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Detection of Abnormalities in Liver Using Image Processing Techniques

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Abstract: The liver is the largest gland and largest internal organ in the human body. The abnormal growth of cell in the liver causes liver cancer which is also known as hepatic cancer where, Hepatocellular Carcinoma (HCC). Most of the peoples who have liver tumour were died due to the fact of inaccurate detection. The detection of this tumours is difficult and mostly found at advanced stage which causes life-threatening issues. Hence it is far essential to discover the tumour at an early stage. So, the principle intention of this project is to detect liver cancer at earlier stage using image processing technique. Computer-aided diagnosis from various medical imaging techniques can assist significantly in detecting liver cancer at a very early stage. This project presents an automated method of detecting liver cancer in abdominal CT images and classifying them using the support vector machine (SVM) algorithm. The proposed model consists of several stages where the image is first normalized and pre-processed using a Median filter to remove noise in the image. After histogram equalization of image, the features are extracted based on Discrete wavelet transformation (DWT). Finally, liver CT images are classified implementing support vector machine and segmented results. The software used here is MATLAB.

Keywords -: Liver tumour detection, CT image**,** DWT, GLCM, K-Mean clustering, SVM segmentation.

INTRODUCTION

Billions of cells in our body divides each day to produce new cells. The newly formed cells occupy the space of dead cells. Basically, cells get together to form tissues together to form organs. Hence, in some abnormal cases, cells divide more than the body needed and form as lumps or growths normally called as tumours. Liver cancer is one of the major death factors in the world. The detection of tumours is difficult and mostly found at advance stage which causes life threating issues. There are two types of cancer namely Primary Liver Cancer and Secondary Liver Cancer. Primary Liver Cancer starts in the liver, and not from another organ which ultimately travels to the liver. Cancers that originate in the liver are known as primary liver cancers. Secondary Liver Cancer is a type growth of cancer cell where the cancer cell originates from different organ and spread to liver. In other words, there may be cancers which start from somewhere else and end up in the liver –those are secondary liver cancer. The most common type of liver cancer is hepatocellular carcinoma (or hepatoma or HCC), and it tends to affect males more than females. The early detection and accurate presentation of liver cancer is a significant issue impractical radiology. Liver lesions refer to those abnormal tissue cell that are found in the liver. Liver lesions are a wound or injury in the tissue areas of the body due to harm caused by a wound or disease. These lesions can be identified in a CT scan by a difference in pixel intensity from other regions of the liver. For proper clinical treatment, manual segmentation of this CT scan is difficult and excessively time-consuming task. Digital image processing is the technique of using computers to process the image with the necessary algorithms. In the recent year medical image processing has become an essential part of diagnosing and accumulating disease in formation for adding in clinical decision support. It is also helpful for monitoring and examining the impact of treatment of infected Detection of liver cancer involves three main steps. It includes pre-processing of image, feature extraction, pattern recognition and classification

LITERATURE REVIEW

- "Diagnosis of liver tumours Using Image Processing" In this work the research aims to develop an automated way to extract suspicious regions of liver area in the scanner image to the abdominal area use a new method for extracting the liver area of the scanned image for abdominal area automatically, depending on the use of connected compounds numbering algorithms CCL, in addition to the use of data collection algorithms FCM to extract suspicious regions of the extracted area of the liver.[1]
- "Detection of Tumour in Liver Using Image Segmentation and Registration Technique" author propose an algorithm for liver cancer detection which is based on concepts of fuzzy logic and neural network. Neuro-fuzzy (NF) systems are suitable tools to deal with uncertainty found in the process of extracting useful information from image.[2]

