flowing through the blood vessels. Unlike X-ray imaging, there is no ionizing radiation exposure associated with ultrasound imaging.

In an ultrasound exam, a transducer (probe) is placed directly on the skin or inside a body opening. A thin layer of gel is applied to the skin so that the ultrasound waves are transmitted from the transducer through the gel into the body.

Fig 2.1 Transducer used during an ultrasound imaging

The ultrasound image is produced based on the reflection of the waves off of the body structures. The strength (amplitude) of the sound signal and the time it takes for the wave to travel through the body provide the information necessary to produce an image.

Medical ultrasound is a diagnostic imaging technique, or therapeutic application

of ultrasound. It is used to create an image of internal body structures such as tendons, muscles, joints, blood vessels, and internal organs. Its aim is often to find a source of a disease or to exclude pathology.

2.2 Uses

Ultrasound imaging is a medical tool that can help a physician evaluate,diagnose and treat medical conditions. Common ultrasound imaging procedures include:

- Abdominal ultrasound (to visualize abdominal tissues andorgans)
- Bone Sonometry.(to assess bonefragility)
- Breast Ultrasound (to visualize breasttissue)
- Doppler fetal heart rate monitors (to listen to the fetal heartbeat)
- Doppler ultrasound (to visualize blood flow through a blood vessel, organs, or otherstructures)
- Echocardiogram (to view the heart)
- Fetal ultrasound (to view the fetus inpregnancy)
- Ultrasound-guided biopsies (to collect a sample oftissue)
- Ophthalmic ultrasound (to visualize ocularstructures
- Ultrasound-guided needle placement (in blood vessels or other tissues ofinterest)

Fig 2.2 Medical Ultrasound Scanner

2.3 Advantages and Disadvantages

Advantages:

- High successrate
- Safe performance ofblocks
- Direct visualization of neuronal and adjacent anatomicalstructures
- Direct visualization of needle placement and spread of localanesthetics
- The individual blocks are cheaper in comparison with other techniques inregional anesthesia
- Amortization of high standard ultrasound equipment after 2500 blocks due tohigh success rates (with very low conversion rates to alternative anesthesia methods), low rate of complication (when the techniques are used appropriately), lower volume of local anesthetics, cheaper needlematerial.
- It is based on non-ionizing radiation, so it does not have the same risks as X-rays or other types of imaging systems that use ionizing radiation.

Disadvantages:

- High sophisticated additional educationnecessary.
- High initial costs of education andequipment.
- The use of ultrasound solely for non-medical purposes such as obtaining fetal 'keepsake' videos has beendiscouraged.
- Ultrasound waves can heat the tissues slightly. In some cases, it can also produce small pockets of gas in body fluids or tissues(cavitation).

CHAPTER 3 IMAGE SEGMENTATION

3.IMAGE SEGMENTATION

3.1 Introduction

In digital image processing and computer vision, **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 analyze. 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 color,intensity, or texture. Adjacent regions are significantly different with respect to the same characteristics. When applied to a stack of images, typical in medicalimaging, the resulting contours after image segmentation can be used to create 3Dreconstructions with the help of interpolation algorithms like marching cubes.

Applications

Some of the practical applications of image segmentation are:

- Content-based imageretrieval[4]
- Machinevision
- Medical imaging, including volume rendered images from computedtomography and magnetic resonanceimaging.
  - Locate tumors and other pathologies
  - Measure tissuevolumes
  - Diagnosis, study of anatomicalstructure

- Surgeryplanning
- Virtual surgerysimulation
- Intra-surgerynavigation
- Objectdetection
  - Pedestriandetection
  - Facedetection
  - Brake lightdetection
  - Locate objects in satellite images (roads, forests, crops,etc.)
- RecognitionTasks
  - Facerecognition
  - Fingerprintrecognition
  - Irisrecognition
- Traffic controlsystems
- Videosurveillance
- Video object co-segmentation and actionlocalization

In the segmentation process, five level set methods in all are discussed, all implemented and compared.

3.2 Conventional LSS

In the conventional level set method, consider a closed parameterized planar curve or surface, denoted by $C(y, t) : [0, 1]x\ R+ \rightarrow Rn$, where $n=2$ is for planar curve and $n=3$ is for surface, and t is the artificial time generated by the movement of the initial curve or surface $C0(y)$ in its inward normal direction $N\sim$. The curve or surface evolution equation is asfollows

$$C(y, t = 0) = C_0(y), \qquad \text{eq.3.1}$$

$$C_t = FN \qquad \text{eq.3.2}$$

$$\emptyset_t + \nabla_\emptyset . C_t = \emptyset_t + \Delta_\emptyset . FN = 0, \qquad \text{eq.3.3}$$

$$\emptyset(x, t = 0) = \emptyset_0(x) \quad \text{eq.3.4}$$

where F is the force function. In the above equation intrinsic drawback of interactively solving (2) lies in its difficulty to handle topological changes of the moving front, such as splitting and merging. This problem can be eliminated by using the level set method (LSM) by modifying the above equation (2) by taking the derivative with respect to time t on the both sides, yielding the following equation:

where gradient operator $\nabla(\cdot) = \partial(\cdot)/\partial x1, \partial(\cdot)/\partial x2, \ldots, \partial(\cdot)/\partial xn$ and $\phi0(x)$ is the initial LSF $C0(y) = \{x \mid \phi0(x) = 0\}$. But (3) fails for too flat or too steep near the zero level set to address this issue re-initialization is introduced

3.2 Reinitialization LSS

But, during evolution, the level set function (LSF) fails for too flat or too steep near the zero level set, causing serious numerical errors. Therefore, a procedure called reinitialization is periodically employed to reshape it to be a signed distance function (SDF). In reinitialization the distance signed function is $(x) = 1\pm\text{dist}2\ (x)$ where $\text{dist}(\cdot)$ is a distance function and $\pm$ denotes the sign inside and outside the contour. But it has many problems, such as expensive computational cost, blocking the emerging of new contours, failures when the LSF deviates much from an SDF, and inconsistency between theory and implementation using XSG shown in Figure 2.1. Therefore, some formulation has been proposed to regularize the variational LSF to eliminate the reinitialization and computationalcost.
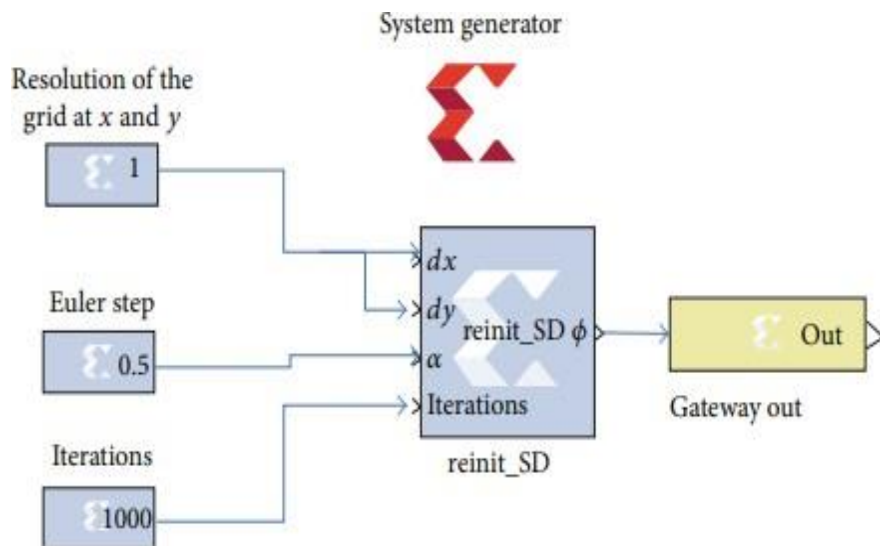
Fig 3.1 Hardware implementation of signed distance function using XSG

3.3 Reaction Diffusion LSS

The RD equation is constructed by adding a diffusion term into the conventional LSE equation. Such an introduction of diffusion to LSE makes LSE stable without reinitialization. The diffusion term "$\varepsilon\Delta\phi$" was added to the LSE equation (3).

