

Image Processing Techniques for Lung Cancer Detection Using SVM and Marker-Controlled Watershed Transform

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Abstract

The real reason for cancer passing is lung cancer. Detection of cancer in the early stage can give greater treatment alternatives, less intrusive surgery and builds the survival rate. For lung cancer, if the infection is detected in time, the survival rate of the patient increments from 14 to 49% in late five years. It is the most risky and across the board sickness on the planet. The cancer cells display in lung causes the lung cancer malady. This cells detection is a critical issue for therapeutic scientists. The odds of an effective treatment will fundamentally increment with early detection. The Computed Tomography (CT) images are utilized as a part of which are more effective than X-ray. MATLAB has generally utilized software for the investigation of lung cancer detection from CT scan images. The procedure incorporates image pre-preparing, image segmentation, feature extraction and grouping technique. This present work proposes a technique to detect the cancerous cells effectively from the lung CT scan images. It will limit the detection mistake made by the doctors' exposed eye.

Keywords—Cancer Detection, Feature extraction, Image handling, Image Enhancement, Marker-Controlled Watershed Transform, Thresholding.

1.INTRODUCTION

Matlab is an information examination and visualization instrument which has been outlined with effective help for grids and lattice operations. As softly as this, Matlab has decision illustrations abilities, and its take effective programming dialect. One reason that Matlab has turned out to be such an imperative device is over the handle of

sets of Matlab programs intended to confirm a specific errand. These arrangements of programs are called toolboxes, and the specific tool compartment of progress to us is the approach handling tool compartment. As opposed to give a depiction of by and large of Matlab's capacities, we should impose ourselves to just those aspects mistook for the treatment of images. We should benefit functions, charges, and techniques as required. A Matlab function is a keyword which acknowledges distinct parameters and delivers some kind of yield: for example a lattice, string, an outline or figure. Cases of such functions are `sin`, `imread`, `imclose` [1-3]. There are many functions in Matlab, and as we should impact, it is simple (and at times important) to compose our own. A charge is a specific utilization of a function. Cases of charges may be

```
>> Sin (pi/3)
```

```
>> c=imread ('cameraman. On the off chance that');
```

```
>> a=imclose (b);
```

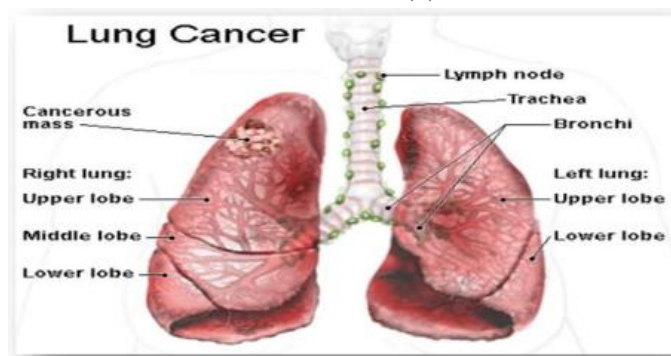


Fig 1. Lung Cancer

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The major cause of cancer death is lung cancer. Detection of cancer in the early stage can give greater treatment choices, less intrusive surgery and increases the survival rate. For lung cancer, if the disease is detected in time, the survival rate of the patient increment from 14 to 49% in late five years. It is the most risky and across the board disease in the world. The cancer cells exhibit in lung the cause lung cancer disease. This cells detection is an imperative issue for therapeutic analysts. The odds of an effective treatment will essentially increment with early detection. The Computed Tomography (CT) images are utilized which are more productive than X-ray. MATLAB has broadly utilized software for the investigation of lung cancer detection from CT scan images. The procedure incorporates image pre-processing, image segmentation, feature extraction and grouping technique. This present work proposes a strategy to detect the cancerous cells effectively from the lung CT scan images. It will limit the detection error made by the doctors' exposed eye.

Recently, the image processing mechanisms are utilized generally in various medicinal territories for increasing prior detection and treatment stages. The time is an exceptionally huge factor to find the disease in the patient as conceivable as fast. Its initial detection increases the odds of an effective treatment [5].

In 2005, approximately 1,372,910 new cancer cases were predictable, and around 570,280 cancer deaths are expected to happen. It is expect there will be 163,510 deaths from lung cancer, which shapes 29% of all cancer deaths. [1] When cells start to become crazy, cancer starts in a piece of the body. The cancer cell start because of crazy extension of abnormal cells. Lung cancer is a disease of abnormal cells duplicating and increasing into a tumors Cancer cells proceed to increment and frame new, abnormal cells [4]. A significant number of them see conceivable. So the result of lung cancer as of now is close yet no cigar essential for effective treatment. Diagnosis is particularly in view of CT scan images. Cancerous tumors start in the piece of the lung is called primary lung cancer.

