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Prior Detection of a Person's Risk Level of Getting Suffered from Liver Cancer

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Abstract*: Liver Cancer becomes a major problem globally because it is responsible for the majority of death. Identification of various Risk factors which can be either genetic or environmental becomes necessary for early detection of Liver Cancer. To solve this problem, the data has been collected from various diagnostic centres, the data consists of 100 cancerous and 100 non-cancerous/healthy persons, then significant frequent patterns are identified by using the Apriori Algorithm. By employing significant frequent pattern, a prediction technique has been developed which identify the person susceptibility toward Liver Cancer by using the Risk Factors. Most peoples do not know that they are suffering from Liver Cancer at the early stage of cancer, and when they knew, that time it becomes impossible to cure. So, for proper cure Early detection of Liver Cancer acquires a necessary step in its diagnosis process, and for making a powerful preventive approach. This prediction system can effectively and successfully predict the Liver Cancer Risk, and it has been predicted in the form of three stages that is low Risk, medium Risk or high Risk. This approach can be used in hospitals for diagnosis of Liver Cancer patients.

Keywords: Apriori Algorithm, Data Mining, Liver, and Liver Cancer.

I. INTRODUCTION

Humans are known as the most advanced creation of god. As time passes, evolution takes place not only in humans but in their life as well. The human body has adapted itself the most useful and productive shape and accordingly, internal organs or structures also acquires structures on the basis of their requirement, due to this adaptation will lead to a Risk to the medical study and investigation. In this era, cancer becomes one of the deadliest disease, which has no limit or on the other word it's the most disastrous one. All over the world, attempts are being continuously made to cure and abolish the disease [1]. Liver Cancer becomes the main common cause globally [2].

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Tumours are formed due to uncontrolled growth of cells which does not have any physiological function; this tumour can be either cancerous or non-cancerous in nature. Liver carcinoma is the most commonly found cancer in the world.

Liver metastases are the secondary cancers caused by the spreading from the primary organs (those organs which is the main source of cancer). So basically, Liver is the main candidate for metastases by cancer primary source organs like breast, lung, stomach, colon, adrenal glands, pancreas, skin (melanoma) and many more. Mostly hepatic metastases cancers are found at the time of primary cancer treatment or maybe after removal of the primary tumour. Despite, secondary Liver Cancers are able to diagnose, and their diagnosis may improve life survivability [3].

Cirrhosis, alcohol drinking and hepatitis is the most important cause of Liver Cancer [4]. Chronic Liver disease, cirrhosis, viral hepatitis and extreme alcohol consumption are the most important known Risk factors for the progression of hepatocellular carcinoma globally. Causes and complications of Risk factors which mainly found in Liver Cancer patient either as disease or habit are represented in Table I. Chronic viral hepatitis results in the formation of either cirrhosis or hepatocellular carcinoma or can be both. Hepatitis B or C is the major cause of the progression of chronic hepatitis globally [4]. The frequency of patients suffering from Liver Cancer is expanding with an alarming rate in developing country like India [5].

So, prior diagnosis of Liver Cancer becomes necessary but the diagnosis requires high expenses in the developing countries. Therefore, in this study, a prediction system is proposed which predict how much a person is susceptible to get affected by Liver Cancer in future, by taking the most common Risk factors into consideration. This system is cheap and easy to utilize.

A globally accepted precise definition for data mining could be explained as "Data mining is the non- trivial extraction of implicit previously unknown and potentially useful information about data". Data mining mostly used in few areas for data analysis like clustering, association rule, classification, correlation and many more [6] and

Table-I: Causes and complication found as a result of various Risk factors responsible for Liver Cancer