RD Level Set Segmentation Algorithm

(1) Initialization is as follows: $\phi n = \phi 0, n$.

(2) Compute $0n+1/2$ as $\phi n+1/2 = \phi n = \Delta t2(\phi n)$.

(3) Compute $0n+1$ as $\phi n+1/2 = \phi n + \Delta t2(\phi n)$.

(4) If $0n+1$ satisfies stationary condition, stop; otherwise, $n=n+1$ and return to step (2):

$\phi n = \phi n+1/2$.

From the analysis in DRLSE and RD, the equilibrium solution of (10) is seen t as $\varepsilon\rightarrow 0+$, which is the characteristic of phase transition. On the other hand, the said equation intrinsic problem of phase transition, that is, the stiff parameter $\varepsilon -1$, makes (10) difficult to implement. In TSSM section, we propose a splitting method to implement (10) to reduce the side effect of stiff parameter $\varepsilon -1$.

Speed of Segmentation. For the reinitialization methods, (4) should be iterated several times to make the LSF be an SDF while keeping the zero level set stationary. This is highly time-consuming for the reinitialization methods. The GDRLSE methods are computationally much more efficient than reinitialization method. Equation (8) in each iteration of the computation of GDRLSE includes two components: the regularization term and LSE term driven by force F, in each iteration of RD method; the computation also includes two similar components. The only difference is that we split the computation into two steps: first compute the LSE term, and then compute the diffusion term. Therefore, the computation complexity of RD is similar to that of GDRLSE methods and, using Xilinx system generator.

CHAPTER 4 METHODOLOGY

4.METHODOLOGY

4.1 Introduction

Figure 4.1 shows the general square outline of the proposed technique. It comprises of the accompanying squares by means of kidney image data set, image preprocessing, image division, wavelet preparing, and ANN arrangement.

Kidney Image Database. Kidney image information base comprises of almost US kidney images gathered from various people of different emergency clinics. It comprises of both typical also, strange images put away in the information base. One of the images is chosen from the information base and exposed to stone discoverymeasure.

Image Preprocessing. The point of preprocessing is to improve the gained low difference ultrasound image with spot clamor. It smothers the undesired mutilations and improves certain image highlights critical for additional processing and stone location. Without preprocessing, the US image quality may not be useful for examining. For careful activities, it is fundamental to distinguish the area of kidney stone precisely. Preprocessing assists with defeating this issue of low difference and dot clamor decrease. Figure 4.2 shows the means associated with preprocessing of US image, which are as follows:

(1) Imagerestoration,

(2) Smoothing andsharpening

(3) Contrastenhancement.

Read image text from run command

Write input image pixels into RAM

Store the pixels in IP core RAM memory

Read all pixels from

RAM

Counter (2^14) (14 bit counter)

Image preprocessing

Level set segmentation for kidney portion

Only kidney portion

Kidney stone portion segmented by level set method

Only stone portion
Doctor can

view
Stone size with
Some colour of treatment

Extraction of energy values by using lifting scheme DWT

Energy values

MLP-BP-ANN

Monitor to view kidney image with stone portion

Display whether the kidney is normal or abnormal

Fig 4.1 Proposed block diagram for kidney stone detection

4.2 Image Restoration

Image restoration is intended to mitigate the debasement of the US image.Corruption might be because of movement obscure, commotion, and camera misfocus. The principle motivation behind picture rebuilding is to decrease the corruptions that are caused during securing of US examining. In this framework, level set capacity is utilized for appropriate direction. Utilizing plane bend movement, bend smoothers, recoils are ultimately eliminated Image restoration is not quite the same as image improvement in that the last is intended to underline highlights of the image that make the image more satisfying to the eyewitness, yet not really to create reasonable information from a logical perspective. Image improvement strategies (like difference extending or de-obscuring by a closest neighbor strategy) given by imaging bundles utilize no deduced model of the interaction that made the image. With image upgrade commotion can adequately be taken out by forfeiting some goal, however this isn't satisfactory in numerous applications. In a fluorescence magnifying instrument, goal in the z-heading is terrible all things considered. Further developed image handling procedures should be applied to recuperate the article. The target of image restoration strategies is to lessen commotion and recuperate goal misfortune Image handling procedures are performed either in the image area or the recurrence space. The most clear and an ordinary strategy for image restoration is deconvolution, which is acted in the recurrence area and subsequent to figuring the Fourier change of both the image and the PSF and fix the goal misfortune brought about by the obscuring factors. This deconvolution procedure, due to its immediate reversal of the PSF which normally has helpless grid condition number, intensifies commotion and makes a defective deblurred picture. Likewise, routinely the obscuring cycle is thought to be shift-invariant. Thus more complex methods, for example, regularized deblurring, have been created to bring to the table strong recuperation under various kinds of commotions and obscuring capacities. It is of 3sorts:
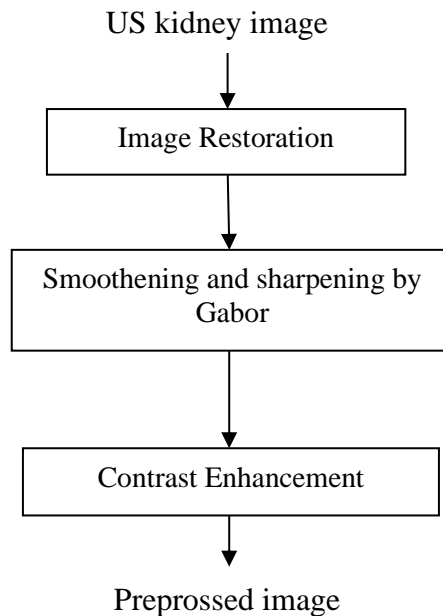
1. Geometric correction 2. radiometric correction 3. noiseremoval

4.3 Smoothening and Sharpening

The restored image is advanced with ideal goal in both spatial and frequency spaces utilizing Gabor channel. This channel goes about as a band pass channel with nearby spatial recurrence circulation.Image smoothing and expulsion of commotion is performed utilizing convolution operator.Smoothing and honing capacity utilize the pixels in a N x N neighborhood about every pixel to adjust a image. For both smoothing and honing channels the bigger the N x N neighborhood the more grounded the smoothing or honing impact. Smoothing and honing capacity can be either non versatile or versatile to neighborhood insights found in every N x N neighborhood of a image. The entirety of the smoothing and honing channels can be utilized with layers, mix modes, darkness, and covers to build their helpfulness. The dull foundation of a image can be smoothed utilizing a backwards luminance covers without affecting the more splendid spaces of the image. A luminance cover can be utilized to hone the brilliant spaces of a image without affecting the dim spaces of the image. The luminance of a image can be honed and utilized as the new luminance part of a image. The Making and Using Masks and Layers, Blend Modes, Opacity, and Covers sections of the ImagesPlus client manual contain point by point data making covers also, utilizing them with layers, mix modes, and obscurity. Commotion in a image can take a few structures. Drive clamor shows up as salt and pepper commotion. Added substance commotion is autonomous of image force. Multiplicative commotion is a component of imagepower.

4.3 Contrast Enhancement

Histogram equilization is utilized for development of the low difference US image and accomplishment of the uniform force. This methodology can be utilized on the image all in all or to a piece of a image. In this framework, contrast upgrade of the images is executed by changing the image force esteems, with the end goal that the histogram of the yield image roughly coordinates a indicated histogram.It is a method for changing image forces to improve contrast. It appoints the force upsides of pixels in the information image to such an extent that the yield image contains a uniform circulation of powers. It improves contrast and acquires a uniform histogram. This strategy can be utilized on an entire image or simply on a piece of a image. This cycle prompts an expansion conversely of the shadow of the stone and the actual stone. In this manner, it turned out to be morenoticeable.