- "Computer Aided Detection of Liver Tumor using SVM Classifier" In this paper, researcher have a new and accurate method for liver tumour segmentation from computed tomography (CT) scans. Initially, the liver CT image is pre-processed, i.e., noise removal and contrast of the image is enhanced. Than they employ a support vector machine (SVM) classifier, which is trained using the user fed image sets, to classify the tumour region from liver image.[3]
- "Intelligent Image Processing Techniques for Cancer Progression Detection, Recognition and Prediction in the Human Liver" The proposed intelligent CDS framework will automate real-time image enhancement, segmentation, disease classification and progression to enable efficient diagnosis of cancer patients at early stages.[4]
- "Detection and classification of liver cancer using CT image" In this work presents the enhancement of Computed tomography (CT) images using two different algorithms. CLAHE enhanced the tumour region in a new look. CVHE enhanced with preserving the globalization of an image. The normal liver detection is done by the ox plot comparison in CLAHE. Primary liver cancer detection is done by CVHE. State vector machines (SVM) classifier works for the classification of CT liver images.[5]
- **"**Liver tumour detection for CT images using image processing techniques" This paper consists of various image processing techniques like image pre-processing and image enhancement which is used to improve the quality of the liver image. This helps to detect and segment the tumour in liver effectively. The automated segmentation of liver is addressed first and then filtering is used to remove unwanted noise finally. The clustering algorithm helps to detect the tumour in liver CT image.[6]
- "Liver Tumor Segmentation in Noisy CT Image Using Distance Regularized Level Set Evolution Based on Fuzzy C-Mean Clustering. In this research work, the liver tumours are detected by the medical images in three stages, pre-processing stage, processing stage and detection stage. First in pre-processing stage, median filter is used to remove the noise from CT image, and then the denoised image is segmented by fuzzy c-means clustering (FCM) algorithm. Finally, in the detection stage distance regularized level set evolution (DRLSE) is used to extract tumour boundaries.[7]
- "Deep learning base liver cancer detection using watershed transform and gaussian mixture model techniques" In this work they proposed a CAD model called watershed gaussian based deep learning technique which consist of intensity base segmentation to efficiently delineate the cancer lesion in CT image of the liver.[8]
- "Detection of liver cancer using image processing techniques" In this paper, it has been used to detect cancer cell of the liver. Here ostu's method is used for enhancing the MRI image and watershed method is used to segment the cancer cell from the image.**[9]**
- "Liver cancer detection using image processing technique". In this proposed work the image undergoes enhancement using anisotropic diffusion filters and segmented by morphological operations which is simple and easy to work.[10]

PROPSE WORK

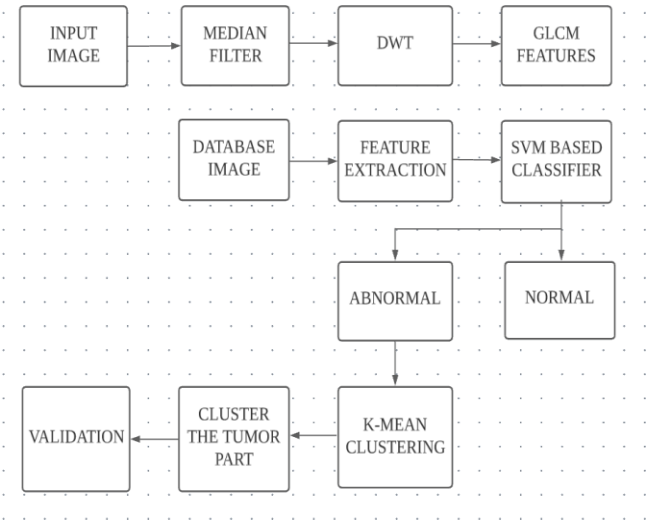

Fig :- Block diagram of system

Liver cancer is the type of cancer that starts in liver it doesn't spreads outside the area of the liver. The liver, which is located below the right lung and under the ribcage, is one of the largest organs of the human body. Now –a- days liver Cancer is growing anonymously in huge rate because this liver cancer has low survival rate even symptoms do not appear until the cancer in the advanced stage if disease caught late the average person survive only a year, it has a range of functions, including removing toxins from the body, and is crucial to survival. Since, we are going to deal with Liver cancer, we are concerned about the liver cancer diagnosis tests. There are various tests for diagnosis of liver cancer. Among these tests CT scan and MRI is of utmost important. Generally, every doctor asks for CT scan to look for the tumour in the liver. If they find the liver affected, then later they ask for MRI to get detail knowledge about the tumour in the liver. Because MRI provides a better view and proper tumour location.