Following are the sorts of this lung cancer, and these are divided into two fundamental sorts:

1. Small cell cancer
2. Non-small cell cancer

In this, current work focuses on discovering tumor and its stages. In this Marker-controlled Watershed, segmentation is used to isolate a lung of a CT picture. Maintaining a strategic distance from of hazard factors, including smoking and air contamination, is the fundamental technique for anticipation. Treatment and whole deal results depend upon the sort of cancer, the stage (level of spread), and the person's general prosperity. Most cases are not treatable. Normal prescriptions fuse surgery, chemotherapy, and radiotherapy. NSCLC is all over treated with surgery, however SCLC as a rule reacts better to chemotherapy and radiotherapy.

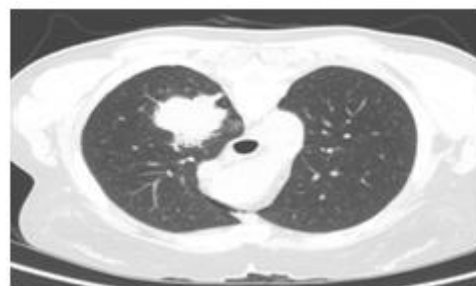


Fig 2. Original image of Lung

II. LITERATURE SURVEY

Region creating algorithm proposed for segmentation of CT scan images of the Lung. This algorithm starts with a seed pixel and besides checks diverse pixels that incorporate it. It chooses the most near one and, on the off chance that it meets certain criteria, it will incorporate into the region. The region is create by inspecting all unallocated neighboring pixels to the region [5-7].

In proposed an approach for detection of cancer cells from Lung CT scan images. This work presents a strategy to detect the cancer cells from the CT scan image. It reduces the error in the detection part made by the doctors for medicinal investigation. It depends on Sobel edge detection and mark matrix. Sobel administrator finds the edges in an image. It does as such

by finding the image gradient. Image gradient gives the adjustment in the power of the image. Additionally in a framework using Computer Aided Diagnosis (CAD) for finding the edges from CT scan images of lung for detection of diseases is utilized. Thresholding algorithm offers filtering to detect the sputum cell from the crude image for early detection. A novel strategy, watershed change is presented for image segmentation. Morphological operations which are opening and closing operations are utilized to process the gradient image. It is utilized to dispense with the over fragmented territory and to reconstruct the morphological gradient which can keep up the state of gradient image. We utilize watershed segmentation to isolate touching objects in an image. It is utilized for treating an image, where light pixels are high and dark pixels are low.

The principle thought of this paper is to detect the tumors and choose whether it is cancerous or not. It likewise finds the lung cancer stage and gives more exact result by using distinctive enhancement and segmentation techniques. This work acquaints a technique with recognize the growth cells from the CT [8] examine picture. It decreases the mistake in the ID part made by the authorities for restorative investigation [10]. It relies upon Sobel edge location and stamp network. Sobel executive finds the edges. Pictures of the Lung. This calculation starts with a seed pixel, besides checks diverse pixels that encompass it.

III. PROPOSED SYSTEM

A. Approach

The Gaussian filter is utilized to smooth the input image in the preprocessing stage. And additionally, in the preprocessing stage, Gabor filter is utilized for enhancement and thresholding and Marker-Controlled watershed change is utilized for the segmentation reason. After image segmentation, the features, for example, normal power, perimeter, range and eccentricity are extracted from the detected tumor. Binarization process [9] is done to choose whether it is cancerous tumor or not. Likewise, if there is cancerous tumor, the cancer organize is distinguished.

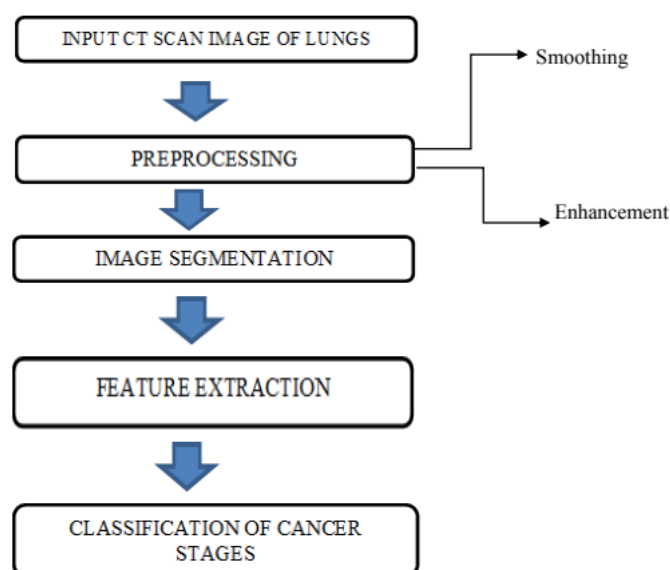


Fig 3. Flow Chart

a. Input CT Scan Image of Lungs

The CT scan images which are utilized for processing are collected from the healing centers. This image dataset contains lung CT scan images with tumor and without tumor. The figure demonstrates a portion of the lung CT scan images with tumor and without tumor.

