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MODERN DETECTION METHODOLOGY FOR LIVER CONTINUAL DISEASES WITH HEPATITIS AND CIRRHOSIS AVOIDANCE BY ESTIMATING THE EUCLIDEAN DISTANCE USING MACHINE LEARNING ALGORITHM

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ABSTRACT

Machine Learning (ML) permits the user to feed a computer based algorithm an enormous quantity of data and encompass the computer to analyze and make decisions and data-driven recommendations based on the input data. ML software parses this data and then "learns" from it by applying patterns from which it is able to make predictions. In the healthcare based application ML can be used to help and detect disease. In recent years, liver oriented disease has materialized as one of the normal occurring disease worldwide. Various algorithms are used to predict the liver disease. A correlation distance metric and nearest rule based k-nearest neighbor approach is used as an effective way to predict the liver disease. Intelligent classification algorithms employed on liver patient dataset are linear discriminant analysis (LDA), diagonal linear discriminated analysis (DLDA), quadratic discriminant analysis (QDA), diagonal quadratic discriminant analysis (DQDA), least squares support vector machine (LSSVM) and k-nearest neighbor (KNN) based approaches are some of the techniques used for detecting liver disease. It is observed that KNN based approaches are superior to all classifiers in terms of attained accuracy, sensitivity, specificity, positive predictive value (PPV) and negative predictive (NPV) value rates. Liver diseases are usually detected in the advanced stage. Hence, mortality rate is high in case of liver patients. Early diagnosis of liver diseases can definitely improve this. Diagnosis of normal and diseased liver is done using clinical data which is derived through blood tests. In this paper an attempt is made to make demarcation between the normal and diseased liver using K-nearest-neighbor (KNN).

KeyWords: Liver Disease, KNN, ML, Medical Science, Linear analysis

INTRODUCTION

Machine learning cannot replace a doctor or specialist: although Machine Learning helps to predict the probability of contracting a disease, it does not replace all the work a specialist does. For example, Machine Learning can help identify relatively quickly and early if someone has cancer but the treatment still needs to be determined by the doctor. The success of Machine Learning is contingent upon good data. If the data is not of good quality or no patterns can be found in it, then it is useless. Similarly, there's a risk that when a model is training using a set of data that existing patterns may not apply to new data. A healthy liver, shiny pinkish-brown triangle tucked under the right rib cage, it is expected for every human being. Liver plays a vital role of removing toxins, converting digested food to energy, storing vitamins and minerals and controlling how much fat and sugar is sent back out to the rest of the body.

Malfunctioning of liver can disturb functioning of other body parts. Hence, it is of utmost importance to detect the status of liver functioning at an early stage. ML is subclasses of artificial intelligence technology, where algorithms process large data sets to detect patterns, learn from them, and execute tasks autonomously without being instructed on exactly how to address the problem. In recent years, the wide availability of powerful hardware and cloud computing has resulted in the broader adoption of ML in different areas of human lives, from using it for recommendations on social media to adopting it for process automation in factories. And its adoption will only grow further. One of the uses of machine learning in healthcare is using optical character recognition (OCR) technology on physicians' handwriting, making the data entry fast and seamless. This data can then be analyzed by other machine learning tools to improve decision-making and patient care.

PREDICTING LIVER DISEASE.

The liver plays a leading function in metabolism. It is vulnerable to diseases like chronic hepatitis, liver cancer, and cirrhosis. It is a very hard task to effectively predict liver disease using enormous amounts of medical data; however, there have already been some significant shifts in this area. Machine Learning algorithms like classification and clustering are making the difference here. The Liver Disorders Dataset or the Indian Liver Patient Dataset (ILPD) could be used for this task. K-Nearest neighbor algorithm (KNN) classifier is a non-parametric method used for both classification and regression. It is commonly used for classification in medical diagnosis. It is known for its simplicity and of interpretation and highly competitive results with low calculation time.

