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Article Title: **Classifying Liver Fibrosis through the Utilization of Transfer Learning and FCNET Classifiers**

Classifying Liver Fibrosis through the Utilization of Transfer Learning and FCNET Classifiers

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ABSTRACT

Abdominal Radiology is used for monitoring patients with liver diseases and to measure severity of liver fibrosis by using Ultrasound (US) images which is obtained by scanning. Scanning uses high frequency sound waves to take images of the affected human organs. Since liver is situated deep into the body the signal get weaker each time it passes through other organs which makes it difficult for diagnosis to overcome this difficult transfer learning technique is proposed in this system. The first step is to remove unwanted disturbances from the US images which is accomplished by pre-processing steps. To ensure the quality of the input images they undergo resizing of resolution, adjusting variations in brightness and contrast. The goal of pre-processing technique is to enhance the quality, uniformity, and relevance of the input images, making them suitable for feature extraction and subsequent classification of liver fibrosis stages. The next step is to apply the Expectation Maximum (EM) algorithm based on Region of Interest (ROI), which is a clustering technique used for image segmentation. The EM algorithm iteratively assigns pixels to different clusters based on their intensities and probabilistic models, aiming to identify distinct regions. The feature extraction process is carried out by Fully Connected Convolutional Neural Network (FCNET) models which enable extracting high level representations from original images and transfer learning classification is used for classification of fibrosis stages with improved accuracy.

Keywords: EMA algorithm, Region of Interest (ROI), Fully Connected Network (FCNET), Transfer Learning classification.

1 Introduction

Liver fibrosis occurs when excessive amount of scar tissues build up in the liver due to inflammation like alcoholism, chronic hepatitis, and non-alcoholic fatty liver. Fibrosis spreads in four stages depending on the severity of the infections. No symptoms of fibrosis is detected in F0-N0 stage. F1-portal fibrosis affects deposition of collagen fibres mainly the portal vein. F2-periportal affects beyond the portal vein. F3-bridging cause higher risk and F4-cirrhosis is considered the advanced stage of fibrosis and need to be cured with high medical support.

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To measure the liver texture, size and the presence of liver fibrosis ultrasound imaging is used. But the original images contain unwanted noises and disturbance hence image pre-processing need to be done to enhance the quality of the input image. To get maximum throughput results from ultrasound imaging Original Radiofrequency (ORF) and Contrast-Enhanced Micro-Flow (CEMF) features is used [1]. And to measure the stiffness of the liver Grey scale Modality (GM) and Elastography Modality (EM) is used [2]. Feature extraction need to be done to recognise the pattern of the images hence Grey-Level Co-occurrence Matrix (GLCM) and Grey-Level Run-Length Matrix (GLRLM) are used where GLRLM extracts the irregular surface roughness in different directions of the image [3]. These feature extraction works based on the ROI where only the part of the image that need to be filtered or operated is considered. For the enhanced performance multiple ROI's need to be used instead of single ROI where number of ROI's their size and position need to be mentioned [4]. ROI is standardised and augmented using the slicing window technique in which augmentation process is done to enhance the input image for better diagnosis [5]. Advanced deep learning techniques like Convolutional Neural Network (CNN) make automatic diagnosis of liver fibrosis easy [6]. Whereas Deep Convolutional Neural Network (DCNN) diagnose the stages of liver fibrosis [7]. The classification stage consist of two stages that is training and testing therefore to reduce the end-to-end data training, Transfer learning techniques is used along with ML techniques which provides better diagnosis [8]. But to identify the different stage of liver fibrosis including normal liver, fibrosis liver or fatty liver, Support Vector Machine (SVM) classifier need to be used [9]. Therefore the main objective of this diagnosis process is to identify early and late stage of liver fibrosis from ultrasound images [10]. But these techniques cannot produce accurate results.

Therefore for accurate diagnosis transfer learning and fully connected network FCNET classifier is used that is capable of reading complex pattern. These classifiers consist of multiple layers of neurons interconnected which enables them to read complex features in liver fibrosis images. FCNET classifiers provide scalable and adaptable operation based on the changing input images. Images containing unwanted disturbances is removed in the pre-processing stage and the poor contrast of image is enhanced in segmentation process. In the feature extraction stage EM algorithm based on ROI is used. Hence this system provides accurate liver fibrosis diagnosis.