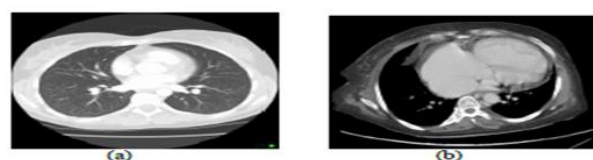


Fig 4. CT scan Images (a) Lung without tumor (b) Lung with tumor

b. Edge detection from CT images of lung

Lung Cancer detection is basic since if doctor may detect it earlier then it is definitely not hard to them to break down and may be possible to recover the disease before all else period. It is one of the fundamental creating diseases now daily in the world.

c. A Novel strategy for image segmentation using watershed change.

Watershed segmentation has recently turned into a well-known apparatus for image segmentation. In any case, its utilization for automatic image segmentation has been constrained especially due to over-segmentation and

affectability to commotion. This paper presents another technique for image segmentation using watershed change. To utilize morphological opening and closing operations to process the gradient image intend to wipe out the over-segmentation ranges, and reconstruction of the morphological gradient can keep up the state of gradient image. The proposed technique can improve gradient image while keeping up the shapes of the exact location of the partitioning line, taking out the underlying drivers of the wonder have been part. Simulation experimental results demonstrate the proposed.

B. Preprocessing

In this image pre-processing stage, image smoothing is the initial step. For smoothing, Gaussian filter is connected on the input image. Gaussian smoothing is exceptionally effective for evacuating noise. Gaussian removes high frequency segments from the image. So it is a low pass filter. Smoothing reduces the noise and giving us a more precise force surface. The mathematical equation for the Gaussian filter is as given in equation (1).

Where x is the separation from the middle on the level axis, y is the separation from the inside on the vertical axis, and σ is indicated as the standard deviation of the Gaussian conveyance. It decides the amount of smoothing. The yield of Gaussian filter [11] for figure 3.2.1(b) is appeared in figure 3.2.2.



Fig 5. Smoothing Image

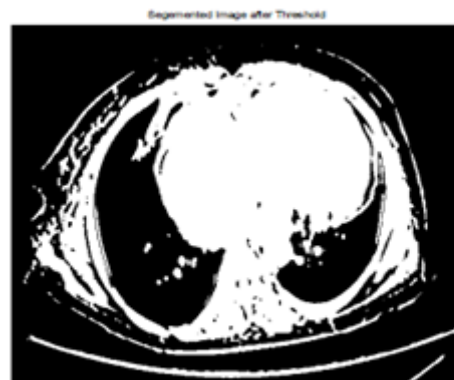


Fig 6. Segmentation image after threshold

Next part in pre-processing is image enhancement arrange. The function of image enhancement organize is to highlight the imperative data of image. In this progression, better visual effects are performed on the image which upgrade the human eyes' recognize capacity of data. It is an approach to enhance the class of image, with the goal that the last output image is better than the original one. For image enhancement, Gabor filter is utilized.

(a).Gabor Filter

The Gabor function is an exceptionally accommodating device in image processing, surface examination. It is a direct filter and its drive reaction is gotten from the augmentation of symphonious function and Gaussian function. It is a band pass filter. It is utilized to expand the differentiation between the knob zones and other structure around it. The mathematical expression for the Gabor filter is given in equation (2).

$$g(x, y) = \exp\left(-\frac{x'^2 + y'^2}{2\sigma^2}\right) \cos\left(2\pi \frac{x'}{\lambda} + \varphi\right) \quad (2)$$

$$x' = x \cos \theta + y \sin \theta \quad (3)$$

$$y' = -x \sin \theta + y \cos \theta \quad (4)$$

λ represents the wavelength of the sinusoidal wave.

θ signifies for the introduction of normal to parallel stripes of Gabor function.

φ signifies stage counterbalance.

