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AN ARTIFICAL NEURAL FUZZY RULE-BASED EXPERT SYSTEM FOR DIAGNOSING CYSTIC FIBROSIS

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Abstract- In recent years, liver disorders have been the most severe in the world. In this research, using Adaptive Neuro Fuzzy Inference System (ANFIS) and Fuzzy C-Means (FCM) strategies, an automated intelligent diagnostic method has been introduced to suggest liver disease by different types and separate details of the disease. Before inspecting the clinical data, the more complicated Neuro Fuzzy Model selected the data needed for the analysis. Identifying liver disease and recommending the exclusion of sensational forms is a very energetic step in ensuring the adeptness of the doctor. Data on patients who have been treated by doctors in different hospitals is obtained in order to make the work more concrete and empirical. Since the research involves the patient's comprehensive details, pre-processing has been completed. The strategies of Neuro Fuzzy have been extended to patient data. The findings of this evaluation indicate that the Neuro Fuzzy approach could be effectively used to advise liver cancer patients.

Keywords- Image Processing, Cystic Fibrosis, Fuzzy Set, Artificial Intelligence, Liver Diseases

I. INTRODUCTION

In medicine, the use of automated diagnostic systems is growing steadily [1]. The efficiency of these methods has strengthened the judgment of doctors in the prediction of disease. The same is true of liver disease, the incidence of which has risen dramatically in recent years. There has been an immense interest in applying advanced computational techniques to liver disorders. In assessing liver damage, artificial neural networks, fuzzy logic, rule-based reasoning, case-based reasoning, Fisher discriminant analysis, artificial immune recognition system, and decision tree approaches were commonly used [2]. In several patients, the advancement of these strategies has decreased the rates of liver death and improved years of living.

The main internal component of the human body is the liver. It performs multiple metabolic functions, like detoxifying harmful chemicals, protein production, drug metabolism, blood clotting, glucose storage, cholesterol production, and bilirubin clearance. Harm to any of the functions alluded to above contributes to liver disease [3]. Abdominal pain, nausea, reduced appetite, exhaustion, energy loss, and losing weight are the small signs of the illness. Diagnoses such as edema, jaundice, ascites, irregular bleeding, quick swelling, redness of the back of the hand, and occasionally confusion of memory[4] are becoming more serious once the illness develops. Alcohol misuse, hepatitis viruses, iron overloading, irregular genes, and Epstein-Barr viruses [5] are the most possible symptoms of the disease. Liver disease could be categorized into more than hundred kinds out of which viral hepatitis, liver cancer, primary biliary cirrhosis, liver fibrosis, neonatal hepatitis, primary hepatoma, alcoholic liver damage, nonalcoholic liver disease, cholelithiasis, liver cirrhosis, hemochromatosis, Main sclerosing cholangitis, tyrosinemia, and Wilson disease are usually prevalent [6].

The paper is organized as follows: Section II describes the Adaptive Neuro based on Fuzzy logic interference system , Section III explain about literature review of liver diseases and section IV and V describes show proposed objectives and results .Section VI demonstrates Conclusion.

II. ADATIVE NEURO FUZZY INFERENCE SYSTEM (ANFIS)

The Neuro-fuzzy method is a machine learning method that is gradually applied to develop a fuzzy system by leveraging neural network classification algorithm. It combines the human reasoning power of fuzzy logic and the neural network's learning capacity for tuning the fuzzy logic parameters [7]. The NFS structure is illustrated in Fig. 1. The fuzzy interface recognizes the input in this design in the form of linear sentences and produces the vector to be given to the neural network that could be conditioned to make desired decisions through the training algorithm. In this, linguistic statements are given in the kind of the if-else rule base created by the Fuzzy Inference System (FIS) and the methodology for hybrid learning is applied, and whether or not the person has liver disease is the final decision to be made.

