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Expert systems for diagnosis of liver diseases

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Abstract

Liver diseases occur when there is any kind of disturbance in the functioning of liver and it becomes the primary source of illness. There are several signs of liver illness such as itchy skin, dark urine colour, vomiting, abdominal pain etc. mostly patients come to know about the liver disorders in the later stages, when it is difficult to give treatment to the patients. It is required to detect the liver disorders in the early stages. This problem mostly arises in the developing areas where patients do not get much medical expertise, as the no. of doctors in not so much high in these areas. So, it would be very much beneficial if medical diagnostic expert systems would be used specially in developing area. With the help of these systems, a person can have idea about the diseases in the early stages. He or she does not need to visit hospitals. They can make use of it by sitting at home. This is the system in which knowledge about the diseases is deployed inside it. User has to input his symptoms and system will suggest the disease that the user has. These systems will give almost the same advice as given by the physician. Further there are many techniques which are applied in these medical diagnostic systems. These techniques are machine learning, deep learning, soft computing etc. Many researchers have already worked on it. They have diagnosed liver diseases using expert systems. In this paper, the work done by authors in the field of expert systems for liver diseases is summarized briefly.

Keywords- Liver, disease, expert system, diagnosis

Introduction

Liver is the largest organ of the body having weight about 3.5 pounds. It performs many important functions such as manufacturing of proteins, elimination of harmful biochemical waste products, storage of carbohydrates etc. So, it is one of the important organs of the body. Liver diseases disturb the functioning of the liver. The most common liver diseases are chronic hepatitis, acute hepatitis, cancer, fatty liver disease and cirrhosis and causes of these diseases are viruses, metabolic problems, genetic abnormalities etc. There are certain tests to check the functioning of liver. These tests are like ALT, AST and alkaline phosphate enzymes. Sometimes people are unable to detect the liver disorders in the earlier stages and it creates much difficulty for human in later stages. So, it is advisable to detect and treat it in earlier stages. For detection in earlier stages, a concept of expert system is used. An expert system is a system which uses knowledge taken from the physicians or experts in a particular domain and give advice to the users based on that knowledge. Its suggestion or recommendation is almost similar to the advice given by the expert. There are many benefits of using expert systems such as to combine various human expert intelligences, minimize human training cost, hold huge amount of information etc. So, it is better to use concept of expert system for medical diagnosis. It will help to detect the disease in early stages without involving any major expenses. Only knowledge of software system is required. This type of concept is much useful in areas where no. of doctors is less and they are not much developed areas. Further for the better performance of the expert systems, various techniques may be applied in these systems.

ISSN: 0971-1260

Vol-22-Issue-17-September-2019

These techniques are machine learning techniques, soft computing and deep learning techniques. Earlier people use simple rule-based approach for the diagnosis of disease. These simple rule-based systems only tell either the user is having that disease or not. They do not tell the probability of the disease. So, to remove this shortcoming, people start using fuzzy logic. With the help of fuzzy logic, now system is able to find the probability of disease that the users have. Further to enhance the diagnostic accuracy people start using advance concepts such as neuro-fuzzy algorithms, neural networks, KNN, SVM, CNN, hybrid mdoels etc. Researchers have got better diagnostic accuracy using these advance techniques of machine learning and deep learning.

Literature Review

E-Liang Chen et al. (1998) [1] used the concept of CT images for diagnosis of liver diseases. In this paper, a classification system is developed to extract the boundary of CT liver and further to classify liver disease. This system works in two phases. In the first phase, there is a DBE method which stands for detect-before-extract method. In this method, it automatically detects the boundary of liver and in second stage, neural network is applied to differentiate normal liver from infected liver. In the first stage or phase, Brownian motion model is used and in the second stage or phase, modified probabilistic neural network is used. This system is tested on 30 liver cases and it is observed that this is effective and efficient method for liver diagnosis.

Chien-Cheng Lee et al. (2006) [2] considered three types of liver diseases. These three types are cyst, cavernous hemangioma and hepatoma. A kernel-based classifier is used in this study. The diagnosis is made on the CT images. The whole research work is done in two steps. First step is feature extraction and classification. In this, features are extracted from the CT scan images. After this multilayer hierarchical model is used. The performance of the proposed system is evaluated with ROC curve.

M.Neshat et al. (2008) [3] developed a fuzzy expert system for diagnosis of liver diseases. Dataset used in this research work is taken from UCI repository. This dataset contains 345 records and each record is having 6 parameters. The output in this work is rate of liver infection. The proposed system is compared with other traditional diagnostic systems and it is found that the proposed system is cheaper, faster and more accurate as compared to other traditional methods. The system is verified with the actual results from physicians and it is observed that the verification rate for the proposed system is 91%.