So, we propose the cancer detection using clustering and Neural networks. In this we go with the three phases of detection processing phase, pre-processing phase and detection phase where the wavelets are applied to signify the segmentation to classify the normal and abnormal stages of the tumour Accurate detection of size and location of tumour plays a vital role in the diagnosis of tumour. The diagnosis method consists of four stages, pre-processing of images, feature extraction, and classification. After histogram equalization of image, the features are extracted based on Discrete wavelet transformation (DWT). In the last stage, Support Vector Machine (SVM) are employed to classify the Normal and abnormal. An efficient algorithm is proposed for tumour detection based on the K-Means Clustering

- **Input Image**

  The input images of patients Liver retrieved from CT scan or MRI will be taken in, In existing system we used scanned images by that we can find the microorganisms over the liver by thresholding also we can find the max and min values of segregation and for extracting the image used Discrete Wavelet transform Or Discrete Fourier transform and classified by Support vector machine.

- **Median Filter**

  The median filter is a non-linear digital filtering technique, often used to remove noise

from an image or signal. Such noise reduction is a typical pre-processing step to improve the results of later processing for example, edge detection on an image, CT images usually contain many noises, so we need to do smoothing for the image which makes the intensity distribution of liver to be smoothed too, so pre-processing step is necessary for accurate liver segmentation. The granular noise in CT image can be reduced by using median filter. The 3 x 3pixel square kernel will be convolved cross the input image. To reduce the computational efforts, it is better to know the shape, intensity and location of abdominal CT image which helps in accurate segmentation.

- **Discrete Wavelet Transform (DWT)**

The feature extraction method that is used for segmentation is Discrete Wavelet Transform (DWT). Here we used DWT for initial libelling of images, in numerical analysis and functional analysis, a discrete wavelet transform is any wavelet transform for which the wavelets are discretely sampled. As with other wavelet transforms, a key advantage it has over Fourier transforms is temporal resolution: it captures both frequency and location information. As in the case of FT, the WT has been discretized and is known as a discrete wavelet transform (DWT) and represents an important advantage over traditional FT methods. The WT decomposes a signal into several scales representing different frequency bands, and, at each scale, the position of the WT can be determined at the important time characteristic with which the electrical noise can be identified and effectively removed. Short-time wavelets allow information to be extracted from high-frequency components. This is important information to eliminate electrical noise since electrical noise is more likely to exhibit high-frequency fluctuations. Long-term wavelets allow you to extract information from low frequencies. With the information of the high and low frequencies, we can define a threshold and zero the frequencies below the undesired threshold of the electric noise.

- **GLCM Features**

A statistical method of examining texture that considers the spatial relationship of pixels is the gray-level co-occurrence matrix (GLCM), also known as the gray-level spatial dependence matrix. The GLCM functions characterize the texture of an image by calculating how often pairs of pixels with specific values and in a specified spatial relationship occur in an image, creating a GLCM, and then extracting statistical measures from this matrix. The gray level Co-occurrence matrix (GLCM) is calculated to know the pixel intensity value i to the spatial relationship to pixel value j. Each element (i, j) in the resultant GLCM is the sum of the number of times that the pixel with value I occurred in the specified spatial relationship to pixel with value j in the input image. The texture filter functions, described in texture analysis cannot provide information about shape, i.e., According to co-occurrence matrix, Haralick defines fourteen textural features measured from the probability matrix to extract the characteristics of texture statistics of CT images.

- **Data base**

Both Normal and Abnormal Images are store into the database. for feature extraction and Classification by comparing CT images. Textual strings can be stored in traditional database systems to be used for image retrieval based on keywords

- **Feature Extraction**

Feature extraction involves reducing the number of resources required to describe a large set of data. When performing analysis of complex data one of the major problems stems from the number of variables involved. Analysis with many variables generally requires a large amount of memory and computation power, also it may cause a classification algorithm to overfit to training samples and generalize poorly to new samples. Feature extraction is a general term for methods of constructing combinations of the variables to get around these problems while still describing the data with enough accuracy. It is a process of dimensionality reduction by which an initial set of raw data is reduced to more manageable groups for processing. A characteristic of these large data sets is a large number of variables that require a lot of computing resources to process. Features will be extracted from the processed CT Liver image. The Features like Contrast, Correlation, Energy, and Homogeneity.