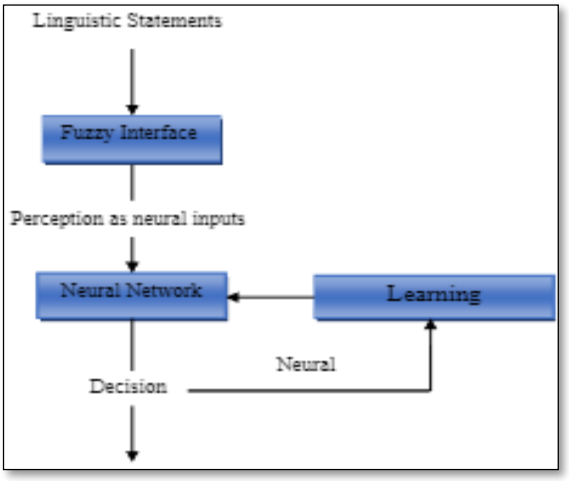

Figure 1: Framework of Neuro fuzzy system[7]

III. LITERATURE SURVEY

Naimi et al., This paper paved the way for precise, Transform-based diagnosis of AIH disease. During the period of 9-month stretch, collected data on 216 biopsies from the Poursina Hakim Research Institute, in addition to highlighting 11 innate features of AIH through the assistance of three specialists. And have used FRI-FCM for classification purposes, which is an efficient FCM addition and trained it for the first time using a new technique consisting of QEA and PSO methods. QEA is used as a method for link reduction and PSO is also used to turn the remaining links. Contrast of FRI-FCM findings collected with those of 10NN, Naïve-Bayes, SVFNN, and SVC, suggests its dominance in AIH data classification. Effectively, FRI-FCM has obtained an AUC of 0.88 that is better than any of the above approaches [8].

Mitani et al., In this paper examined the impact of an improvement in the ROI image in the classification of cirrhosis liver on CNNs. From our experiment conducted, the classification efficiency of the CNNs has been enhanced with the augmentation by a perspective transformation. Also, author tried to explore the variety of different techniques of augmentation but the results turned out to be bad. In this issue of liver classification with cirrhosis, the efficacy of an augmentation is seen only by a change of perspective. And will be researching the impact of the amount of augmented ROI images in relation to the average rate of error in future [9].

Kuo et al., In this paper, presented a computer-aided diagnostic method with CT images for texture analysis of liver tumors. Integrated with the enhanced PSO approach and SVM, the suggested two-stage selection approach reduces the amount of the best features to below 20. In the meantime, a fluffy logic weight value is introduced to achieve the actual outcome of the classification. The five outcomes of the assessment were all above 80%. The suggested technique therefore offers a computer-aided framework for the diagnosis of liver tumors with high differential accuracy [10].

Bedi et al., Classification of the normal and cirrhotic liver was correctly performed in this study. out of 53 feature extraction, seven of the great attributes are selected for classification. Weighted FDR method is used by choosing optimum WD threshold for classification. With a high precision of 96.38 percent and an excellent stability of 98.33 percent, this method can differentiate the cirrhotic liver from normal liver [11].

Mitrea et al., plan to expand the range of texture-based features by introducing multi-resolution attributes capable of making the cirrhotic tissue more suitable. More complex classification methods, including those listed in and also deep learning techniques for both supervised and unsupervised classification are also within our goals, with the intention of further enhancing the performance of automatic detection of the severity grades of cirrhosis. The approach has been verified by supervised classification, offering a rate of recognition above 95% [12].

Reddy et al., Such quantitative analysis or diagnostic precision relies on the radiologist's experience and abilities. With the emergence of Health 4.0 and the Computer Assisted Diagnosis (CAD) strategies, the sonographers and clinicians will enhance the precision in detecting FLD using ultrasound. , in addition to an accurate diagnosis, the CAD methods can help radiologists identify more patients in less time . Therefore suggest a framework CAD system using convolution neural networks and transfer learning (pre-trained VGG-16 model) to enhance the accuracy of FLD using ultrasonic images. Performance findings show that in classifies and fatty liver images, the new plan provides a FLD classification accuracy of 90.6 per cent [13].

Kasturi et al., It overcomes the challenge in early detection of nodules of lung and liver cancer. It's using MATLAB tools to diagnose lung cancer early on. The tomography image of the machine chest is used in this article. The various conventional methods of image processing are used for extracting the region of interest. The research framework specifically defines the area

where cancer is present. The findings show that in the initial point of the diagnostic process, this device may allow the doctor to identify a liver cancer in the lung. The research work on further progress in the segmentation technique identified various areas for future research including more effective detection of small micro chronic inflammation with quicker computational time [14].