KNN is basically used for lower dimensional data i.e. less number of input variables and for a classification study when there is little or no prior knowledge about the distribution of the data. KNN, unlike most of other supervised learning algorithms, does not learn any model. KNN makes predictions using the training dataset directly. It assumes that the training data is in a feature space. Testing data is also placed in this feature space. K decides the number of training instances that will remain in the periphery of the sample. To determine which of the K instances in the training dataset are most similar to a test sample a distance measure is used. The most popular distance measure is Euclidean.

The Euclidean distance between two points in Euclidean space is the length of a line segment between the two points. Human lifestyle is changing daily with food, clothing, and

shelter uses. This causes increase in medical diseases. The result of this thing is that, new disease with greater effect is arising and expert of medical field is finding difficulty to treat that patient. KNN is one of the popular techniques used for diagnosis of disease with better performance in short period time. KNN algorithm is divided into two parts, in first part need to define neighbor which are closest to each other. To get over imbalanced data problem frequency estimation and local estimation of prior probability is considered. Difference between frequency and local estimation solves the imbalanced data problem.

EXISTING SYSTEM

Chronic hepatitis often causes general symptoms, such as a vague feeling of illness (malaise), poor appetite, and fatigue. Sometimes affected people also have a low-grade fever and some discomfort in the upper abdomen. Jaundice (a yellow discoloration of the skin and whites of the eyes caused by deposits of excess bilirubin) is rare unless liver failure develops. Many people with chronic hepatitis have no symptoms. Often, the first specific symptoms occur when liver disease has progressed and there is evidence of cirrhosis.

CAUSES OF CHRONIC HEPATITIS

The most common causes of chronic hepatitis are Hepatitis C virus, Hepatitis B virus, Fatty liver not due to alcohol use (nonalcoholic steatohepatitis), Alcohol-related liver disease. Many researchers' finds that the hepatitis C virus causes about 60 to 70% of cases of chronic hepatitis, and at least 75% of acute hepatitis C cases become chronic. About 5 to 10% of hepatitis B cases in adults become chronic, sometimes with hepatitis D coinfection. (Hepatitis D does not occur by itself. It occurs only as a coinfection with hepatitis B.) Acute hepatitis B becomes chronic in up to 90% of infected newborns and in 25 to 50% of young children. Rarely, hepatitis E virus causes chronic hepatitis in people with a weakened immune system, such as those who are taking drugs to suppress the immune system after an organ transplant, who are taking drugs to treat cancer, or who have HIV infection. Hepatitis A virus does not cause chronic hepatitis.

Nonalcoholic steatohepatitis (a type of chronic inflammation of the liver) usually occurs in people with excess body weight (obesity), diabetes, and/or abnormal levels of cholesterol and other fats (lipids) in the blood. All of these conditions cause the body to synthesize more fat or process (metabolize) and excrete fat more slowly. As a result, fat accumulates and is then stored inside liver cells (called fatty liver). Fatty liver can lead to chronic inflammation and eventually progress to cirrhosis. (Fatty liver due to any condition other than excessive consumption of alcohol is called nonalcoholic fatty liver disease.)

Alcohol, after being absorbed in the digestive tract, is usually processed (metabolized) in the liver. As alcohol is processed, substances that can damage the liver are produced. Alcohol-related liver disease typically occurs in people who drink heavily for many months or years. Alcohol-related liver disease is characterized by fatty liver and widespread liver inflammation that can result in the death of liver cells. If people continue drinking, scar tissue can form in the liver and may eventually replace a large amount of normal liver tissue, resulting in cirrhosis.