Risk Factor	Causes	Complications
Cirrhosis	Drinking too much alcohol or Chronic alcohol abuse Being overweight Having viral hepatitis or Chronic viral hepatitis (hepatitis B, C and D). NAFLD (Non-Alcoholic Fatty Liver Disease) Hemochromatosis (Iron buildup in the body) Cystic fibrosis Wilson's disease (Copper accumulated in the Liver) Biliary atresia (Poorly formed bile ducts) Alpha-1 antitrypsin deficiency Galactosemia or Glycogen storage disease Alagille syndrome (Genetic digestive disorder) Autoimmune hepatitis Primary biliary cirrhosis Primary sclerosing cholangitis Infection, such as syphilis or brucellosis Medications, including methotrexate or isoniazid	High blood pressure in the veins that supply the Liver (portal hypertension) Swelling in the legs (edema) and abdomen (ascites) Enlargement of the spleen (splenomegaly) Bleeding Vulnerable to infection Malnutrition A buildup of toxins in the brain (hepatic encephalopathy) Jaundice Bone disease Increased Risk of Liver Cancer. Acute-on-chronic cirrhosis
Hepatitis	Sexual contact Sharing of needles Accidental needle sticks Mother to child	Scarring of the Liver (cirrhosis). Liver Cancer. Liver failure Might develop kidney disease or inflammation of blood vessels.
Smoking	Biological Psychological Social and Environmental	Increased blood pressure and heart rate Increased Risk of developing coronary artery disease and heart attack Increased Risk of developing peripheral artery disease and stroke Increased Risk of developing lung cancer, throat cancer, chronic asthma, chronic bronchitis and emphysema Increase the tendency for blood clotting Respiratory infections are more common among children exposed to second-hand smoke
Diabetes	Family history Environmental factors The presence of damaging immune system cells (autoantibodies) Geography Weight Inactivity Race Age Gestational diabetes Polycystic ovary syndrome High blood pressure Abnormal cholesterol and triglyceride levels	Cardiovascular disease Nerve damage (neuropathy) Kidney damage (nephropathy) Eye damage (retinopathy) Foot damage Skin conditions Hearing impairment Alzheimer's disease Depression Excess growth Low blood sugar Preeclampsia Subsequent gestational diabetes
NAFLD	Overweight or obesity Insulin resistance, in which your cells don't take up sugar in response to the hormone insulin High blood sugar (hyperglycemia), indicating prediabetes or actual type 2 diabetes High levels of fats, particularly triglycerides, in the blood High cholesterol Metabolic syndrome Polycystic ovary syndrome Sleep apnea Type 2 diabetes An underactive thyroid (hypothyroidism) Underactive pituitary gland (hypopituitarism)	The main complication of nonalcoholic fatty Liver disease and nonalcoholic steatohepatitis is cirrhosis, which is late-stage scarring (fibrosis) in the Liver. Cirrhosis can lead to: Fluid buildup in the abdomen (ascites) Swelling of veins in your esophagus (esophageal varices), which can rupture and bleed Confusion, drowsiness and slurred speech (hepatic encephalopathy) Liver Cancer End-stage Liver failure, which means the Liver has stopped functioning About 20 per cent of people with nonalcoholic steatohepatitis will progress to cirrhosis.
Tobacco use	Biological. Psychological Social and Environmental	Ischemic heart diseases Cancers Diabetes Chronic respiratory diseases

extensively and intensively in many institutions. In medical management centres, data mining progressively gaining popularity. Data mining also contribute to the procedure and technology for doing data analysis and extract some useful information for decision making. Data pre-processing is a very important, fundamental and essential step of data mining. This step is mainly employed to make data relevant for clustering, and this could do by removing duplicated records and filling or adding missing data in accordance with the previously stored data.

The major profit of using data pre-processing is, it shortens the memory.

Two algorithms are mainly used for finding the frequent patterns from dataset such as Apriori and Decision Tree algorithm [7]. Both of these algorithms are very easy to use and powerful for finding significant frequent patterns. A significant frequent pattern is a set of data which occurred mostly inside the whole dataset. We have developed a prediction framework for Liver Cancer by employing these significant frequent patterns (shown in Table III). This research has been done with the aim of implementing a prediction framework, which can be further utilized by any person who wants to know his/her Liver Cancer Risk level.

II. METHODS AND MATERIALS

A. Collection of Dataset

In this study, a survey has been done on 200 patients, which comprises of 100 cancerous and 100 non-cancerous/healthy persons, this data is collected from various diagnostic centres, on the basis of an oral questionnaire with the OPD patient under-diagnosis, shown in Table II. This data comprises of both male and female patients with age restriction 20-80 years old. After analysing literature, 21 Risk factors were identified, and they were further employed for Liver Cancer evaluation in the population of India. These Risk factors include- age, gender, alcohol drinking, smoking, cirrhosis, hepatitis, diabetes, hereditary, NAFLD (non-alcoholic fatty Liver disease), obesity, tobacco use, air pollution, balanced diet, occupational hazards, inherited metabolic disease, blood AFP, radiation therapy, physical activity, food habit, hypertension and uptake of red meat.