Vohra et al., Six strategies have been explored on ILPD (Indian Liver Patient) dataset. It included patients with 72 per cent liver and 28 per cent non-liver. Techniques for optimizing dataset were conducted under sampling and over sampling. If genetic modeling was used under sampling (50 per cent), then 84.75 per cent accuracy was achieved. If oversampling (200 per cent) was conducted then best result was provided by Random Forest (89.10 per cent). After ten cross validations all the equations were used in this article [15].

IV. PROPOSED OBJECTIVES

4.1 PROBLEM FORMULATION

It's very harder to identify Liver cirrhosis early. All liver cirrhosis testing is time-consuming, costly and involves special skills. A total of three methods are calculated in literature to diagnose disease but these are not enough to diagnose Liver Cirrhosis. Medical experts make diagnostic decisions based on heuristic knowledge and experience that can often conclude wrong decisions, so there is an enormous required for such a image processing approach or a hierarchical fuzzy expert system that can position vector decisions and help in early stage progression of liver Cirrhosis.

4.2 RESEARCH GAPS

From the literature review it was found that the above are problems relating to liver cirrhosis disease that must be addressed:

1. Early detection of Liver Cirrhosis is not feasible because all the methods used to diagnose it are very time-consuming and expensive, so that a methodology is required for a hierarchical expert system that can easily identify Liver Cirrhosis at an initial stages
2. A total of three are found in literature to identify disease but are not adequate to diagnose Liver Cirrhosis.
3. The most commonly used method for Liver Cirrhosis diagnosis is the study of scanned and ultrasound images. A hepatic specialist is expected to read to them.

4.3 OBJECTIVES

1. To study the various methods for detection of Liver cirrhosis**.**
2. To detect Liver Cirrhosis using fuzzy logic.
3. To compare the proposed techniques of Liver cirrhosis with conventional techniques.

4.4 RESEARCH METHODOLOGY

It explains the systematic approach to be practiced in research work, and briefly explains the following:
Firstly, research study should be started under this, all properties of fuzzy logic must be studied and full knowledge of the subject should be achieved with Liver Cirrhosis. After reviewing the literature, choosing input and output parameters of cirrhosis in the liver must be performed using effects and risk parameters, and applying fuzzy. This step is where, gather information to identify membership roles. If membership functions are well established, then built up fuzzy IF-ELSE rules, then move back to the previous stage. After fuzzy only if built, checking for liver cirrhosis will be done if the cirrhosis test is correct than the next stage, else the processing will stop. Develop a hybrid hierarchical structure with the use of effects and risk parameters. This step is where, gather information to identify membership roles. If membership functions are well established, then built up fuzzy IF-ELSE rules, then move back to the previous stage. Testing for the identification of liver cirrhosis is performed after fuzzy or otherwise is built. Cirrhosis testing is correct, so the next step will be taken, else the processing will end. Following this method interface for the Fuzzy Logic System suggested. Lastly there is the application of work being.