Less often, chronic hepatitis results from Autoimmune hepatitis, Drugs, Alpha-1 antitrypsin deficiency (a hereditary disorder), Celiac disease, Hemochromatosis (a hereditary disorder that causes the body to absorb too much iron), Primary biliary cholangitis, A thyroid

disorder. In children and young adults, Wilson disease (a rare hereditary disorder involving abnormal retention of copper in the liver). In autoimmune hepatitis, the chronic inflammation resembles inflammation caused by the body attacking its own tissues (an autoimmune reaction). Autoimmune hepatitis is more common among women than men. Certain drugs can cause chronic hepatitis, particularly when they are taken for a long time. They include amiodarone, isoniazid, methotrexate, methyldopa, nitrofurantoin, and tamoxifen and rarely acetaminophen.

CHRONIC HEPATITIS IS INFLAMMATION OF THE LIVER THAT LASTS AT LEAST 6 MONTHS.

- Common causes include hepatitis B and C viruses and certain drugs.
- Most people have no symptoms, but some have vague symptoms, such as a general feeling of illness, poor appetite, and fatigue.
- Chronic hepatitis can progress to cirrhosis and ultimately liver cancer and/or liver failure.
- A biopsy is sometimes done to confirm the diagnosis, but chronic hepatitis is usually diagnosed based on blood test results.
- Drugs, such as antiviral drugs or corticosteroids, may be used, and for advanced disease, liver transplantation may be needed.
- Some of the symptoms of chronic hepatitis are an enlarged spleen, small spiderlike blood vessels visible in the skin (called spider angiomas), redness of the palms, accumulation of fluid within the abdomen (ascites), a tendency to bleed (coagulopathy), bleeding in the digestive tract due to esophageal varices, jaundice, deterioration of brain function (hepatic encephalopathy) and liver cancer

PROPOSED SYSTEM

Supervised learning training method is defined and called as back propagation neural network. In this algorithm error notification is taken into consideration to improve the performance of algorithm. This algorithm consists of three layers input layer, hidden layer and output layer. By back propagating it is easy to find errors in hidden layer also. The inputs are analyzed still desired output is found. In February 2022, approx. 2.7 to 3.9 million people are infected with hepatitis C virus .The people affected with Hepatitis B Virus 800000 to 1.4 million and 12000 people died. 40% people are suffering with Hepatitis B and C and alcohol addicts are 60%. Following figure 1 shows the disadvantage of alcohol consumption and disease possible due to heavy consumption of alcohol. Figure 1 shows the different stages of

liver damage.