B. Preprocessing of Dataset

The primary aim of doing data pre-processing is to remove noisy data from the gathered dataset. It further lowers the memory and filling the missing data by analyzing previously stored data. The whole collected dataset is placed under two categories, out of which one category is for storing relevant data and the other one is for storing non-relevant data for Liver Cancer.

This step is the most meaningful and essential step of data mining. The problem for which data mining is utilized is to identify or to predict the significant frequent items or patterns from the whole collected dataset.

C. Identification of Significant frequent pattern

Numerous algorithms are developed for finding a significant frequent pattern from the datasets like classifications, clusters, association rules and correlation etc. like FP-tree, AprioriTid, Apriori, Decision Tree. After gathering data, Apriori algorithm has been applied to find out the significant frequent pattern. Apriori and Decision Tree algorithm is one of the best and efficient algorithms used for extracting a significant frequent pattern from the collected dataset. For high, medium and low-Risk level significant frequent patterns are identified separately. Then assigned a weight to every Risk factor on the basis of their percentage of being in Liver Cancer patients.

D. Prediction System

This system is implemented using MATLAB. Risk level of getting affected by Liver Cancer in future predicted with the help of their Risk factors. Methodology used in this paper is shown in Fig. 1.

Table III: Predicted Significant Patterns with Their Corresponding Weightage Value using Apriori Algorithm.

Sr.	Significant patterns	Support	Score
1	>60years, Smoking, Cirrhosis, Hepatitis, Diabetes, Inheritance, NAFLD, Tobacco use, Blood AFP, Physical activity	27	26
2	Smoking, Inheritance, NAFLD, Tobacco use, AFP, 40-60 years, Drinking, Obesity	45	17
3	Smoking, Inheritance, NAFLD, Tobacco use, AFP, 40-60 years, Drinking, Diabetes	45	17
4	Smoking, Inheritance, NAFLD, Tobacco use, AFP, 40-60 years, Obesity, Diabetes	44	17
5	Smoking, Inheritance, NAFLD, Tobacco use, AFP, Drinking, Obesity, Diabetes	44	17
6	Smoking, Inheritance, NAFLD, Tobacco use, 40-60 years, Drinking, Obesity, Diabetes	44	17
7	Smoking, Inheritance, NAFLD, AFP, 40-60 years, Drinking, Obesity, Diabetes	44	17
8	Smoking, Inheritance, Tobacco use, AFP, 40-60 years, Drinking, Obesity, Diabetes	45	17
9	Smoking, NAFLD, Tobacco use, AFP, 40-60 years, Drinking, Obesity, Diabetes	44	17
10	Inheritance, NAFLD, Tobacco use, AFP, 40-60 years, Drinking, Obesity, Diabetes	45	16

III. RESULTS

The analytical results are represented in two separate parts. First, part is used for showing the predicted significant frequent pattern while the other part shows the implemented predicted tool for Liver Cancer. Significant frequent patterns are extracted with the help of the Apriori algorithm and Decision tree algorithm represented in Table III, with their support and computed the score. In this table, the first row represents the significant frequent pattern predicted from Liver Cancer patients while other represents the significant frequent pattern predicted from non-cancerous or healthy persons. The scoring is done with the help of weight given to each and every Risk factor shown in Table IV. One decision tree has been made, which represents scoring on which comparison is done shown in Fig. 2. Top ten Risk factors found in Liver Cancer patients represented in Fig. 3.