US kidney image

```
┌─────────────────────────┐
│   Image Restoration     │
└─────────────────────────┘
```

```
┌─────────────────────────┐
│ Smoothening and sharpening by │
│          Gabor          │
└─────────────────────────┘
```

```
┌─────────────────────────┐
│   Contrast Enhancement  │
└─────────────────────────┘
```

Preprossed image

Fig 4.2 Preprocessing of kidney image

4.4 Watershed Algorithm

The reason for watershed algorithm is envisioning a dim level image into its geological portrayal sorting it into three fundamental ideas as minima, catchment bowls and watershed lines. In this way, in the information test image, the dull territories are expected to have low heights and the splendid zones are to have high heights making it resemble a geological surface. Consequently, watershed algorithm shows extraordinary potential in image division and appropriately sections the recognized strange regions.The watershed is a traditional algorithm utilized for division, that is, for isolating various items in a image. Beginning from client characterized markers, the watershed algorithm treats pixels esteems as a neighborhood geography (height). The algorithm floods bowls from the markers until bowls credited to various markers meet on watershed lines. As a rule, markers are picked as nearby minima of the image, from which bowls are flooded.There are diverse specialized meanings of a watershed. In diagrams, watershed lines might be characterized on the hubs, on the edges, or half breed lines on the two hubs and edges. Watersheds may likewise be characterized in the ceaseless domain.There are additionally various algorithms to figurewatersheds.

Watershed algorithms are utilized in image handling essentially for division purposes.

- Watershed byflooding
- Watershed by topographicdistance
- Watershed by the drop of waterprinciple
- Inter-pixelwatershed
- Topological watershed

4.5 Lifting Schemes Wavelet Processing

The segmented image (only stone) obtained from the previous block is applied to the lifting scheme wavelet processing block.This block consists of Daubechies filter (Db12), Symlets filter (sym12), and Biorthogonal filter (bio3.7, bio3.9, and bio4.3). In Daubechies filter (Db12) the number 12 denotes the number of vanishing moments. The higher the number of vanishing moments, the smoother the wavelet (and longer the wavelet filter) and the length of the wavelet (and scaling) filter should be twice that of the number. Symlets filter (sym12) extracts the kidney image features and analyses the discontinuities and abrupt changes contained in the signals. One of the 12th-order Symlets wavelets is used for feature extraction. Biorthogonal filter (bio3.7, bio3.9, and bio4.4) filter's wavelet energy signatures were considered and averages of horizontal and vertical coefficients details werecalculated.
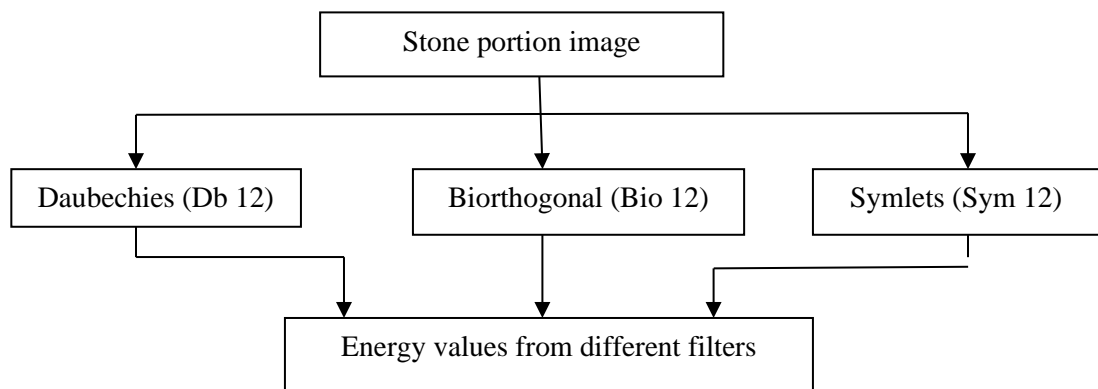
Fig 4.3 Wavelet filters to extract energy features

Dh 12

Kidney stone image

Split   Predict   Update

Cv12
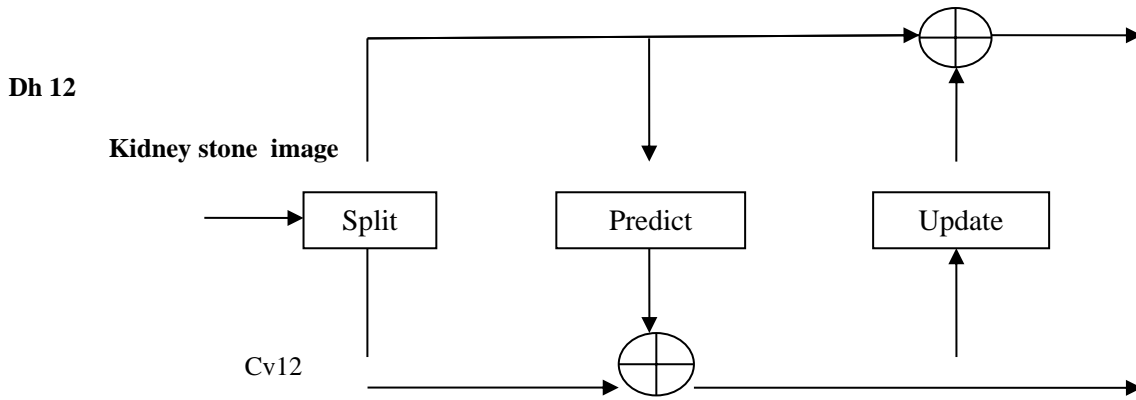
Fig 4.4   2D lifting scheme DWT

Figure 4.3 shows different filter used in the lifting scheme that gives different energy levels or energy features. These energy features will have significant difference if there is any stone present in the particular region or location. The identification of type of stone is explained in next section. In 2D lifting scheme wavelets transformation consists of update and predictor to get Db12, sym12, bio3.7, bio3.9, and bio4.3 as shown in Figure 4.4.

The equations of predict and update are given by

$d1\ i = \alpha\ (x2i + x2i+2)+x2i+1$ eq 4.1

$a1\ i = \beta\ (d1\ i + d1\ i-1)+x2i$ eq 4.2

$d2i=(a1i+a1i+1)+d1i$ eq 4.3

$a2i=(d2i+d2i-1)+a1i$ eq 4.4

$di = d2$,   eq 4.5

where $x2i$ and $x2i+2$ are even pixels, $2i+1$ is odd pixels of stone image, and $\alpha,\beta,\gamma,\delta,\varepsilon$ are the constants

23

4.6 ANN Classification

Two architectures are used in the ANN classification, namely, multilayer perceptron and back propagation, which are described in detail in the following sections. Multilayer Perceptron (MLP). A multilayer perceptron is a feedforward artificial neural network algorithm that helps in the mapping of different sets of energy and average values obtained from the wavelets subbands energy extraction shown in Table 1. These energy values are given to the input layer and multiplied with initial weights. The back propagation is the modified version of linear perceptron which uses three or more hidden layers with the nonlinear activation function. The back propagation is the most extensively used learning algorithm for multilayer perceptron inneural networks and it employs gradient descent to minimize the mean squared error between the network output value and the desired output value. These error signals are taken for completion of the weight updates which represent the power of knowledge learnt by the back propagation. Multilayer perceptron with back propagation (MLP-BP) is the core algorithm. Based on the literature survey, MLP-BP algorithm was found to be better than the other algorithms in terms of accuracy, speed, andperformance.
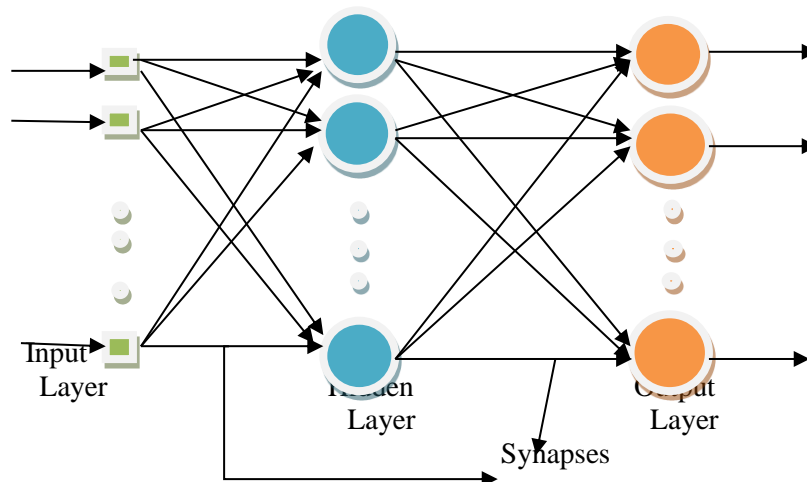
Fig 4.5 Multilayer Perceptron Architectutr