- **SVM Based Classifier**

The feature extracted in the previous step is taken and is utilized in training the classifier. The classifier used for the classification of these features is SVM classifier. Linear Support vector Machine is a technology used to classify the vectors with high accuracy in minimizing errors. The SVM technology used to classify the non-linear and linear data which is the gives good accuracy in statistical learning theory. Non-linear mapping is used to transform the original training data into higher dimension. SVM technique can be useful in optimizing various problems such as regression, the classic problem is that of data classification.

- **Validation**

The tumour region is segmented using region growing algorithm for segmentation and tumour detection, then followed by classification using Support vector machine (SVM) by using GLCM features. Afterwards it can be classified as Normal or Abnormal. If the Image is classified as abnormal with help of Clustering. We can identify the types or Size of tumour depending upon reference images available in database.

Software Description

MATLAB is the most popular software used for Digital Image Processing. MATLAB (matrix laboratory) is multipurpose tool used for matrix manipulation, plotting of functions and data, implementation of algorithm and creating user interface. For detecting liver cancer using image processing, MATLAB software is used. It is a general usage programming language. When it is used to process images by generally writing function files, or script files to perform the necessary operations. It forms a formal record of the processing used and the results can be tested and replicated by others. It provides many important advantages for forensic image processing.

Result

The liver tumour diagnosis is an important criterion in medical field. In this work, we detect and segment the tumour area from the liver CT image. The segmented liver tumour can be diagnosed using Support vector machine, which then classifies the liver tumour. we propose the cancer detection using clustering and Neural networks. In this we go with the three phases of detection processing phase, pre-processing phase and detection phase where the wavelets are applied to signify the segmentation to classify the normal and abnormal stages of the tumour Accurate detection of size and location of tumour plays a vital role in the diagnosis of tumour. The diagnosis method consists of four stages, pre-processing of images, feature extraction, and classification. After histogram equalization of image, the features are extracted based on Discrete wavelet transformation (DWT). In the last stage, Support Vector Machine (SVM) are employed to classify the Normal and abnormal. An efficient algorithm is proposed for tumour detection based on the K-Means Clustering. Finally, the tumour region marked in red colour.

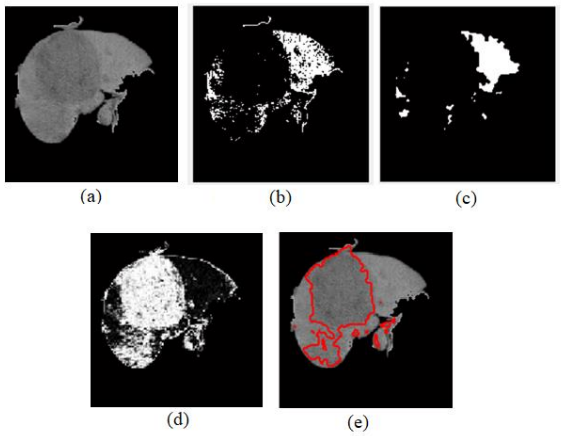

Fig :- (a) Input Image, (b)&(c) K-Mean Output, (d)&(e) SVM Output

Conclusion

In this proposed work, we presented an automated method of classifying the Liver image with Liver cancer or malignant tumour. Our proposed algorithm is novel in terms of segmenting the liver boundary and clustering based approach with SVM model on CT image. Segmenting the cancer region is a difficult and burdensome task as we must correspond with structures of high irregularity with a huge amount of noise. In addition, the structures also vary in accordance with complex texture changes. Therefore, our proposed system is robust in terms of segmenting and able to apprehend complexity with highly variable features. Also, a linear SVM requires less computation but exhibits a very good accuracy within this approach. Better accuracy and robustness could be achieved if more training samples were provided to train the classifier.

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