2 Recent Works

Rosanna Villani [2020] [11] have developed 2D-Shear wave elastography (SWE) technique for automatic diagnosis of liver fibrosis and stiffness of the liver. SWE is an ultrasound image based technique that functions on ROI algorithm where only the particular part is examined. Therefore this techniques provides accurate diagnosis of liver fibrosis along with its stages

which is easy to use. Despite this image pre-processing need to be done to removed unwanted disturbance in the input image

Silvia Bettini [2021] [12] have introduced diagnosis of liver fibrosis using the shear wave elastography (SWE) techniques that measures the stiffness of the liver from the ultrasound (US) images. SWE and US technique provide accurate diagnosis of different stages of liver fibrosis, fatty liver. Therefore this provide the diagnosis of both early and late stage of liver fibrosis. However classifier need to be used for the better classification of images.

Davide chicco [2021] [13] have implemented machine learning technique for the diagnosis of liver diseases using the random forest classifier to detect the most affect areas. Random forest detect the disease based on aspartate aminotransferase (AST) and alanine aminotransferase (ALT) enzymes. Therefore the machine learning technique detects the liver disease with high accuracy. Nevertheless transfer learning techniques need to be used for easy diagnosis of liver disease.

X. Dong [2020] [14] have developed a Hybridized Fully Convolutional Neural Network (HFCNN) for accurate liver segmentation to detect liver cancer and liver diseases. HFCNN is a classification technique used for detecting the liver diseases using the ultrasound images or CT scan images. Therefore HFCNN classifier provides accurate liver segmentation. However input images need to be enhanced using the feature extraction to improve image quality.

Z. Tian [2020] [15] have introduced a transition learning technique for the diagnosis of liver fibrosis in which the feature extraction using the multi-scale extraction. Multi-scale extraction enhances the quality of the input images. Therefore this techniques provide accurate diagnosis of liver disease. However a two-stage classifier need to be used for better classification of the liver disease.

3 Proposed Work Explanation

The main objective of this system is to identify liver fibrosis based on US image that is obtained by scanning the patient body. The detection of liver fibrosis consists of the following steps. **Figure 1:** Represents the process diagram of the proposed system.

The raw ultrasound images contain unwanted noises and disturbances which is removed in the pre-processing stage. The main objective of the pre-processing stage is to enhance the image quality by standardising the image size and resolution. The segmentation process is carried out by the EM algorithm which functions based on the ROI technique where only the particular part is filtered or operated. To extract the features of the image FCNET technique is implemented using the CNN classifier. CNN classifier functions based on the transfer learning technique that diagnose the liver using the given image.

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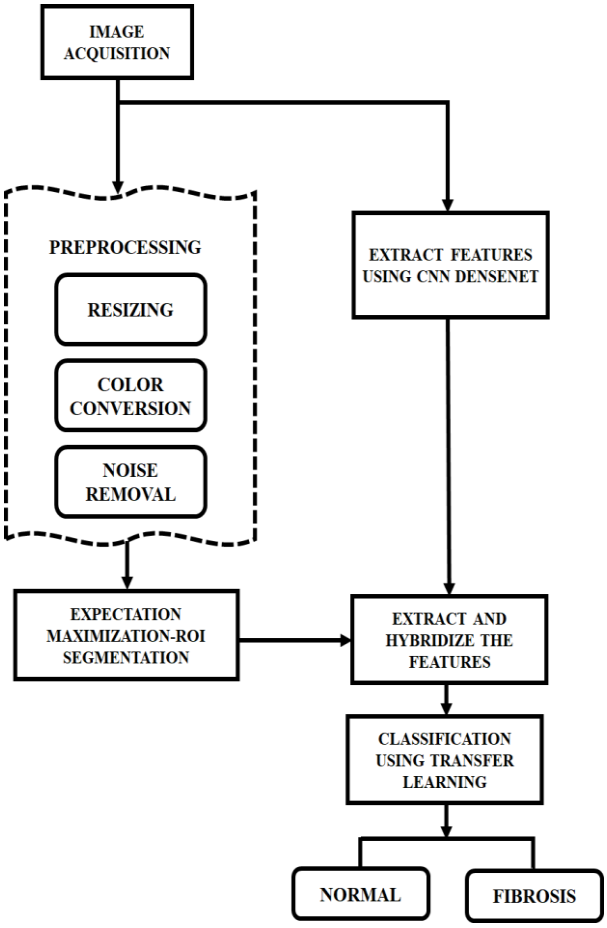