Nowadays artificial neural network has become most widely tool used for diagnosis of diseases. Because of the Fault tolerance, Generalization and Learning from environment like capabilities of Artificial neural networks it is becoming more and more popular in medical diagnosis and many more others areas. One of the network structures that have been widely used is the feed forward network where network connections are allowed only between the nodes in one layer and those in the next layer. Feed-forward back propagation neural network is used as a classifier to distinguish between infected or non- infected person. Figure 2 shows the architecture of feed forward neural networks (MLP) for decision making. In this structure three inputs are provided to network and then inputs and weights are summed by using summation function. Finally output is in binary form either Yes or No. Yes for a patient who is suffering from disease and no for unaffected person. In this work three neural network algorithms LVQ, RBF and feed forward architecture with back propagation algorithms have been investigated for diagnosis of kidney stones for early detection of disease. All three algorithms are compared against their classification accuracy to classify affected and unaffected persons.
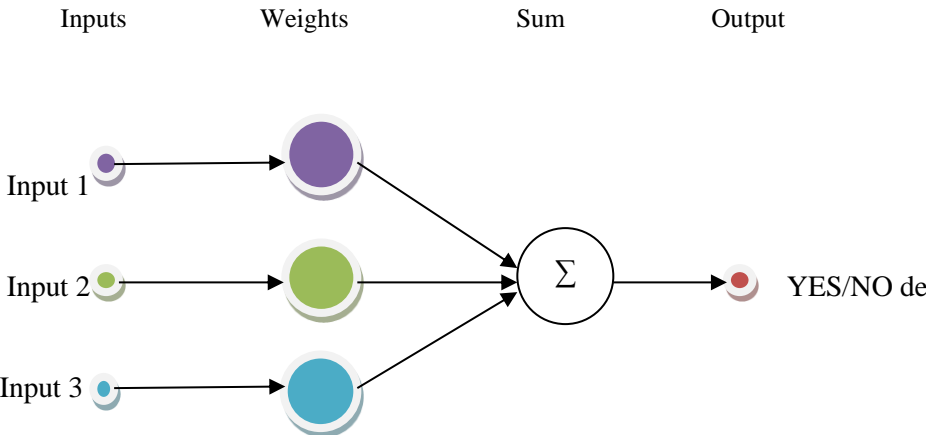
Fig 4.6 Feedforward Architecture in decision making

CHAPTER 5 NOISE MODELS
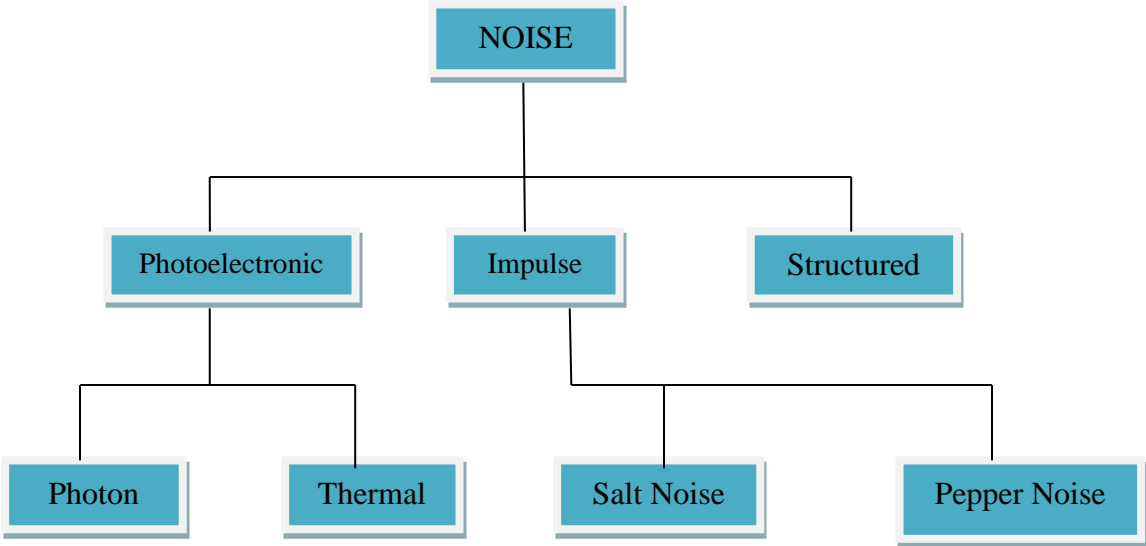
5.NOISE MODELS

5.1 Introduction

Any unwanted disturbance is Noise.Noise tells undesirable data in advanced pictures. noise produces unfortunate impacts, for example, ancient rarities, unreasonable edges, inconspicuous lines, corners, obscured protests and upsets foundation scenes. To lessen these unwanted impacts, earlier learning of commotion models is fundamental for additional preparing. Computerized noise may emerge from different sorts of sources like Charge Coupled Device (CCD) and Complementary Metal Oxide Semiconductor (CMOS) sensors. In some sense, focuses spreading capacity (PSF) and tweak move work (MTF) have been utilized for opportune, complete and quantitative examination of noise models. Likelihood thickness work (PDF) or Histogram is likewise used to plan and describe the noise models. Here we will talk about not many noise models, their sorts and classifications in computerized pictures. Image noise is random variation of brightness or color information in the images captured. It is degradation in image signal caused by external sources.Images containing multiplicative noise have the characteristic that the brighter the area the noisier it. But mostly it is additive.

Sources of Image noise*:*

- While image being sent electronically from one place toanother.

- **Sensor heat** while clicking animage.

- Withvarying**ISOFactor**whichvarieswiththecapacityofcameratoabsorb light.

Types of Image noise*:*

There are different types of image noise. They can typically be divided into 3 types.

```
                    ┌─────────────┐
                    │    NOISE    │
                    └─────────────┘
                           │
          ┌────────────────┼────────────────┐
    ┌──────────────┐  ┌──────────┐  ┌──────────────┐
    │Photoelectronic│  │ Impulse  │  │  Structured  │
    └──────────────┘  └──────────┘  └──────────────┘
          │                  │
     ┌────┴────┐        ┌────┴────────┐
  ┌────────┐ ┌────────┐ ┌──────────┐ ┌─────────────┐
  │ Photon │ │Thermal │ │Salt Noise│ │Pepper Noise │
  └────────┘ └────────┘ └──────────┘ └─────────────┘
```

5.2 Gaussian Noise

Gaussian Noise is a statistical noise having a probability density function equal to normal distribution, also known as Gaussian Distribution. Random Gaussian function is added to Image function to generate this noise. It is also called as electronic noise because it arises in amplifiers or detectors. Source: thermal vibration of atoms and discrete nature of radiation of warm objects. It is additionally called as electronic noise since it emerges in speakers or finders. Gaussian noise brought about by regular sources, for example, warm vibration of molecules and discrete nature of radiation of warm items . Gaussian noise for the most part upsets the dark qualities in advanced pictures. That is the reason Gaussian noise model basically planned and qualities by its PDF or standardizes histogram regarding dim worth. For the most part Gaussian noise numerical model addresses the right guess of genuine situations. In this noisemodel, the mean worth is zero, fluctuation is 0.1 and 256 dark levels as far as its PDF, which is appeared in Fig.5.1
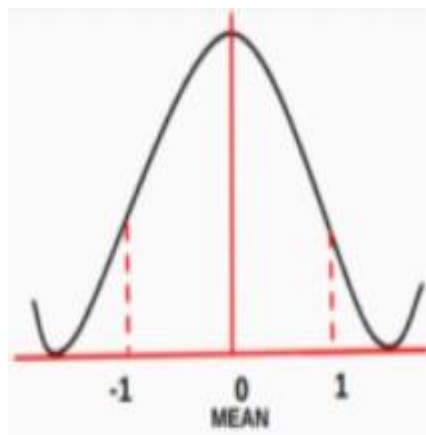
Fig 5.1 PDF of Guassian Noise

5.3 Impulse Noise

Impulse Function: In the discrete world impulse function on a vale of 1 at a single location and In continuous world impulse function is an idealised function having unit area.