Rong-Ho Lin (2009) [4] developed an intelligent system for diagnosis of liver diseases. In this work, diagnostic accuracy is improved by using classification, regression tree and case-based reasoning. There are two steps followed in this research work. In the first step, classification and regression tree are applied. It would tell either the patient is suffering from liver disease or not. Further in the second step, case-based reasoning is applied to know the type of liver disease. The performance analysis of the proposed system is done and it is found that the system obtained 92.94% diagnostic accuracy in the first step and 90% diagnostic accuracy in the second step. This model acts as supporting tool for those patients and physicians who work on diagnosis of liver diseases.

ISSN: 0971-1260

Vol-22-Issue-17-September-2019

Shinya Kohara et al. (2010) [5] designed a model to classify the cirrhosis liver and normal liver. Basically, this model is a statistical shaped and used to evaluate variations of organ shape. This model recognizes that either the liver is normal or not. It also works in two stages. In first stage, statistical shape model is used and in second stage, coefficients of the model are used.

Chun-Ling Chuang (2011) [6] developed an expert system for diagnosis of liver diseases. In this research work, case-based reasoning is integrated with different data mining techniques and in each case, performance of the system is evaluated. It is observed that the maximum accuracy is obtained by BPN-CBR method and it is 95%. Similarly, other performance parameters are also calculated for this method and they are sensitivity and specificity. The sensitivity is 98% and specificity is 94%.

Lifu Zhao et al. (2011) [7] designed ALSS (Artificial liver support system) for liver transplantation. Non biological liver instrument and bio artificial liver are combined to form an artificial liver support system. The proposed system consists of pump drive module, human machine interaction interface and a sensor network. The proposed system is verified by testing it on pigs. It is proven to be a reliable and efficient system for liver treatments.

Sanjay Kumar and Sarthak Katyal (2018) [8] used various data mining algorithms for diagnosis of liver diseases. A reliable and trustworthy dataset is considered for the proposed research work and five classification techniques are applied on the dataset. Further, performance of the proposed system is evaluated in terms of different parameters such as recall, accuracy and precision. Proposed system is tested and these performance parameters are calculated. The parameters show good values for the proposed system.

Pushpendra Kumar and Ramjeevan Singh Thakur (2019) [9] considered LFT (Liver function dataset) and classification algorithms are applied on this dataset for the diagnosis of liver diseases. In this research work, hybrid model is developed. This hybrid model consists of fuzzy based adaptive KNN and neighbour weighted KNN to detect liver diseases. In this paper, it is stated that this method gives better results as compared to existing methods.

A review of different studies for diagnosis of liver diseases is also described in table I.

Table I: Studies for diagnosis of liver diseases

S No.	Author(s)	Year	Disease	Technique	Remarks
1	E-Liang Chen et al.	1998	Liver	Computer assisted image processing technique	The proposed system is tested on 30 liver patients and good results are obtained.
2	Chien-Cheng Lee et al.	2006	Liver	Kernel-based classifiers	

ISSN: 0971-1260

Vol-22-Issue-17-September-2019

					The performance of the system is evaluated in terms of ROC curve.
3	M.Neshat et al.	2008	Liver	Fuzzy expert system	In this research work, obtained verification rate is 91%.
4	Rong-Ho Lin	2009	Liver	Classification, regression tree and case-based reasoning	Accuracy obtained for this research work is 92.94%
5	Shinya Kohara	2010	Liver	Statistical shape model	The proposed model consists of two phases. In first, statistical model is used, in second, coefficients for model are used.
6	Chun-Ling Chuang	2011	Liver	Case based reasoning and data mining techniques	Accuracy obtained for this research work is 95%.
7	Lifu Zhao et al.	2011	Liver	Artificial support system	It is proven to be reliable and efficient method for liver disease diagnosis.
8	Sanjay Kumar and Sarthak Katyal	2018	Liver	Data mining techniques	Recall, precision and accuracy parameters show good values for the proposed work.
9	Pushpendra Kumar and Ramjeevan Singh Thakur	2019	Liver	Fuzzy adaptive and neighbour weighted KNN method	Proposed hybrid model gives better results as compared to other existing systems.

Conclusion and future scope

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It is concluded that there are many studies from different authors on diagnosis of liver diseases. Different authors have applied different machine learning and soft computing techniques for detection and treatment of liver diseases. The performance of these expert systems is evaluated in terms of different parameters such as precision, accuracy, sensitivity and specificity. Some authors have also shown performance of the system in term of ROC curve. From the studies considered in this review paper, it is found that maximum accuracy is obtained by using hybrid model consisting of case-based reasoning and data mining techniques. It is also observed that there is not much work done using deep learning techniques for diagnosis of liver diseases. Although it is expected that the deep learning techniques may have better results as compared to other techniques for diagnosis of liver disorders. So, there is a scope to work with deep learning techniques for diagnosis of liver diseases, but there is requirement of large dataset for deep learning techniques.

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