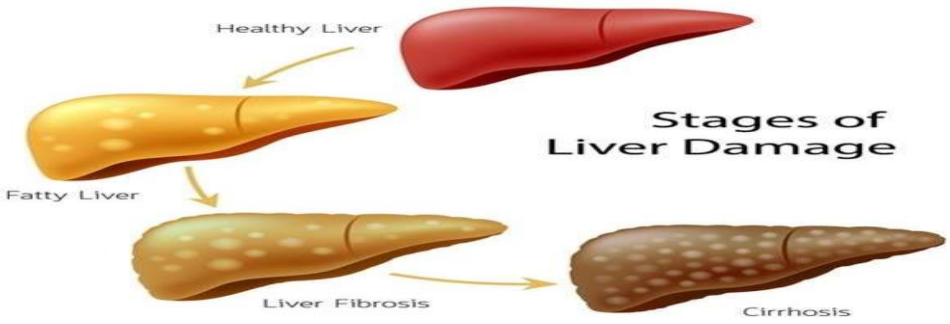


Fig 1 :Different Stages of Liver Damage

KNN ALGORITHM

This is supervised learning algorithm used for many pattern recognition, object based technique used to classify on the closet data example. The neighbor value is taken into consideration while performing classification. K is positive integer value used to search neighbor element. This algorithm consists of different steps. Initially it finds the number of neighbors by using k, use distance measure technique to calculate distance between instance query and training samples. Then all training samples are sorted and kth minimum distance is found by using nearest neighbor, Check sorted data and categorized the training data comes under K and this value of K is found with majority of nearest neighbor. For determination of point belonging to neighbor, the distance from all training set must be calculated. Euclidean distance is technique used to get K-Nearest neighbor. For n attribute it is calculated as follow. Smoothing parameter is needed to find next neighboring element. The value of K must be large to hold the priority of Non-Bayesian decision, but small enough togive accurate result. The optimal value of K depends on number of sample available andstructure of each population. It performs better than linear and quadratic equation to give result. Advantage: Especially if we use Inverse Square of weighted distance as the "Distance" so itbecomes robust to noisy training data. If the training data is large then it is more effective. Simplicity, effectiveness, intuitiveness and competitive classification performance in many domains. Disadvantage: In which we need to determine value of parameter K (numberof nearest neighbors). Distance based learning is not clear which type of distance to use and
which attribute to use to produce the best result.

Algorithm:

1. Find neighbors by using KNN algorithm and calculate distance using Euclidean distance method.
2. Sort the data set and find the Kth distance for data from neighbor with minimum distance.
3. Then provide the output obtained from KNN layer to back propagation neural network method.
4. Define hidden layer and calculate weight of data obtained with kth distance from KNN algorithm.
5. Use activation function to get accurate weight and bias value for data
6. If error is there the reverse the working of algorithm and corrected data with weight.

7. Then update weight and bias value for data of output layer.

8. Provide data with new value to medical expert so that the accurate diagnosis of the disease takes place.

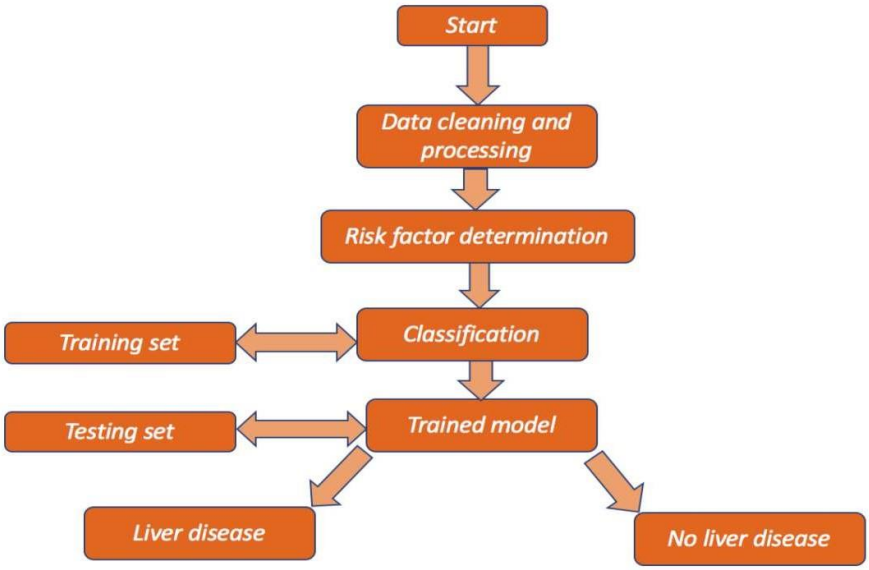


Fig 2: System Flow Diagram

Figure 2 explains the overall system flow diagram. Chronic hepatitis, although much less common than acute viral hepatitis, can persist for years, even decades. In many people, it is quite mild and does not cause significant liver damage.