σ signifies standard deviation γ is spatial aspect proportion

The output image of Gabor filter is appeared in figure 3.2.3



Fig 7. Output image of Gabor filter

Image introduction in view of Gabor function constitutes an awesome neighborhood and multi scale disintegration with respect to logons that are in the meantime (and preferably) confinement in space and repeat ranges [5]. A Gabor filter is a direct filter whose drive reaction is characterized by a harmonic function copied by a Gaussian function. In light of the duplication convolution property (Convolution speculation), the Fourier change of a Gabor filter's inspiration reaction is the convolution of the Fourier change of the harmonic function and the Fourier change of the Gaussian function. Figure 3.2.3 portrays the original image and the improved image using Gabor Filter. The result of applying Gabor enhancement technique [7]

Auto enhancement strategy is emphatically relies upon subjective perception and factual operations, for example, mean and difference calculation. The enhancement percentage in this examination was equivalent to 38.025%.

C. Binarization Approach

Binarization approach depends upon the fact that the quantity of dark pixels is considerably more noteworthy than white pixels in normal lung images, so we started to

count the dark pixels for normal and abnormal images to get a normal that can be utilized later as a limit, if the quantity of the dark pixels of another image is more noteworthy that the edge, at that point it shows that the image is normal, generally, if the quantity of the dark pixels is not as much as the edge, it demonstrates that the image is abnormal. The edge esteem that is utilized as a part of this examination is 17178.48 and the True acknowledgment rate (TAR) is (92.86%) and false acknowledgment rate (FAR) is (7.14%). Figure binarization technique methodology [4-6].

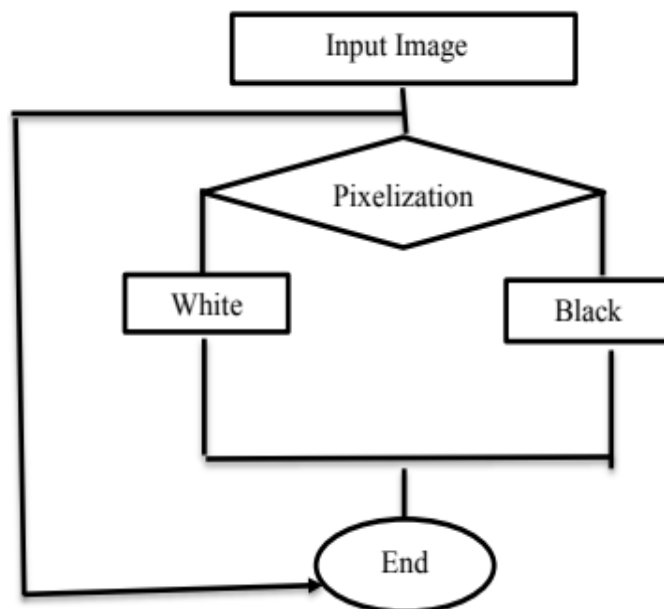


Fig8. Binarization method procedure

III .Marker Controlled Segmentation is utilized for the Medical Application

CANCER STAGE GROUPING

Stage 0: This stage portrays cancer in situ, which signifies "set up". Stage 0 cancers are situated in where they have started and not spread to close-by tissues. This stage of cancer is consistently highly treatable, generally speaking by removing the entire tumor with surgery.

Stage 1: This stage is for the most part a little cancer or tumor that has not formed into contiguous tissues. It is moreover has not spread to the lymph center points or distinctive parts of the body. It is much of the time called starting time cancer.

Stage 2 and 3: These stages show bigger cancers or tumors that have developed all the more profoundly in to close-by tissue. They may likewise need to spread to the lymph hubs yet not to alternate parts of the body.

Stage 4: This stage implies that the cancer has spread to different organs or different parts of the body. It might likewise be called propelled stage of cancer.

To beat the drawbacks of this watershed segmentation i.e. over segmentation, the marker based watershed segmentation technique is utilized. It can fragment limits from an image. Morphological operations are performed on the watershed fragmented image to get last divided image. Here the strategy is to utilize morphological operations called opening by reconstruction and closing by reconstruction to tidy up the image. These operations will produce level maxima inside each object which is found using in regional max. The output of marker-based watershed fragmented image is appear in figure 3.2.5.

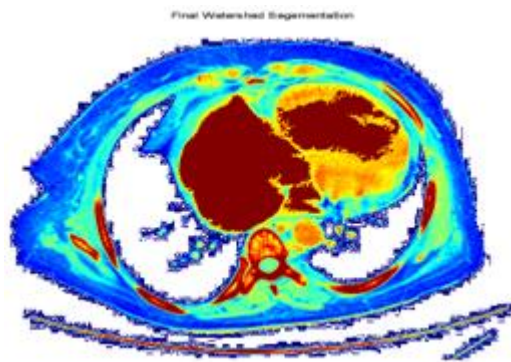


Fig 9. Marker-Controlled Watershed -based segmented Image

After segmentation process, a binarization procedure is finished. In this approach, the aggregate number of black pixels and white pixels are check. In the event that the aggregate number of black pixels of an input image is more than limit, at that point the tumor is a normal. Something else, if the aggregate number of the black pixels is not as much as the edge then the tumor is a cancerous tumor. By using this result, sensitivity and precision are ascertain. To discover these parameters,

first a portion of the conditions like true positive, false negative, True negative and false positive.