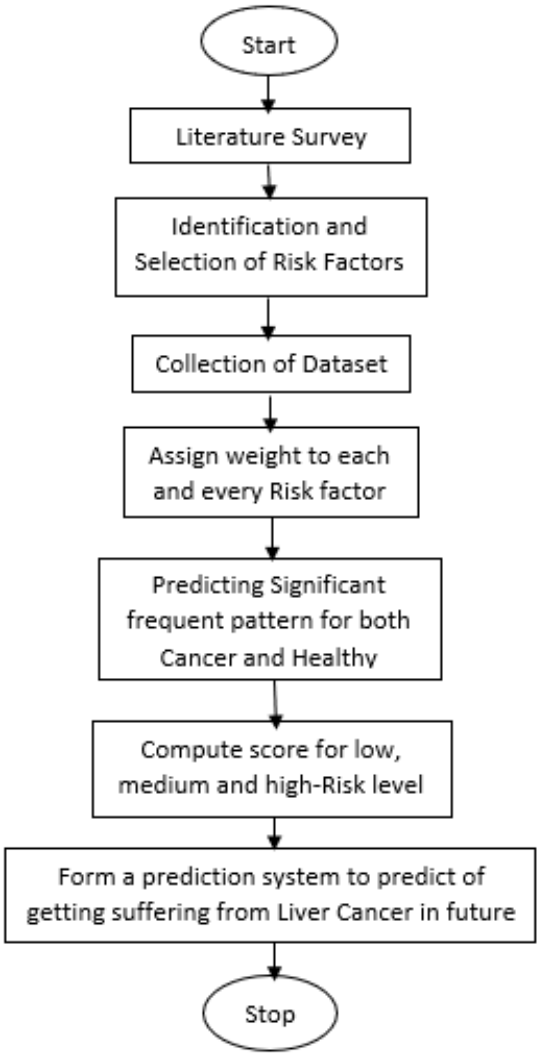

Figure 1: Methodology used in this research article

At last, by utilizing significant frequent pattern, a prediction tool of Liver Cancer has been developed and how it works also shown in Fig. 4, Fig. 5 and Fig.6.

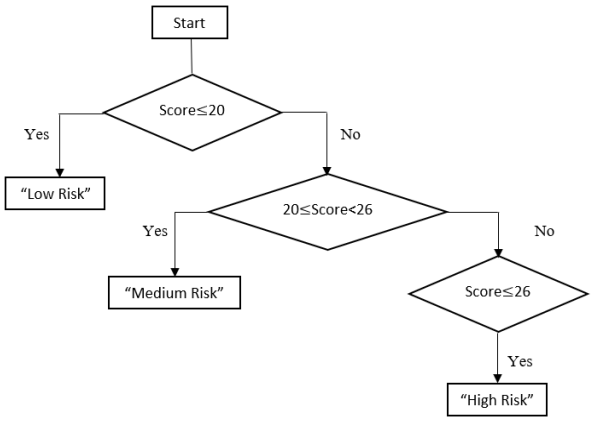

Figure 2: Flow Diagram to know Risk level of getting suffered from Liver Cancer using significant frequent pattern predicted using Apriori algorithm.

Table IV: Used Risk factors with Their equivalent Values and Score

Sr.	Name of Risk factors	Value	Score
1	Age	<=40 years	1
		40 – 60 years	2
		> 60 years	3
2	Smoking	Yes	3
		No Passive Smokers Yes	2
		No	1
3	Cirrhosis	Yes	4
		No	1
4	Hepatitis	Yes	3
		No	1
5	Diabetes	Yes	2
		No	1
6	Inheritance	Yes	2
		No	1
7	NAFLD	Yes	2
		No	1
8	Tobacco use	Yes	2
		No	1
9	Blood AFP	Yes	2
		No	1
10	Physical activity	Yes	1
		No	3
11	Sex	M	3
		F	1
12	Obesity	Yes	2
		No	1
13	Alcohol drinkers	Yes	2
		No	1

IV. CONCLUSION

The huge numbers of peoples are affected by Liver Cancer, most of them do not even know that they are suffering from it. Till now, not even a single treatment is developed for the diagnosis of Liver Cancer before the patient has not been completely affected by the cancer disease. So, the prior detection of Liver Cancer has a vital and essential part of the correct interpretation of Liver Cancer. In this research