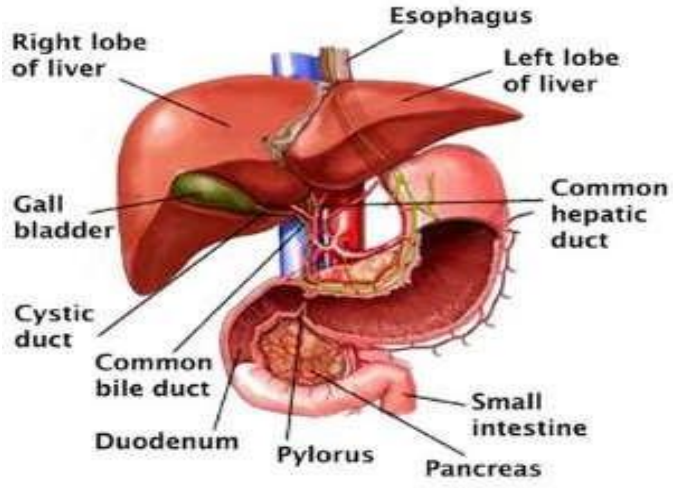


Fig 3: Liver dataset analysis and classification

However, in some people, continued inflammation slowly damages the liver, eventually resulting in cirrhosis (severe scarring of the liver), liver failure, and sometimes liver cancer. Figure 3 presents the Liver dataset analysis and classification. Brain function deteriorates because the badly damaged liver cannot remove toxic substances from the blood as it normally does. These substances then build up in the blood and reach the brain. Normally, the liver removes them from the blood, breaks them down, then excretes them as harmless by-products into the bile (the greenish yellow fluid that aids in digestion) or blood.

Treatment of hepatic encephalopathy can prevent the deterioration of brain function from becoming permanent. Blood cannot clot as it normally does because the damaged liver can no longer synthesize enough of the proteins that help blood clot.

A few people have jaundice, itchiness, and light-colored stools. Jaundice and itchiness develop because the damaged liver cannot remove bilirubin from the blood as it normally does. Bilirubin then builds up in the blood and is deposited in the skin. Bilirubin is a yellow pigment produced as a waste product during the normal breakdown of red blood cells. Stool is light-colored because the flow of bile out of the liver is blocked and less bilirubin is eliminated in stool. Bilirubin is what gives stool its typical brown color.

AUTOIMMUNE HEPATITIS

It may cause other symptoms that involve other body systems. Symptoms can include cessation of menstrual periods, joint pain and swelling, loss of appetite, and nausea. People with autoimmune hepatitis may also have other autoimmune disorders such as type 1 diabetes mellitus, ulcerative colitis, celiac disease, or autoimmune disorders that cause anemia or inflammation of the thyroid gland or kidneys. In many people, chronic hepatitis does not progress for years. In others, it gradually worsens. The outlook depends partly on which virus is the cause and whether treatment is available:

- Chronic hepatitis C, if untreated, causes cirrhosis in about 20 to 30% of people. However, cirrhosis may take decades to develop. The risk of liver cancer is increased usually only if cirrhosis is present.
- Chronic hepatitis B tends to worsen, sometimes rapidly but sometimes over decades, leading to cirrhosis. Chronic hepatitis B also increases the risk of liver cancer whether cirrhosis develops or not. (In people with liver disease caused by other conditions, liver cancer is usually a risk only if cirrhosis develops.) Rarely, chronic hepatitis B resolves on its own, without treatment.
- Chronic co-infection with hepatitis B and D, if untreated, causes cirrhosis in up to 70%.
- Autoimmune hepatitis can be effectively treated in most people, but some develop cirrhosis.
- Chronic hepatitis caused by a drug often completely resolves once the drug is stopped.

LIVER CANCER STAGES

After someone is diagnosed with liver cancer, doctors will try to figure out if it has spread, and if so, how far. This process is called staging. The stage of a cancer describes how much cancer is in the body. It helps determine how serious the cancer is and how best to treat it. Doctors also use a cancer's stage when talking about survival statistics. Liver cancer stages range from stage I (1) through IV (4). As a rule, the lower the number, the less the cancer has spread. A higher number, such as stage IV, means cancer has spread more. Although each person’s cancer experience is unique, cancers with similar stages tend to have a similar outlook and are often treated in much the same way. There are several staging systems for liver cancer, and not all doctors use the same system. The staging system most often used in the United States for liver cancer is the AJCC (American Joint Committee on Cancer) TNM system, which is based on 3 key pieces of information:

- The extent (size) of the tumor (T): How large has the cancer grown? Is there more than one tumor in the liver? Has the cancer reached nearby structures like the veins in the liver?
- The spread to nearby lymph nodes (N): Has the cancer spread to nearby lymph nodes?
- The spread (metastasis) to distant sites (M): Has the cancer spread to distant lymph nodes or distant organs such as the bones or lungs?