Sensitivity = $TP / (TP + FN)$ (5)

Exactness = $(TN + TP) / (TN + TP + FN + FP)$ (6)

Here,

ByTP is True Positive, TN is True Negative, FN is False Negative, and FP is False Positive. Sensitivity is characterized as an amount of true positives that are correctly recognized by a symptomatic test. Precision is characterize as the quantity of true results, which is either true positive or true negative. It gauges the level of unwavering quality of a demonstrative test on a condition. In the CT scan lung image dataset, mean 14 images are available. With the help of this dataset, the estimations of TP, FP, FN, TN, Sensitivity, and exactness are resolve.

Examination, it is find that the Marker - Controlled Watershed Transform performs predominantly than the current algorithms. The outcomes have demonstrated 100% of precision in Marker-Controlled Watershed Transform algorithm by detecting the tumors from the CT scan lung images. Lung knobs are the smallest advancements in the lung that measure between 5 mm to 25 mm in estimate. In irregular images handle measure is more prominent than 25 mm.

Primary Tumor (T)	Criteria
T1	< 3cm in diam; T 1a <= 2cm; T 1b > 2cm <= 3cm
T2	> 3cm <= 7cm; T 2a > 3cm <= 5cm; T 2b > 5cm <= 7cm
T3	> 7cm
T4	Any Size greater than above

Table (i)Cancer Stage Criterion

The features, for example, normal force, zone, perimeter and flightiness are extracted, and according to these features, tumors will be order into the stages of cancer.

1. In stage I, the cancer tumors is small.
2. In stages II and III, the cancer tumors are constrained to the chest.
3. In stage IV, cancer tumors reach to different parts of the body.

IV. ALGORITHM

a. K – MEANS CLUSTERING

K – Means clustering is a technique for vector quantization, at first from flag processing that is prevalent for aggregate examination in information mining. K – means clustering focuses package of n perceptions into k bundles in which each has a place with the sincere mean, filling in as a model. K-deduces gathering is a strategy for vector quantization, at first from sign preparing that is extraordinary for bunch examination in information mining. k -infers Grouping expects to section N discernments into k clusters in which each recognition has a place with the nearest mean, filling in as a model of the gathering. This is the results in a partitioning of the information space into regions.

The issue is computationally troublesome (NP-hard); in any case, there are effective heuristic calculations that are for the most part used and join quickly to an area perfect. These are by and large like the coveted lift calculation for mixes of Gaussian spreads using and iterative refinement approach used by the two calculations. Besides, they both utilize cluster centers to exhibit the data; in any case, k infers grouping has a tendency to find packs of practically spatial degree, while the want growth framework licenses bundles to have distinctive shapes.

This algorithm goes for compelling an objective function, for this circumstance a squared goof function. The algorithm is gain out of the running with ground:

1. Place K demonstrates into the space talked by the objects that are being grouped. These concentrations address starting social affair centroids.
2. Allot each object to the social occasion that has the closest centroid.
3. Right when the aggregate of what objects have been relegated until the centroids, recalculate the spots of the K centroids.
4. Repeat Steps 2 and three until the centroids never again move.

This conveys a partition of the objects into bunches from which the metric to be restricted can be figured. The expression "k-means" was at first used by James Macqueen as a part of 1967. A more productive interpretation was proposed and dispersed in FORTRAN by Hartigan and Wong in 1975/1979. Be that as it may, the idea backtracked to Hugo Steinhaus in 1957. The standard calculation was at first proposed by Stuart Lloyd in 1957 as a method for pulse code alteration, be that as it may, it isn't appropriated outside of Bell Labs until 1982. In 1965, E.W.Forgy circulated a similar technique, which is the reason it is on occasion alluded to as Lloyd-Forgy. A more productive version was proposed and dispersed in FORTRAN by Hartigan and Wong in 1975/1979.

b. Marker-Controlled Watershed Transformation

Segmentation implies the way toward partitioning an advanced image into different sections (sets of pixels, generally called super-pixels). The objective of segmentation is to unravel and change the portrayal of an image into something that is more important and simpler to examine. Image segmentation is used to bunch pixels into striking image regions, i.e., regions identifying with singular surfaces, objects, or parts of objects. The watershed change has properties that make it valuable for various image segmentation applications: it is straightforward and instinctive, can be parallelized, and dependably delivers total division of the image. Be that as it may, when connected to restorative image investigation, it has critical downsides (over-segmentation, sensitivity to noise).