Fig 5.2 Impulse function in discrete world and continuous world

Impulse noises are short duration **noises** which degrade an **image**. They may occur during **image** acquisition, due to switching, sensor temperature. They may also occur due to interference in the channel and due to atmospheric disturbances during**image**transmission.

Types of Impulse Noise:

There are three types of impulse noises. Salt Noise, Pepper Noise, Salt and Pepper Noise.

SaltNoise: Saltnoiseisaddedtoanimagebyadditionofrandombright(with255pixel value) all over theimage.

PepperNoise: Saltnoiseisaddedtoanimagebyadditionofrandomdark(with0pixel value) all over theimage.

Salt and Pepper Noise: Salt and Pepper noise is added to an image by addition of both random bright (with 255 pixel value) and random dark (with 0 pixel value) all over the

image.This model is also known as data drop noise because statistically it drop the original data values . Source: Malfunctioning of camera's sensor cell. This is likewise called data drop noise in light of the fact that measurably its drop the first information esteems.

This noise is additionally alluded as salt and pepper noise. Anyway the picture isn't completely debased by salt and pepper noise rather than some pixel esteems are changed in the picture. Albeit in uproarious picture, there is a conceivable outcomes of certain neighbors doesn't changed . This noise is found in information transmission. Picture pixel esteems are supplanted by adulterated pixel esteems either most extreme 'or' least pixel esteem i.e., 255 'or' 0 individually, if number of pieces are 8 for transmission. Allow us to consider 3x3 picture frameworks which are appeared in the Fig. 4. Assume the focal worth of grids is adulterated by Pepper commotion. Hence, this focal worth i.e., 212 is given in Fig. 4 is supplanted by esteem zero. In this association, we can say that, this noise is embedded dead pixels either dull or splendid. So in a salt and pepper noise, logically dull pixel esteems are available around there and the other way around. Salt-and-pepper noise is a type of noise now and then seen on pictures. It is otherwise called motivation noise. This noise can be brought about by sharp and unexpectedaggravations
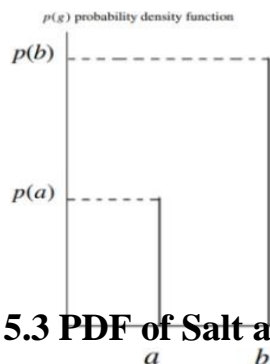
Fig 5.3 PDF of Salt and Pepper Noise

5.4 Speckle Noise

A fundamental problem in optical and digital holography is the presence of speckle noise intheimagereconstructionprocess.Speckleisagranularnoisethatinherentlyexistsinan image and degrades its quality. Speckle noise can be generated by multiplying random pixel values with different pixels of an image. This noise is multiplicative noise. Their appearance is seen in rational imaging framework, for example, laser, radar and acoustics and so forth, Spot noise can exist comparative in a picture as Gaussian noise. Its likelihood thickness work follows gamma distribution.Speckle is a granular impedance that naturally exists in and corrupts the nature of the dynamic radar, engineered opening radar (SAR), clinical ultrasound and optical rationality tomography pictures. It is brought about by cognizant preparing of backscattered signals from various circulatedtargets.

5.5 White Noise

Noise is basically distinguished by the noise power. Noise power range is consistent in white noise. This noise power is comparable to control ghostly thickness work. The assertion "Gaussian noise is regularly repetitive sound" wrong. Anyway neither Gaussian property suggests the white sense. The scope of absolute noise power is - ∞ to +∞ accessible in background noise recurrence space. That implies in a perfect world noise power is boundless in repetitive sound. This reality is completely obvious on the grounds that the light produces from the sun has all the recurrence segments. In background noise, is unimaginable on account of each pixel esteems are unique in relation to their neighbors. That is the reason autocorrelation is zero. So that picture pixel esteems are ordinarily upset decidedly because of repetitive sound. In signal processing, white noise is a random signal having equal intensity at different frequencies, giving it a constant power spectral density.White noise draws its name from white light, although light that appears white generally does not have a flat power spectral density over the visible band. n discrete time, white noise is a discrete signal whose samples are regarded as a sequence of serially uncorrelated random variables with zero mean and finite
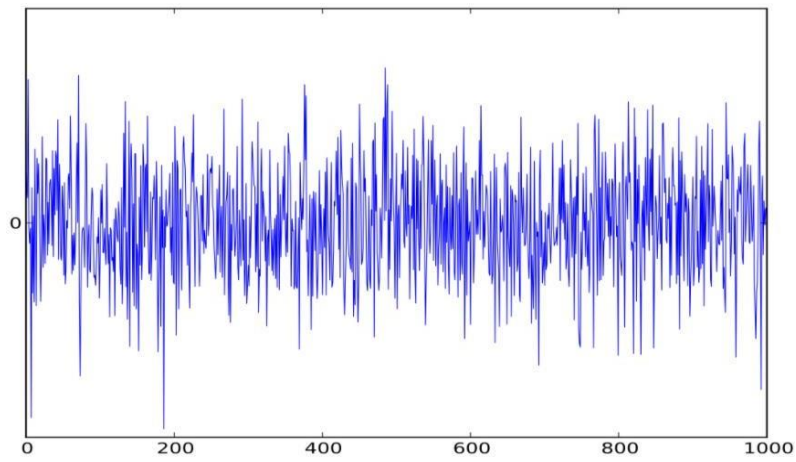
variance; a single realization of white noise is a random shock.

Depending on the context,one may a require that the samples be independent and have identicalprobability (in other words independent and identically distributed random variables are the simplest representation of white noise). In particular, if each sample has a normal distribution with zero mean, the signal is said to be additive white Gaussian noise.[4]

The samples of a white noise signal may be sequential in time, or arranged along one or more spatial dimensions. In digital image processing, the pixels of a *white noise image* are typically arranged in a rectangular grid, and are assumed to be independent random variables with uniform probability distribution over some interval. The concept can be defined also for signals spread over more complicated domains, such as a sphere.Some "white noise" sound(Loud)

An *infinite-bandwidth white noise signal* is a purely theoretical construction. The bandwidth of white noise is limited in practice by the mechanism of noise generation, by the transmission medium and by finite observation capabilities. Thus, random signals are considered "white noise" if they are observed to have a flat spectrum over the range of frequencies that are relevant to the context. For an audio signal, the relevant range is the band of audible sound frequencies (between 20 and 20,000 Hz). Such a signal is heard by the human ear as a *hissing sound*, resembling the /h/ sound in a sustained aspiration. On the other hand, the /sh/ sound in "ash" is a colored noise because it has a formant structure. In music and acoustics, the term "white noise" may be used for any signal that has a similar hissing sound.

The term white noise is sometimes used in the context of phylogenetically basedstatistical methods to refer to a lack of phylogenetic pattern in comparative data.

Fig 5.4 Waveform Of GWN signal plotted on graph

Depending on the context,one may a require that the samples be independent and have identicalprobability (in other words independent and identically distributed random variables are the simplest representation of white noise). In particular, if each sample has a normal distribution with zero mean, the signal is said to be additive white Gaussian noise.[4]

The samples of a white noise signal may be sequential in time, or arranged along one or more spatial dimensions. In digital image processing, the pixels of a *white noise image* are typically arranged in a rectangular grid, and are assumed to be independent random variables with uniform probability distribution over some interval. The concept can be defined also for signals spread over more complicated domains, such as a sphere.Some "white noise" sound(Loud).

CHAPTER 6 FILTERS

6.FILTERS

6.1 Introduction

In **image processing** filters are mainly used to suppress either the high frequencies in the image, i.e. smoothing the image, or the low frequencies, i.e. enhancing or detecting edges in the image. The filter function is shaped so as to attenuate some frequencies and enhance others. There are two main types of image processing: image filtering and image warping. Image filtering changes the range (i.e. the pixel values) of an image, so the colors of the image are altered without changing the pixel positions, while image warping changes the domain (i.e. the pixel positions) of an image, where points are mapped to other points without changing the colors. In signal processing, a filter is a device or process that removes some unwanted components or features from a signal. **Filtering** is a class of signal processing, the defining feature of filters being the complete or partial suppression of some aspect of thesignal.