The system described below is the most recent AJCC system, effective January 2018.

Numbers or letters after T, N, and M provide more details about each of these factors. Higher numbers mean the cancer is more advanced. Once a person's T, N, and M categories have been determined, this information is combined in a process called stage grouping to assign an overall stage. For more information see Cancer Staging. Liver cancer is usually staged based on the results of the physical exam, biopsies, and imaging tests (ultrasound, CT or MRI scan, etc.), also called a clinical stage. If surgery is done, the pathologic stage (also called the surgical stage) is determined by examining tissue removed during an operation. Cirrhosis is a late stage of scarring (fibrosis) of the liver caused by many forms of liver diseases and conditions, such as hepatitis and chronic alcoholism.

Each time your liver is injured, whether by disease, excessive alcohol consumption or another cause, it tries to repair itself. In the process, scar tissue forms. As cirrhosis progresses, more and more scar tissue forms, making it difficult for the liver to function (decompensated cirrhosis). Advanced cirrhosis is life-threatening. The liver damage done by cirrhosis generally can't be undone. But if liver cirrhosis is diagnosed early and the cause is treated, further damage can be limited and, rarely, reversed.

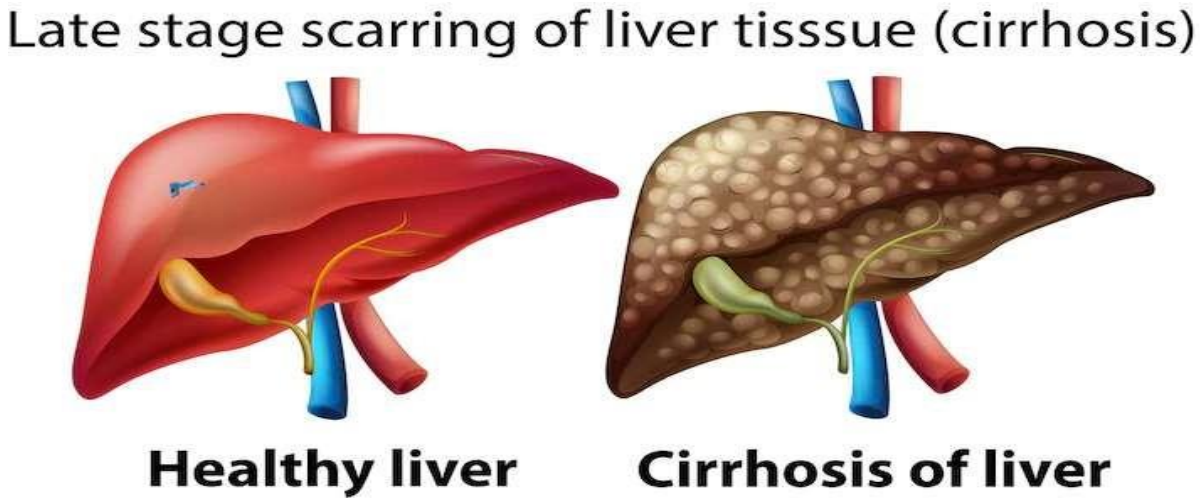


Fig 4: Cirrhosis of liver

RANDOM FOREST ALGORITHMS

Numerous industries and fields, including agriculture, transportation, electricity, and healthcare, have benefited from the attention-grabbing tree-based ensemble learning algorithms. These techniques have been used to forecast outcomes across a range of healthcare settings. When designing a healthcare system, clinical outcomes, healthcare expenditures, and healthcare efficiency are considered. Because these algorithms