c. SVM algorithm and advancement techniques

(I) Particle Swarm Optimization Method:

In swarm advancement methodology is used which is a multilevel edge technique separating images. The point of confinement issue is clarified the rule of particle swarm, enhancement. Image according to a health function by finding the fitting estimations of edge dangling modifier. To get a legitimate bundle of target, PSO algorithm can be use. The exploratory results show the practicality of technique and has been trying on all

the three images. Particle swarm advancement (PSO) [3] is a masses based improvement algorithm after the diversion of social conduct of winged animals in a run. This algorithm scans for optima by reviving ages in the wake of presenting with a social affair of arbitrary particles. Every particle's is balanced in view of its separation from its very own best position and furthermore the separation from the best particle of swarm all through the hunt space. The closeness of a particle from the worldwide ideal, i.e., its execution is acquired using a wellness function which depends on the enhancement issue.

(ii) Genetic Optimization technique: Genetic algorithms have a place with the bigger class of formative algorithms, which deliver answers for improvement issues using systems persuaded by normal progression, for instance, legacy, transformation, selection, and mixture.

(iii) Support Vector Machine: To separate data and recognize outlines for course of action reason, controlled learning models with related learning algorithms are using as a part of this paper generally called help vector machine limits (Xiabi Liu, 2015). It instates by taking an arrangement of input information and predicts for each given input the predetermined class among the two decisions accessible, which makes it a probabilistic paired direct classifier. For mapping, the given information into an alternate space SVM utilizes portion function, for example, polynomial, BF, quadratic, Multi-Layer Perceptron (MLP) [7]. The partitions can be made even with exceptionally complexes limits .Despite the fact that techniques, for instance, Platt scaling exist to use SVM in a probabilistic characterization setting.

In machine learning, bolster vector machines (SVMs, likewise bolster vector networks) are managed learning models [7] with related learning algorithms that examine information utilized for grouping and relapse examination Given a game plan of preparing representations, each set apart as having a place with both of two orders, a SVM preparing algorithm creates a model that doles out new cases to either, making it a non-probabilistic twofold direct classifier (regardless of

the fact that procedures, for instance, Platt scaling exist to use SVM in a probabilistic characterization setting).

A SVM display is a portrayal of the cases as focuses in space, mapped with the objective that the diverse characterizations are disconnected by a sensible hole that is as wide as would be reasonable. New cases are mapped into that a similar space and predicted to have a place with an arrangement given which side of the hole they fall. In extension to performing straight characterization, SVMs can capably play out a non-direct request using what is known as the bit trap, certainly mapping their inputs into high-dimensional segment spaces.

A few applications

Image processing has a huge scope of applications is practically every region of science and innovation can make usage of image processing techniques. Here is a short once-over just to give some indication of the scope of image processing applications.

1. Pharmaceutical Inspection and interpretation of images got from X-rays, MRI or CAT examines examination of cell images is chromosome karyotypes.
2. Farming Satellite/elevated perspectives of land, for instance, to decide how much land is being use for various purposes, or to explore the appropriateness of different regions for various products, inspection of leafy foods—recognizing generosity and crisp deliver from old.
3. Industry Automatic inspection of things on a production line and paper tests.
4. Law prerequisite Fingerprint examination, sharpening or de-clouding of speed-camera pictures.

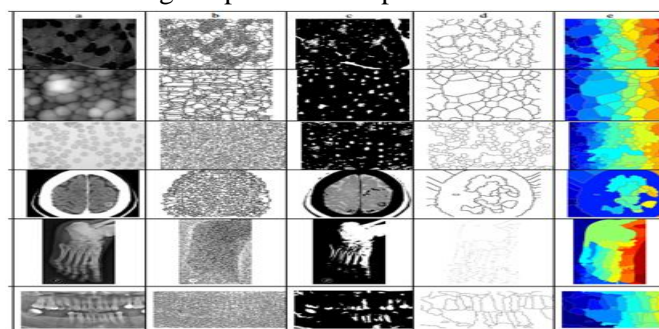


Fig 10. Segmentation Result

V. Simulation Result

Output Image for Cancerous

In this section, to detect the likelihood of lung cancer presence different operations are performed on input image which gives the accompanying result.