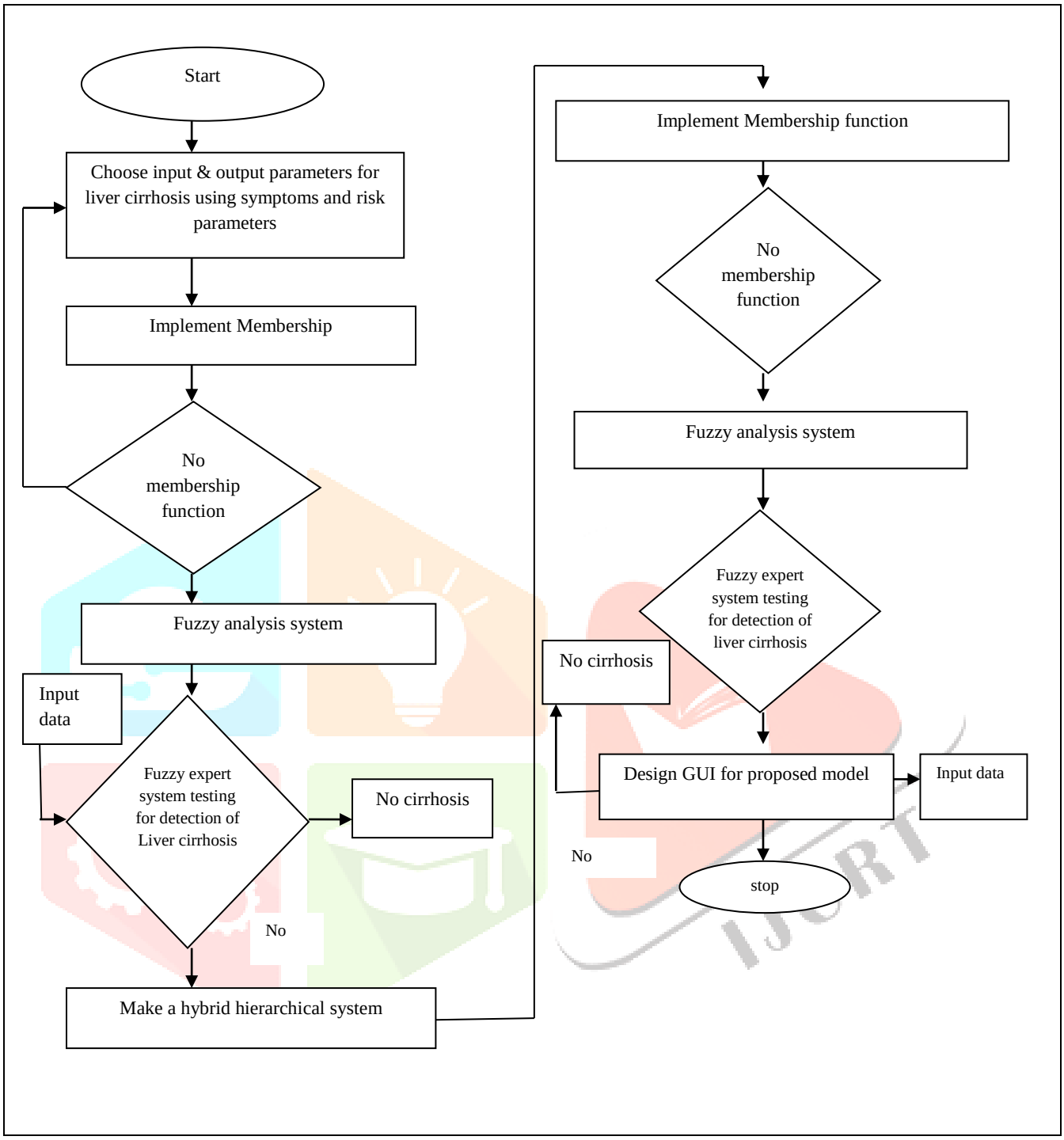

Figure 2: Flow chart of proposed methodology

V. RESULTS

The aim of this study is to use a set of input parameters from the patient dataset to overcome the estimation concern with liver fibrosis phases for blood count patients. The Artificial neural Fuzzy logic scheme was introduced to accomplish this aim. For liver fibrosis diagnosis, this is a new medical fuzzy inference scheme. By finding the fuzzy rules using a fuzzy rule reasoning approach from training data, they also built a statistical approach and generalized the interaction functions for both input and output parameters. Implement the fuzzy inference technique, focused on fuzzy sequence created by the FDT, through a fuzzy logic toolbox given in the Matlab programme. Because of its flexibility and extensibility of the performance, the Mamdani FIS is typically used particularly for decision support applications.

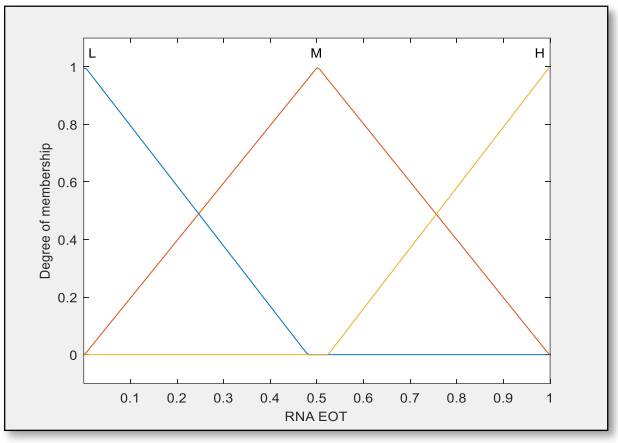

Figure 3: Plot the membership functions for the first input variable RNA EOT

The degree of membership categorizes the degree of the element's membership to the fuzzy set. A score of zero indicates that it is not a member of the fuzzy set; a value of 1 indicates that it is a member of the fuzzy set.