Figure 1: *Process Flow Diagram*

3.1 Pre-processing

The pre-processing is and essential stage for classifying liver fibrosis involves several essential steps to ensure the quality and standardization of the input images. These images is subjected to various pre-processing steps including resizing to a standard resolution, normalization to correct variations in brightness and contrast, denoising to remove any artifacts or noise to enhance image clarity and detail.

3.2 Segmentation

The process of segmentation is carried out by EM algorithm that works based on the ROI technique. EM algorithm is an iterative optimization method that iteratively assigns pixels to different clusters based on their intensities and probabilistic models, to identify distinct regions. ROI is a clustering technique that only detects the specific part of the image that is instructed by the operators or the doctors.The ROI segmentation using the EM algorithm is crucial for isolating and highlighting relevant regions within liver images, enabling accurate and effective

classification of liver fibrosis stages based on image analysis techniques. **Figure 2:** Represents the EM algorithm flowchart.

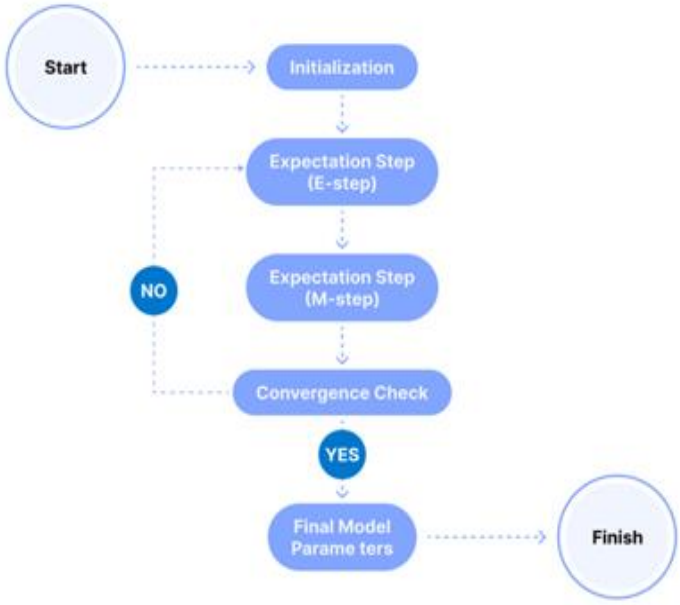

Figure 2: *EM algorithm Flowchart*

3.3 Feature Extraction

Feature Extraction is the process of identifying the meaning-full patterns and features for further classification. This process works based on the FCNET consisting of a series of fully connected layers in which all the neurons are connected to all the other neurons in the next layer. FCNET processes the liver images through multiple layers of convolutional, pooling, and activation functions, extracting meaningful features such as texture patterns, shapes, and structural characteristics.