Applications

1. ImageCompression

2. ImageMatching

3. ImageSegmentation

4. ObjectRecognition

5. Tracking

Image filtering is useful for many applications, including smoothing, sharpening, removing noise, and edge detection.
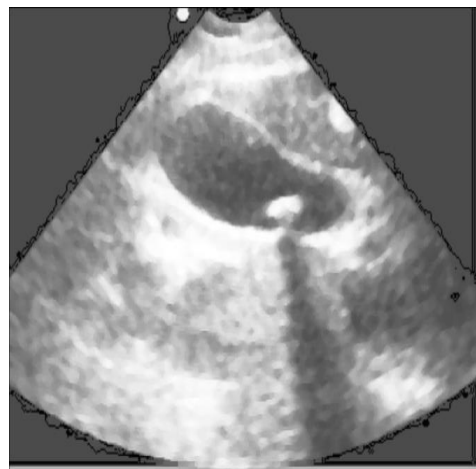
6.2 Median Filter

Median filtering is a nonlinear method used to remove noise from images. It is widely used as it is very effective at removing noise while preserving edges. It is particularly effective at removing 'salt and pepper' type noise. The median filter works by moving through the image pixel by pixel, replacing each value with the median value of neighbouring pixels. The pattern of neighbours is called the "window", which slides, pixel by pixel over the entire image 2 pixel, over the entire image. The median is calculated by first sorting all the pixel values from the window into numerical order, and then replacing the pixel being considered with the middle (median) pixelvalue. There are other approaches that have different properties that might be preferred in particular circumstances: – Avoid processing the boundaries, with or without cropping the signal or image boundary afterwards. – Fetching entries from other places in the signal. With images for 4 example, entries from the far horizontal or vertical boundary might be selected. – Shrinking the window near the boundaries, so that every window is full.

Fig 6.1 Input Image ofKidney Stone

Fig6.2 Median Filter appliedimage

6.3 Gaussian Filter

Gaussian filtering g is used to blur images and remove noise and detail. In one dimension, the Gaussian functionis:

$$G(x) = \frac{1}{\sqrt{(2\pi\sigma^2)}} e^{-\frac{x}{2\sigma^2}} \text{eq.6.1}$$

Where, sigma is the standard deviation

The distribution is assumed to have a mean of 0. Shown graphically, we see the familiar bell shaped Gaussian distribution.
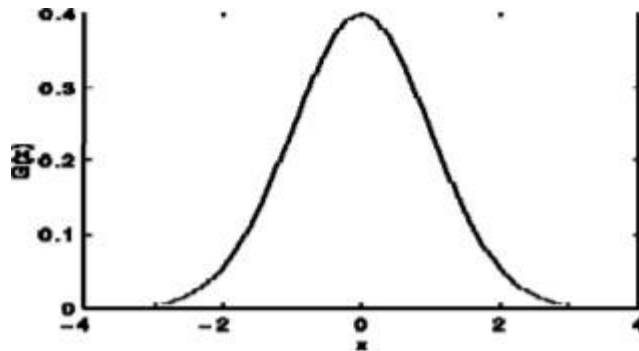
Fig 6.3 Guassian distribution

Standard Deviation

The Standard deviation of the Gaussian function plays an important role in its behaviour. The values located between +/- σ account for 68% of the set, while two standard deviations from the mean (blue and brown) account for 95%, and three standarddeviations (blue, brown and green) account for 99.7%. account for 99.7%. This is very important when designing a Gaussian kernel of fixed length.

The Gaussian function is used in numerous research areas:

– It defines a probability distribution for noise ordata.

– It is a smoothingoperator.

– It is used inmathematics.

In probabilistic terms, it describes 100% of the possible values of any given space when varying from negative to positive values Gauss function is never equal to zero. It is a symmetric function.

When working with images we need to use the two dimensional Gaussian function.
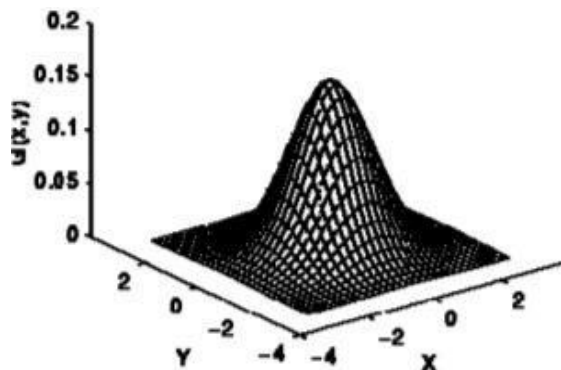
Fig 6.4 A graphical representation of the 2D Gaussian distribution

A graphical representation of the 2D Gaussian distribution with mean(0,0) and σ = 1 is shown to the right.

The Gaussian filter works by using the 2D distribution as a point-spread function. This is achieved by convolving the 2D Gaussian distribution function with the image. We need to produce a discrete approximation to the Gaussian function. This theoretically requires an infinitely large convolution kernel, as the Gaussian distribution is non-zero

everywhere. Fortunately the distribution has approached very close to zero at about three standard deviations from the mean.

This means we can normally limit the kernel size to contain only values 23 This means we can normally limit the kernel size to contain only values within three standard deviations of the mean. The Gaussian filter is a non-uniform low pass filter. The kernel coefficients diminish with increasing distance from the kernel's centre. Central pixels have a higher weighting than those on the periphery. Larger values of σ produce a wider peak (greater blurring). Kernel size must increase with increasing σ to maintain the Gaussian nature of the filter. Gaussian kernel coefficients depend on the value of σ. At the edge of the mask, coefficients must be close to 0. The kernel is rotationally symmetric with no directional bias. Gaussian kernel is separable which allows fast computation 25 Gaussian kernel is separable, which allows fast computation. Gaussian filters might not preserve image brightness.

6.4 Laplacian Filter

Laplacian Operator is also a derivative operator which is used to find edges in an image. The major difference between Laplacian and other operators like Prewitt, Sobel, Robinson and Kirsch is that these all are first order derivative masks but Laplacian is a second order derivative mask. In this mask we have two further classifications one is Positive Laplacian Operator and other is Negative Laplacian Operator.

Another difference between Laplacian and other operators is that unlike other operators Laplacian didn't take out edges in any particular direction but it take out edges in following classification.

- InwardEdges
- OutwardEdges

Let's see that how Laplacian operator works.

Positive Laplacian Operator

In Positive Laplacian we have standard mask in which center element of the mask should be negative and corner elements of mask should be zero.

0	1	0
1	-4	1
0	1	0

Table 6.1: Positive Laplacian Operator

Positive Laplacian Operator is use to take out outward edges in an image.

Negative Laplacian Operator

In negative Laplacian operator we also have a standard mask, in which center element should be positive. All the elements in the corner should be zero and rest of all the elements in the mask should be -1.

0	-1	0
-1	4	-1
0	-1	0

Table 6.2: Negative Laplacian Operator

Negative Laplacian operator is use to take out inward edges in an image.

Laplacian is a derivative operator; its uses highlight gray level discontinuities in an image and try to deemphasize regions with slowly varying gray levels. This operation in result produces such images which have grayish edge lines and other discontinuities on a dark background. This produces inward and outward edges in an image.

The important thing is how to apply these filters onto image. Remember we can't apply both the positive and negative Laplacian operator on the same image. we have to apply just one but the thing to remember is that if we apply positive Laplacian operator on the image then we subtract the resultant image from the original image to get the sharpened image. Similarly if we apply negative Laplacian operator then we have to add the resultant image onto original image to get the sharpened image.

6.5 Gabor Filter

In image processing, a Gabor filter, named after Dennis Gabor, is a linear filter used for texture analysis, which essentially means that it analyzes whether there is any specific frequency content in the image in specific directions in a localized region around the point or region of analysis. Frequency and orientation representations of Gabor filters are claimed by many contemporary vision scientists to be similar to those of the humanvisual system.[1]They have been found to be particularly appropriate for texture representation and discrimination. In the spatial domain, a 2D Gabor filter is a Gaussian kernel function modulated by a sinusoidal plane wave (see Gabortransform).