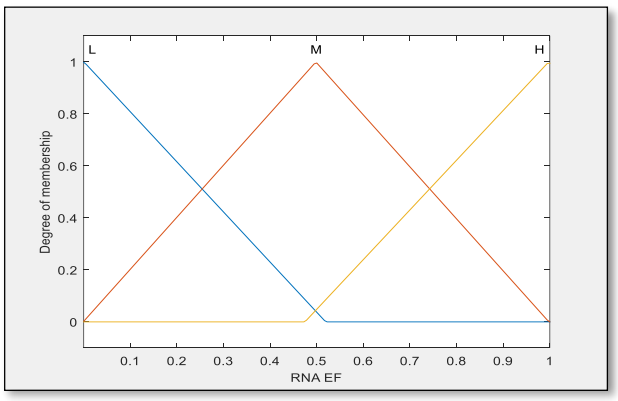

Figure 4: Plot the membership functions for the first input variable RNA EF

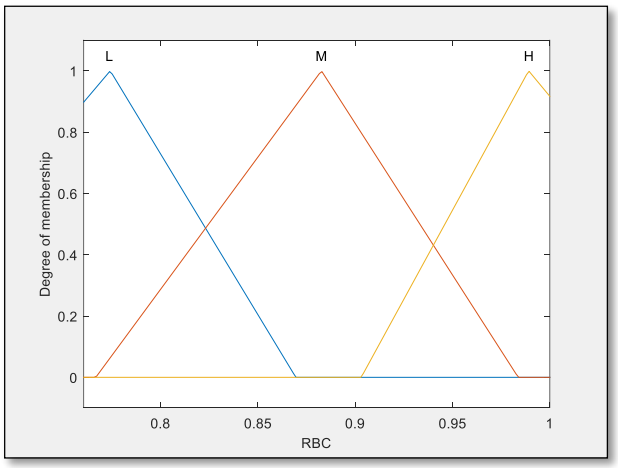

Figure 5: Plot the membership functions for the first input variable RBC

The fuzzy rule-based method for forecasting the diagnosis class was established and the necessary MFs for input fuzzification and output defuzzification were found in the FIS. Designers have four output classes and the prediction method uses 243 fuzzy rules.

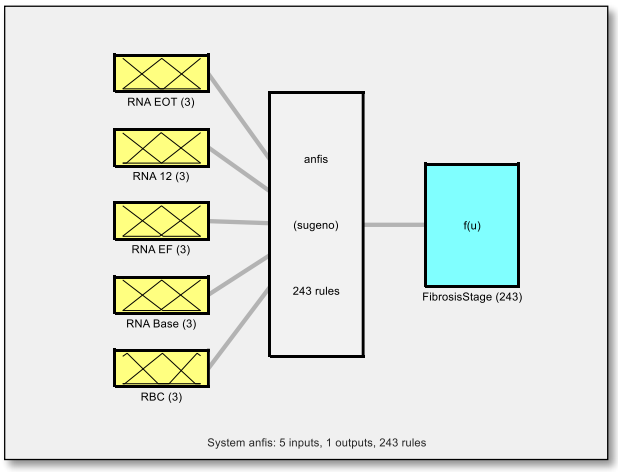

Figure 6: ANFIS SYSTEM for proposed work

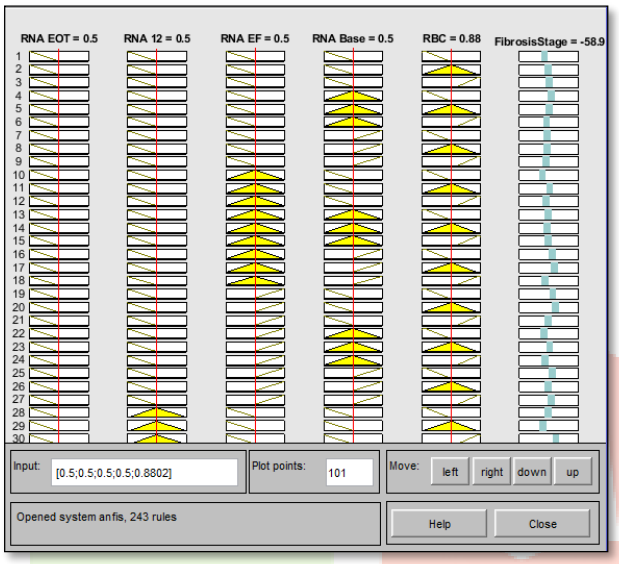

Figure 7: The chart of rules for the Sugeno ANFIS is shown with the parameters used.