automatically handle interactions, they are also accurate predictors, even when a large number of variables are present. Random Forests (RFs) are a type of ensemble approach based on trees that is commonly used for classification and regression. Numerous recent studies have yielded reassuring empirical and theoretical findings. Additionally, RFs are gaining traction in the healthcare industry, where they can be used for various purposes. A large number of decision trees are generated by RFs. These trees are constructed by substituting variables from a randomly chosen subset of the original dataset for variables from the randomly chosen subset. RFs are capable of dealing with both categorical and numerical variables in prediction situations. One of the characteristics of RFs is their built-in cross-validation capability, which enables the independent variables to be ranked according to their association with the outcome variable, from most effective to least effective.

This simplifies the process of extracting functions from multisource data analysis. Breiman's presentation provides an in-depth overview of radio frequency (RF) technology. While radiofrequency (RF) devices have the potential to automate a wide variety of operations on large and complex datasets, their utility in the context of particular safety culture has yet to be thoroughly investigated and evaluated. Researchers intend to build on the result of this research by combining an entirely new application field with a specialized PSC background with a survey dataset to maximize radiofrequency (RF) technology benefits. Researchers intend to classify the most significant features (e.g., composites and qualities from the Survey) that influence patient safety grades in order to determine patient safety grades using the study approach described below. By subjecting the algorithm to an exhaustive grid scan, the hyper-parameters are evaluated to improve the algorithm's accuracy. Grid search identifies the most influential parameter combinations for tuning purposes during the gadget learning process. Several metrics were used to analyze and interpret the predictive output of each version after the grid seek analysis, including the mean absolute percent error (MAPE), the mean absolute error (MAE), and the mean rectangular error (MRE).

$$\text{MAPE} = \frac{1}{N}\sum_{i=1}^{N}|y_i - p_i| \,/\, y_i \quad (1)$$

$$\text{MAE} = \frac{1}{N}\sum_{i=1}^{N}|y_i - p_i| \quad (2)$$

$$\text{MSE} = \frac{1}{N}\sum_{i=1}^{N}|y_i - p_i|^2 \quad (3)$$

Where, yi is the real value in the ith observation and pi is the estimate in the similar observation within the dataset size.

EXPERIMENTATION AND RESULTS

The goal of this chapter is to figure out which composite scores and individual safety culture components are the most closely linked for disease detection. Overall patient safety has been assigned a grade. Prior to the experiment, descriptive statistics were employed to classify missing data and possible distributional outliers. As a result, they were left out of

the final report, leaving only 672 people who took part. For the measured composites, the descriptive statistics are easily accessible here: The figure's mean value is used to determine the average percent. The statistical features of the data were determined by a series of linear correlation experiments with composites (continuous variables) and the patient safety grade. Patient safety is typically regarded as good: processes and systems efficiently prevent errors, but patient safety concerns are regarded as inadequate. Help with administration: The hospital management promotes a safe working environment for patients and priorities personnel safety. The comparative analysis shows that KNN and random forest algorithms works and gives better than the other which is shown in figure 5 and 6.