Some authors claim that simple cells in the visual cortex of mammalian brains can be modeled by Gabor functions. Thus, image analysis with Gabor filters is thought by some to be similar to perception in the human visualsystem.

Its impulse response is defined by a sinusoidal wave (a plane wave for 2D Gabor filters) multiplied by a Gaussian function.[4]Because of the multiplication-convolution property (Convolution theorem), the Fourier transform of a Gabor filter's impulse response is the convolution of the Fourier transform of the harmonic function (sinusoidal function) and the Fourier transform of the Gaussian function. The filter has a real and an imaginary component representing orthogonal directions.[5]The two components may be formed into a complex number or used individually. Gabor filters are directly related to Gaborwavelets, since they can be designed for a number of dilations and rotations. However, in general, expansion is not applied for Gabor wavelets, since this requires computation of bi-orthogonal wavelets, which may be very time-consuming. Therefore, usually, a filter bank consisting of Gabor filters with various scales and rotations is created. The filters are convolved with the signal, resulting in a so-called Gabor space. This process is closely related to processes in the primary visual cortex.[6]Jones and Palmer showed that the real part of the complex

Gabor function is a good fit to the receptive field weight functions found in simple cells in a cat's striatecortex.

Applications of 2-D Gabor filters in imageprocessing

In document image processing, Gabor features are ideal for identifying the script of a word in a multilingual document. Gabor filters with different frequencies and with orientations in different directions have been used to localize and extract text-only regions from complex document images (both gray and colour), since text is rich in high frequency components, whereas pictures are relatively smooth in nature. It has also been applied for facial expression recognition [14]Gabor filters have also been widely used in pattern analysis applications. For example, it has been used to study the directionality distribution inside the porous spongy trabecular bone in the spine. The Gabor space is very useful in image processing applications such as optical characterrecognition, iris recognition and fingerprint recognition. Relations between activations for a specific spatial location are very distinctive between objects in an image. Furthermore, important activations can be extracted from the Gabor space in order to create a sparse object representation.

Fig 6.5 Input Image of Kidney Stone
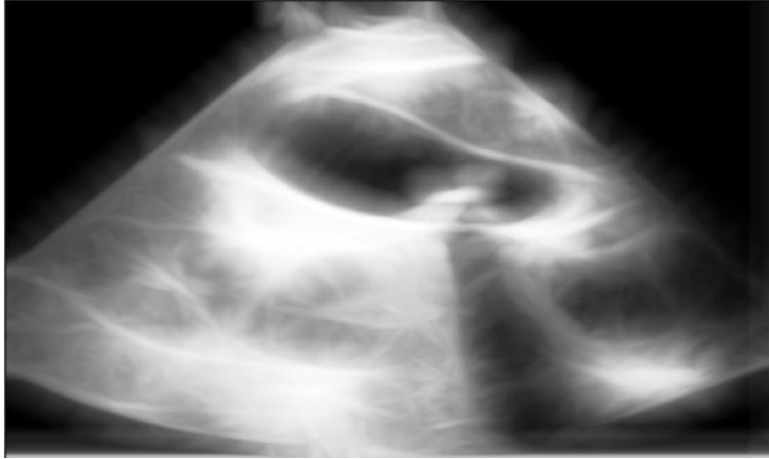
Fig 6.6 Gabor Filter applied image

To apply the Gabor filters to an image, use the imgaborfilt function. g = gabor(,Name,Value ,...) creates an array of Gabor filters using name-value pairs to control aspects of Gabor filter design. If you specify a vector of values, the output array g contains all the unique combinations of the input values. Features are extracted directly from gray-scale character images by Gabor filters which are specially designed from statistical information of character structures. An adaptive sigmoid function is applied to the outputs of Gabor filters to achieve better performance on low-quality images.

CHAPTER 7 MATLAB

7.MATLAB

7.1 Introduction

In this project,we implemented using MATLAB. **MATLAB** (an abbreviation of "matrix laboratory") is a proprietary multi-paradigm programming language and numericcomputing environment developed by MathWorks. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages.

Although MATLAB is intended primarily for numeric computing, an optional toolbox uses the MuPADsymbolic engine allowing access to symbolic computing abilities. An additional package, Simulink, adds graphical multi-domain simulation and model-baseddesign for dynamic and embedded systems.

As of 2020, MATLAB has more than 4 million users worldwide. MATLAB users come from various backgrounds of engineering,science, and economics.

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. Typical uses include:

- Math andcomputation
- Algorithmdevelopment
- Modeling, simulation, andprototyping
- Data analysis, exploration, and visualization
- Scientific and engineeringgraphics

- Application development, including Graphical User Interfacebuilding

MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. This allows you to solve many technical computing problems, especially those with matrix and vector formulations, in a fraction of the time it would take to write a program in a scalar noninteractive language such as C or Fortran.

The name MATLAB stands for matrix laboratory. MATLAB was originally written to provide easy access to matrix software developed by the LINPACK and EISPACK projects, which together represent the state-of-the-art in software for matrix computation. MATLAB has evolved over a period of years with input from many users. In university environments, it is the standard instructional tool for introductory and advanced courses in mathematics, engineering, and science. In industry, MATLAB is the tool of choice for high-productivity research, development, and analysis.

MATLAB features a family of application-specific solutions called toolboxes. Very important to most users of MATLAB, toolboxes allow you to *learn* and *apply* specialized technology. Toolboxes are comprehensive collections of MATLAB functions (M-files) that extend the MATLAB environment to solve particular classes of problems. Areas in which toolboxes are available include signal processing, control systems, neural networks, fuzzy logic, wavelets, simulation, and many others.

7.2 Matlab System

The MATLAB system consists of five main parts:

The MATLAB language.

This is a high-level matrix/array language with control flow statements, functions, data structures, input/output, and object-oriented programming features. It allows both "programming in the small" to rapidly create quick and dirty throw-away programs, and "programming in the large" to create complete large and complex application programs.

The MATLAB working environment.

This is the set of tools and facilities that you work with as the MATLAB user or programmer. It includes facilities for managing the variables in your workspace and importing and exporting data. It also includes tools for developing, managing, debugging, and profiling M-files, MATLAB's applications.

Handle Graphics.

This is the MATLAB graphics system. It includes high-level commands for two-dimensional and three-dimensional data visualization, image processing, animation, and presentation graphics. It also includes low-level commands that allow you to fully customize the appearance of graphics as well as to build complete Graphical User Interfaces on your MATLAB applications.

The MATLAB mathematical function library.

This is a vast collection of computational algorithms ranging from elementary functions like sum, sine, cosine, and complex arithmetic, to more sophisticated functions like matrix inverse, matrix eigenvalues, Bessel functions, and fast Fourier transforms.

The MATLAB Application Program Interface (API).

This is a library that allows you to write C and Fortran programs that interact with MATLAB. It include facilities for calling routines from MATLAB (dynamic linking), calling MATLAB as a computational engine, and for reading and writing MAT-files.

7.3MATLAB's Power of Computational Mathematics

MATLAB is used in every facet of computational mathematics. Following are some commonly used mathematical calculations where it is used most commonly −

- Dealing with Matrices andArrays
- 2-D and 3-D Plotting and graphics
- LinearAlgebra
- AlgebraicEquations
- Non-linear Functions
- Statistics
- DataAnalysis
- Calculus and DifferentialEquations
- NumericalCalculations
- Integration
- Transforms
- CurveFitting
- Various other specialfunctions

7.4 Features of MATLAB

Following are the basic features of MATLAB −

- It is a high-level language for numerical computation, visualization and applicationdevelopment.

- It also provides an interactive environment for iterative exploration, design and problemsolving.

- It provides vast library of mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, numerical integration and solving ordinary differentialequations.

- It provides built-in graphics for visualizing data and tools for creating custom plots.

- MATLAB's programming interface gives development tools for improving code quality maintainability and maximizingperformance.