The Evaluation by following Measured Terms:

- True Positive (TP): is the amount of cases correctly detected as cirrhosis.
- True Negative (TN): is the amount of cases correctly detected as non-cirrhosis.
- False Negative (FN): is the amount of cases incorrectly detected as non-cirrhosis.
- False Positive (FP): is the amount of cases incorrectly detected as cirrhosis.

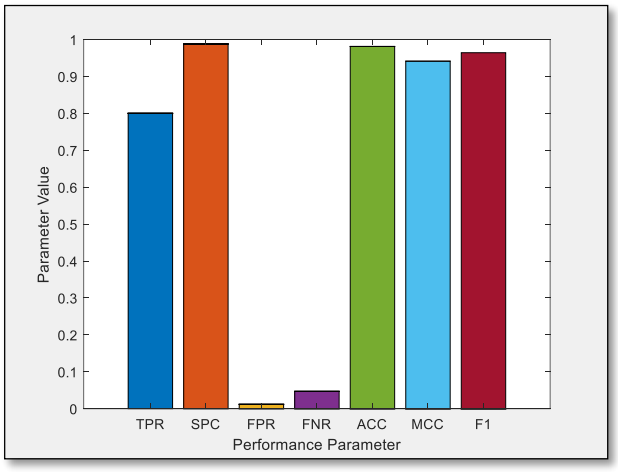

Figure 8: Comparsion table of performance parameter versus parameter value

These outcomes were used to calculate the performance of the suggested work. The contrasted is provided in Fig.9. The outcomes are reported in various different terms considering accuracy ACC= $\frac{TP+TN}{TP+TN+FN+FP}$, sensitivity TPR = $\frac{TP}{TP+FN}$, and

specificity SPC = $\frac{TN}{TN+FP}$+,false positive rate FPR =$\frac{FP}{FP+TN}$, and false negative rate FNR =$\frac{FN}{TP+FN}$, $F1$Score = $\frac{2TP}{2\,TP+FP+FN}$and Matthews correlation coefficient

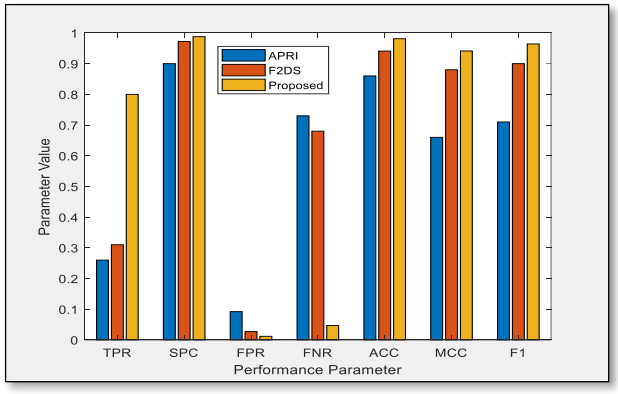

Figure 9: Comparsion graph shows comparison of proposed work with different algorithm

As shown in Fig. 9, shows the analysis of the contrast among the suggested, F2DS and the APRI medical test, showing 99.4 percent accuracy for the suggested task, and so on. These effects reinforce the medical importance of our suggested device sensitivities. It produces more specific outcomes than current work.

VI. CONCLUSION

In our research, a fuzzy logic was used and a new knowledge-based approach for estimating stages of liver fibrosis was proposed. The research framework has been developed to be sufficient to evaluate the diagnosis of the liver better than the current work. The research data illustrate that the suggested methodology has a high accuracy of 99.4 percent in spite of error detecting liver disease on the sample of liver disease. In addition, to establish the membership functions and verify the fuzzy knowledge base, the system depends on domain expert knowledge. In our work, the suggested findings expected liver cirrhosis phases in advanced stages through Artificial Neural Fuzzy.

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