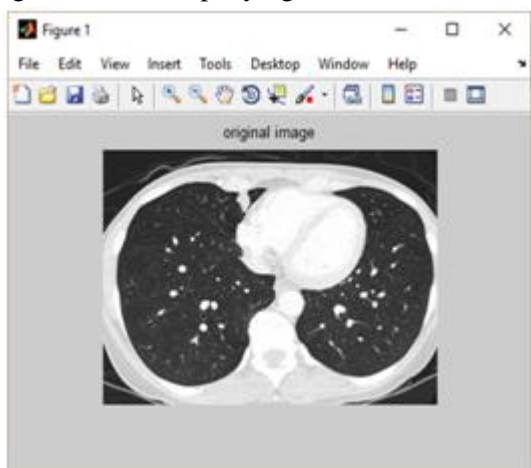


Fig 11.Original Image

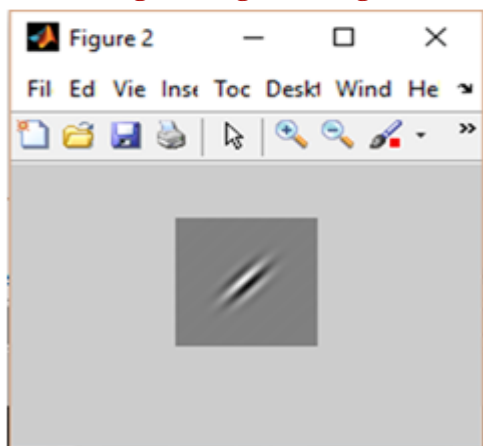


Fig 12. Gabor Mask

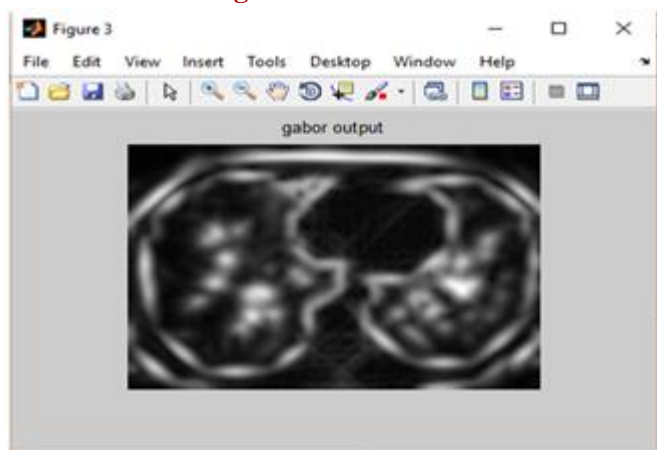


Fig 13. Gabor Output

The figure demonstrates the output of preprocessing stages which incorporate the image enhancement and image segmentation. We stack CT scan image of the lung as the input image. The image preprocessing starts with the image enhancement; the point of the image enhancement is normalization to enhance the interpretability and impression of the image included for human watchers or to give the better input to other automated image processing techniques [10].

Here image enhancement is finished using Gabor filter inside the Gaussian run the show. The improved image acts as input for segmentation which is performed using Marker-Controlled Watershed Segmentation Approach. Twofold image examines played out the different morphological operation on the image which was normal performed on the medicinal image.

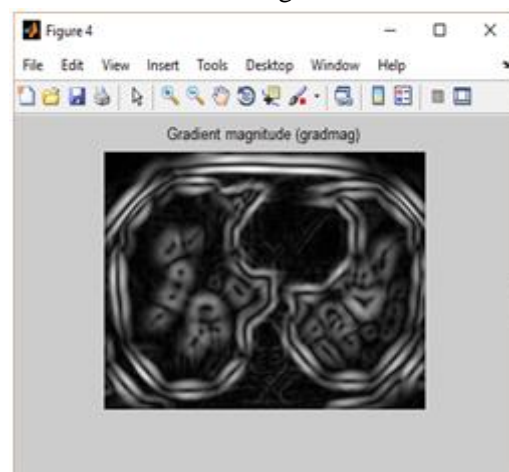


Fig 14.Gradient magnitude

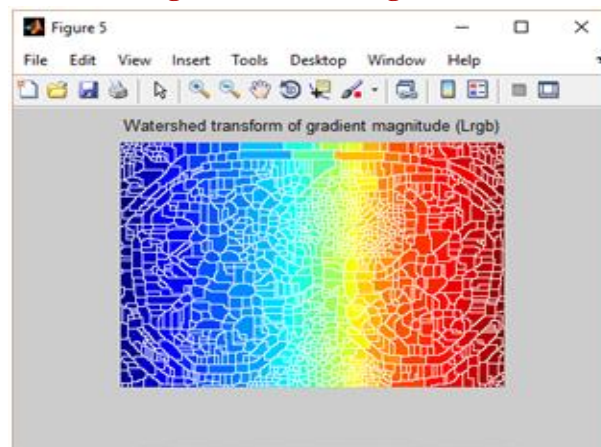


Fig 15. Watershed transform of LRGB

The resulting investigation we take the CT scan image as the input. To check the presence of cancerous cells (knobs), different operations can be performed like transforming the shades of the image. The result is appear in figure. In Histogram evening out is delivered on input and in addition an output image. Histogram Manipulation can use for image enhancement. Here the power of image can be resolved with the assistance of histogram.