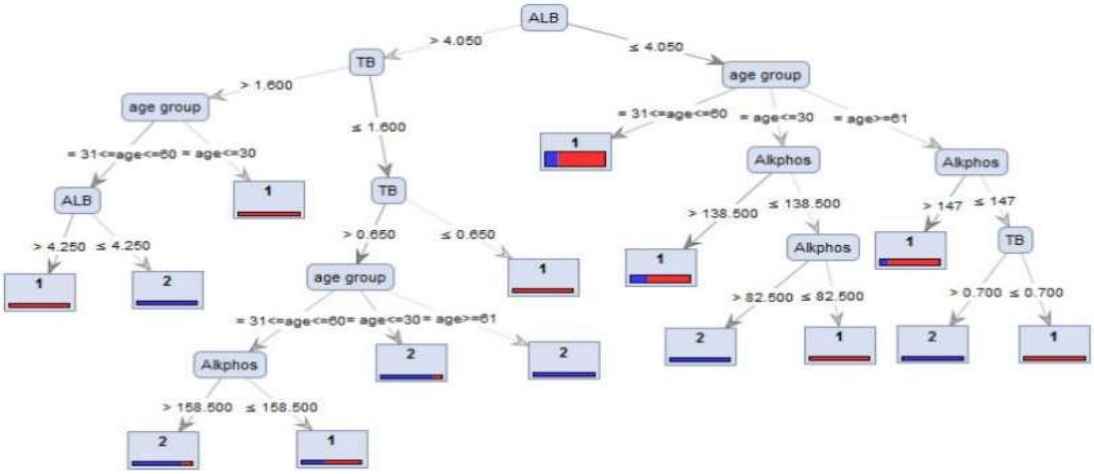
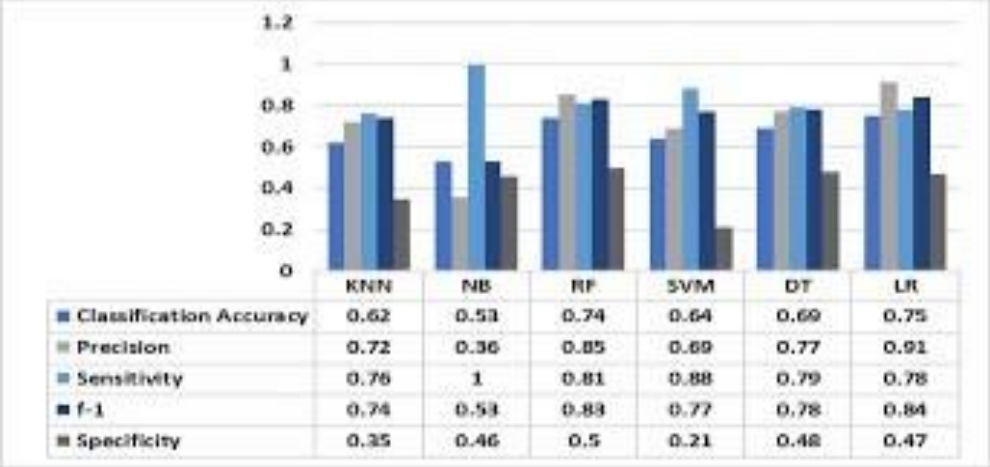


Fig 5: Analysis UCI liver disease dataset



	KNN	NB	RF	SVM	DT	LR
Classification Accuracy	0.62	0.53	0.74	0.64	0.69	0.75
Precision	0.72	0.36	0.85	0.69	0.77	0.91
Sensitivity	0.76	1	0.81	0.88	0.79	0.78
f-1	0.74	0.53	0.83	0.77	0.78	0.84
Specificity	0.35	0.46	0.5	0.21	0.48	0.47

Fig 6: Performance Analysis of different ML algorithm

CONCLUSION

Diseases related to liver and heart is becoming more and more common with time. With continuous technological advancements, these are only going to increase in the future. Although people are becoming more conscious of health nowadays and are joining yoga classes, dance classes; still the sedentary lifestyle and luxuries that are continuously being

introduced and enhanced; the problem is going to last long. So, in such a scenario, this work will be extremely helpful to the society. With the dataset that we used for this project, we got 100 % accuracy for different model of ML, and though it might be difficult to get such accuracies with very large datasets, from these projects results, one can clearly conclude that we can predict the risk of liver diseases with accuracy of 90 % or more. Today almost everybody above the age of 12 years has smart phones with them, and so we can incorporate these solutions into an android app or ios app. Also it can be incorporated into a website and these app and website will be highly beneficial for a large section of society.

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