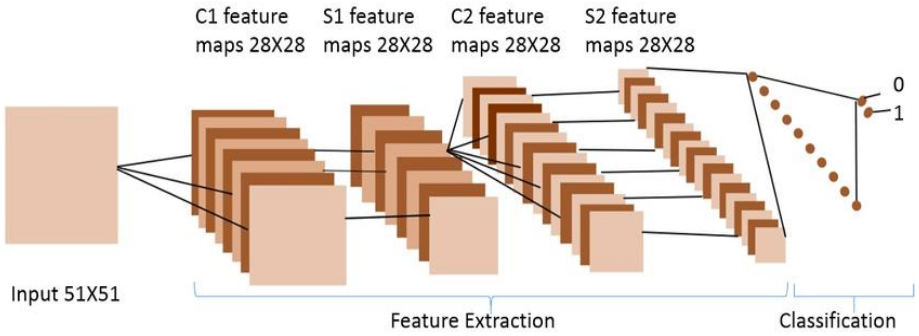

Figure 3: *Feature Extraction process*

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3.4 Classification

The two-stage classification is done by CNN classifier which is used to recognise complicated patterns. This classification technique helps in finding the stages of fibrosis that is detection of early and late fibrosis. CNN consists of multiple layers namely Input layer, Convolutional layer, pooling layer, and fully connected layer with each layer performing its own task. Input layer consist of the input image which is filtered in the convolutional layer which is then compressed in the pooling layer for reducing computation and finally the fully connected layer that predicts the output.

4 Result and Discussion

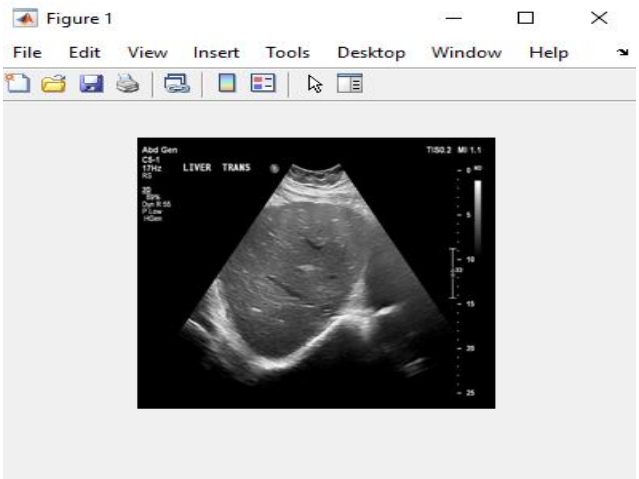

Figure 4: *Input Image*

Figure 4: Represents the input image which needs to be diagnosed for liver fibrosis or normal liver.

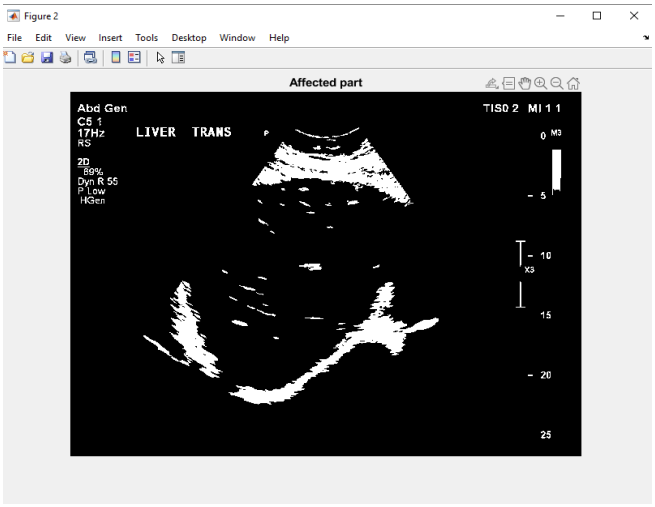

Figure 5: *Image displaying affected part*

Figure 5: Represents the affected parts of the image after the diagnosis process.

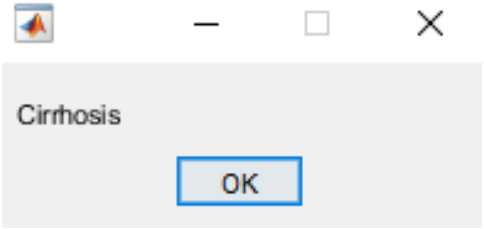

Figure 6: *Output Image*

Figure 6: Represents the output of the diagnosis process displaying whether the patient is affected or not and also the stage of the liver disease.

5 Conclusion

Thus the classification of liver fibrosis using the transfer learning technique and FCNET classifier is detected with high accuracy and the liver fibrotic images containing unwanted disturbances is removed in the pre-processing stage and ROI based EM algorithm is used in the segmentation stage and the required part of the image is operated. Therefore the early and the late stages of the liver fibrosis is detected.

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