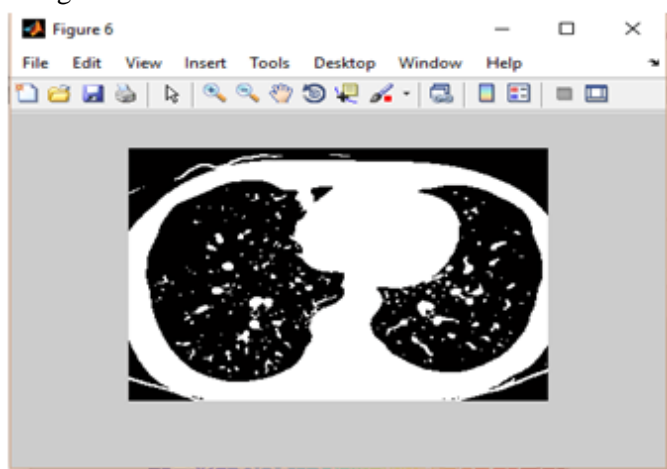


Fig 16. Histogram equalization image

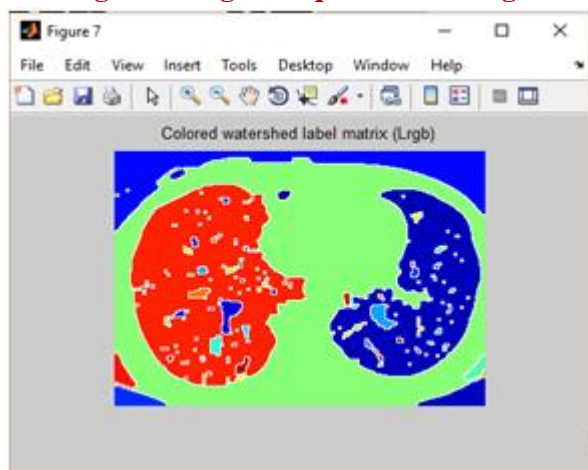
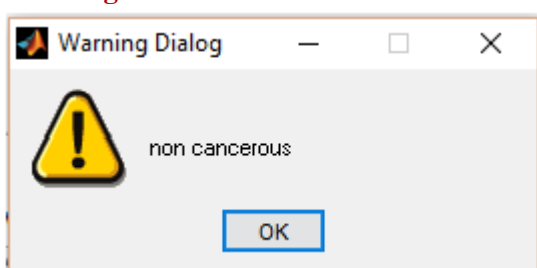


Fig 17. Colored watershed label



After segmentation process, a binarization procedure is doned. In this approach, the aggregate number of black pixels and white pixels are tally. In the event that the aggregate number of black pixels of an input image is more than the limit, at that point the tumor is a normal. Something else, if the aggregate number of the black pixels is not as much as the limit, at that point the tumor is a cancerous tumor. That time cautioning discourse is shown, the result appears if cancer is present it demonstrates it is cancerous if not present then non-cancerous.

VI CONCLUSION

The framework comprises of pre-processing, segmentation, feature extraction, and last characterization. The proposed marker-controlled watershed segmentation technique isolates the touching objects in the image. It gives the best recognizable proof of the primary edge of the image and furthermore maintains a strategic distance from over-segmentation. It gives 100% exactness contrasted with the thresholding algorithm. So it is productive for segmentation. The treatment recognizable proof framework in lung peril keeps developing. In this manner, the image processing technique should likewise advance in a direction of discovering cancer as right on time as could be allowed. The proposed technique gives extraordinarily reassuring results differentiating and other utilized techniques.

Since lung diseases are dynamic and transformative, their detection, treatment will similarly progress in light of the dynamic idea of the diseased. The screening techniques in cancer detection must be dependable, strong and must have high-a level of analytic esteem. For this reason, appropriate from the image obtaining to the detected of cancer we should be painstakingly enough to recognize the genuine pointers of cancer knobs. For this reason, we have utilized algorithm motivated by the similarity of filling water in an uneven topology. For our situation, likewise cancerous part of the lung turns out to be high or a region is having worldwide maxima and non-cancerous part having less force when contrasted with destructive part or basically

the finished lung tissues having commonplace power esteem concerning their tendency. This procedure is called watershed algorithm with separate change. This algorithm goes highly fruitful in dividing or distinguishing the cancerous knob after the expulsion of thorax or foundation of lungs.

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