It provides functions for integrating MATLAB based algorithms with external applications and languages such as C, Java, .NET and MicrosoftExcel.

7.5 Uses Of MATLAB

MATLAB is widely used as a computational tool in science and engineering encompassing the fields of physics, chemistry, math and all engineering streams. It is used in a range of applications including −

- Signal Processing andCommunications
- Image and VideoProcessing
- Control Systems
- Test andMeasurement
- ComputationalFinance
- ComputationalBiology

MATLAB environment behaves like a super-complex calculator. You can enter commands at the >> command prompt.

MATLAB is an interpreted environment. In other words, you give a command and MATLAB executes it right away.

CHAPTER 8 RESULTS AND DISCUSSIONS

8. RESULTS AND DISCUSSIONS

In this project,we have implemented procedure in this way. There are several images from the database.It comprises of both normal and abnormal images.Betweenthem,one is selected and subjected to stone detection procedure.Here we read image text using command unread.It stores pixels in memory and read those pixels.To reduce the unwanted disturbances,we will perform image preprocessing.Without this preprocessing the quality will be not good for examining.During surgeries it is very important to predict the correct location of the kidney stone correctly.Generally ultrasound image consists of speckle noise.So we can overcome that noise by performing image preprocessing.Next,image is sent to segmented block where segmentation is performed.Inthis,level set function is used to remove curves.It is good in accuracy,speed and performance.Now segmentation is done for stone portion.Segmented image is sent to discrete wavelet transforms block.It consists of two filters namely Daubeches and Symlettefilters.Finally,if single object is detected it will display stone is detected or else no stone isdetected.
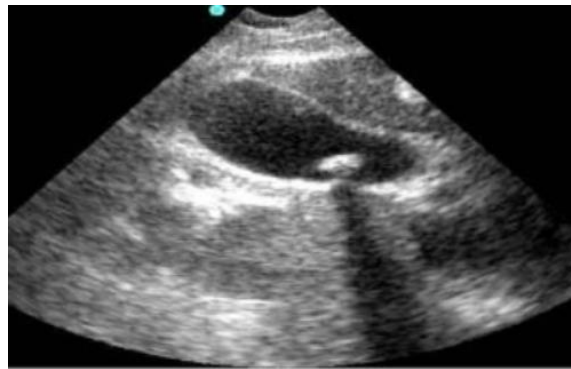
Fig 8.1 Input image of Kidney Stone
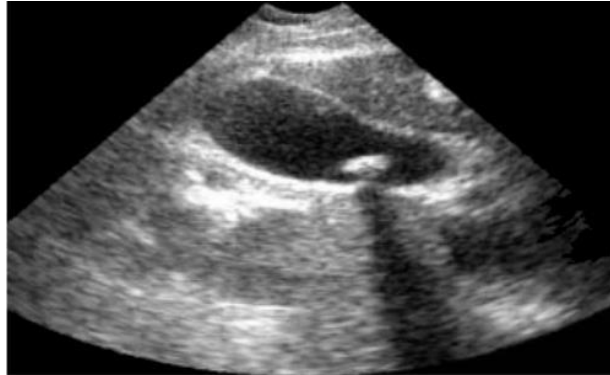
Fig 8.2 RGB to GrayImage

Fig 8.3 ThresholdingImage
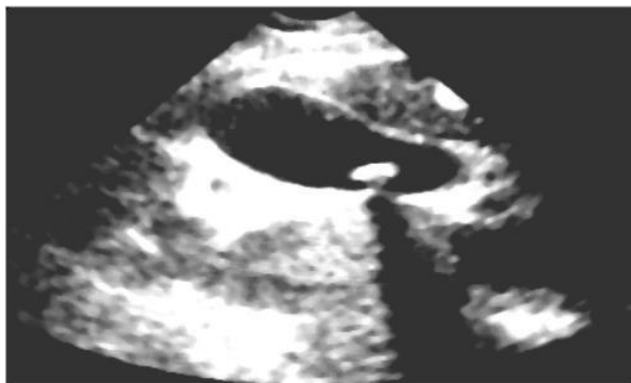

Fig 8.4 Holes free Image

Fig 8.5 Preprocessed Image

Fig 8.6 Iamge using Median filter

Fig 8.7 Thresholding Image

Fig 8.8 Watershed Image

Fig 8.9 Polygon form of Stone Portion

Fig 8.9.1 Stone Portion Image

CHAPTER 9 CONCLUSION

9. CONCLUSION

The proposed work is implemented on matlab. We had a picture of a ultrasound of a kidney containing a stone. We applied the median Filter for the Image Enhancement followed by Histogram Equalization. The reestablished picture went under Image Segmentation. The ANN is trained with normal kidney image and classified image input for normal or abnormal conditions. Specifically, Watersheds after which Marking was done and the last picture was created. This work proves that the combination of image segmentation, histogram equalization, and multilayer perceptron with back propagation means a better approach for the detection of stones in the kidney. The last picture showed a particular area of the stone in the kidney. Henceforth the stone was recognized.

REFERENCES

[1] Vinayagam.P, Sreemathi.M, Jeevitha K, Sandhya S KIDNEY STONE DETECTION USING NEURALNETWORK,2019.

[2] N.Nithyavathy, Basil .M. Kuriakose, S.Arunkumar1, P. Deepasundar, S.Amirthamani Ultrasound Imaging Technique for the Identification of Kidney Stones using Gsd Platform, June2016.

[3] Kalannagari Viswanath1 and Ramalingam Gunasundari2 Analysis and Implementation of Kidney Stone Detection by Reaction Diffusion LevelSet Segmentation Using Xilinx System Generator on FPGA,April2015.

[4] T. Rahman and M. S. Uddin, "Speckle noise reduction and segmentation of kidney regions from ultrasound image," in Proceedings of the 2nd International Conferenceon Informatics, Electronics and Vision (ICIEV '13), pp. 1–5, IEEE, Dhaka, Bangladesh, May 2015.

[5] W. G. Robertson, "Methods for diagnosing the risk factors of stone formation," Arab Journal of Urology, vol. 10, no. 3, pp. 250– 257,2014.

[6] B. Hess, "Metabolic syndrome, obesity and kidney stones," Arab Journal of

Urology, vol. 10, no. 3, pp. 258–264, 2013.

[7]   K. Viswanath and R. Gunasundari, "Kidney stone detection from ultrasound images by Level Set Segmentation and multilayer perceptron ANN," in *Proceedings of the International Conference on Communication and Comuting (IMCIET-ICCE '14)*, pp. 38– 48, Elsevier,2014.

[8]   M. E. Abou El-Ghar, A. A. Shokeir, H. F. Refaie, and A. R. El-Nahas, "Low-dose unenhanced computed tomography for diagnosing stone disease in obese patients," *Arab Journal of Urology*, vol. 10, no. 3, pp. 279–283,2012.

[9]   N. Dheepa, "Automatic seizure detection using higher order moments & ANN," in *Proceedings of the 1st International Conference on Advances in Engineering, Science and Management (ICAESM '12)*, pp. 601–605, March2012.

[10] K. Kumar, "Artificial neural network for diagnosis of kidney stone disease," *International Journal of Information Technology and Computer Science*, vol. 7, pp. 20–25,2012.

[11] W. M. Hafizah, "Feature extraction of kidney ultrasound images based on intensity histogram and gray level cooccurrence matrix," in Proceedings of the 6th AsiaModeling Symposium (AMS '12), pp. 115–120, IEEE, May 2012

[12] N. Koizumi, J. Seo, D. Lee et al., "Robust kidney stone tracking for a non-invasive ultrasound theragnostic system—servoing performance and safety enhancement," in *Proceedings of the IEEE International Conference on Robotics and Automation (ICRA '11)*, pp. 2443–2450, Shanghai, China, May2011.

[13] V. P. G. P. Rathi and S. Palani, "Detection and characterization of brain tumor using segmentation based on HSOM, wavelet packet feature spaces and ANN," inProceedings of the 3rd International Conference on Electronics Computer Technology (ICECT '11), vol. 6, pp. 274–277, IEEE, Kanyakumari, India, April 2011.

PAPER PUBLICATION DETAILS