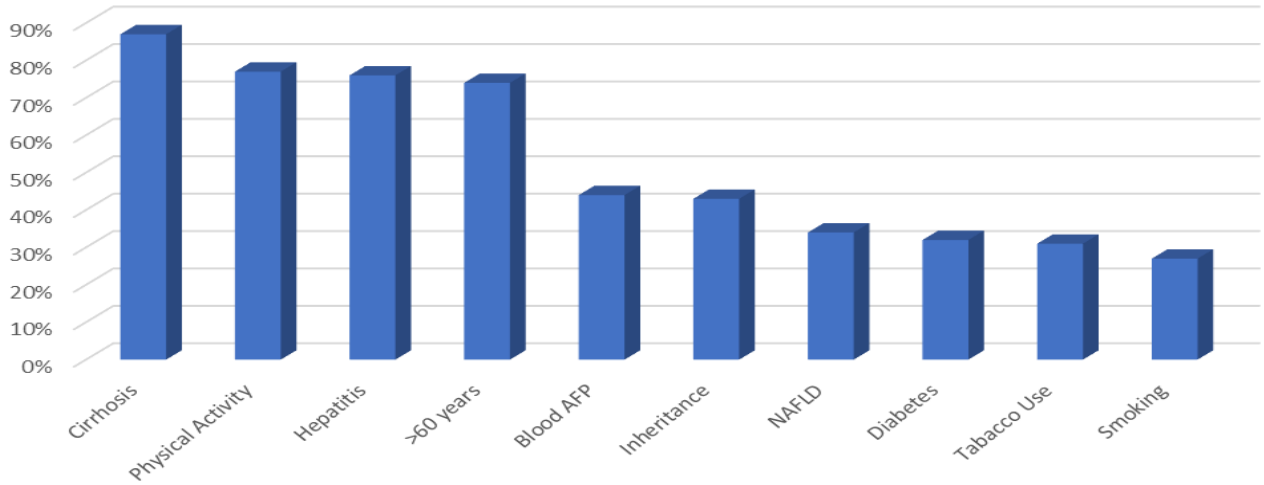

Figure 3: Top ten Risk factors found in Liver Cancer patients.

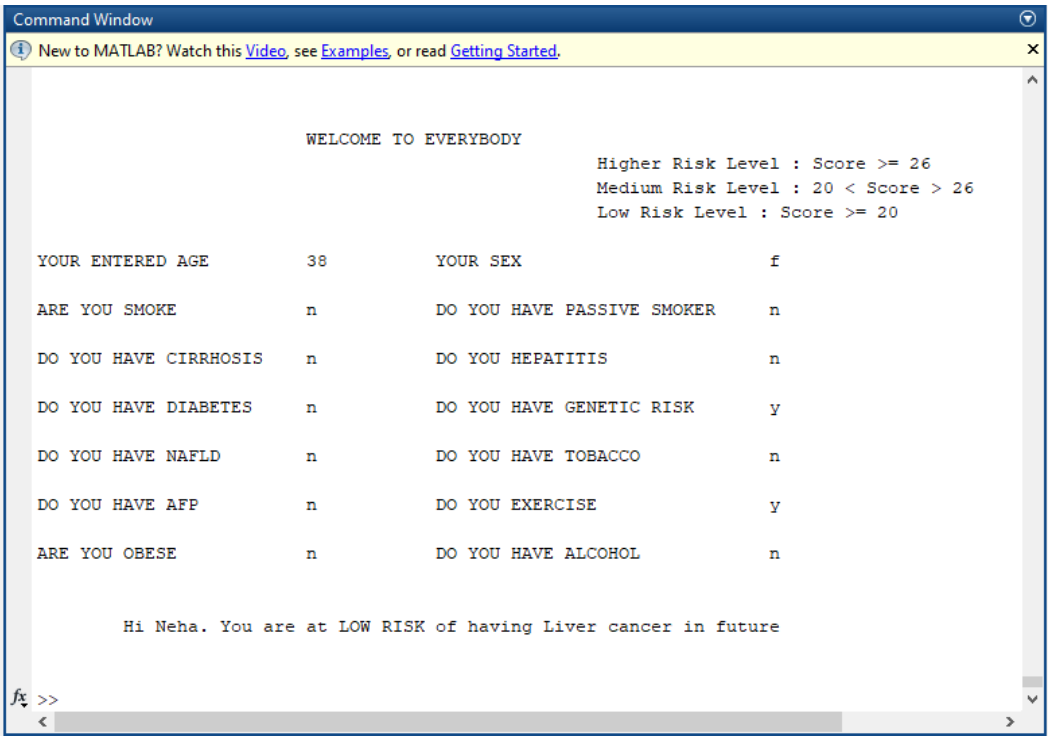

Figure 4: Prediction of Liver Cancer with the level of Low Risk.

article, Risk factors are identified through literature survey, on the basis of data mining Apriori algorithm, we implemented an efficient prediction system for identifying Liver Cancer at its early stage. An effective approach is also given, for the identification of significant frequent pattern from the whole dataset, for predicting Liver Cancer efficiently. This approach is implemented using MATLAB. This implemented way can effectively and successfully identify Liver Cancer Risk in the form of low Risk, medium Risk and high Risk.

FUTURE WORK

Future work is to develop a robust and intelligent Clinical Decision Support (CDS) framework that offers an approach to detect the Liver Tumour at the initial stage of development with the help of digital image processing. It is clearly known that digital image processing is useful in solving medical diagnosis.

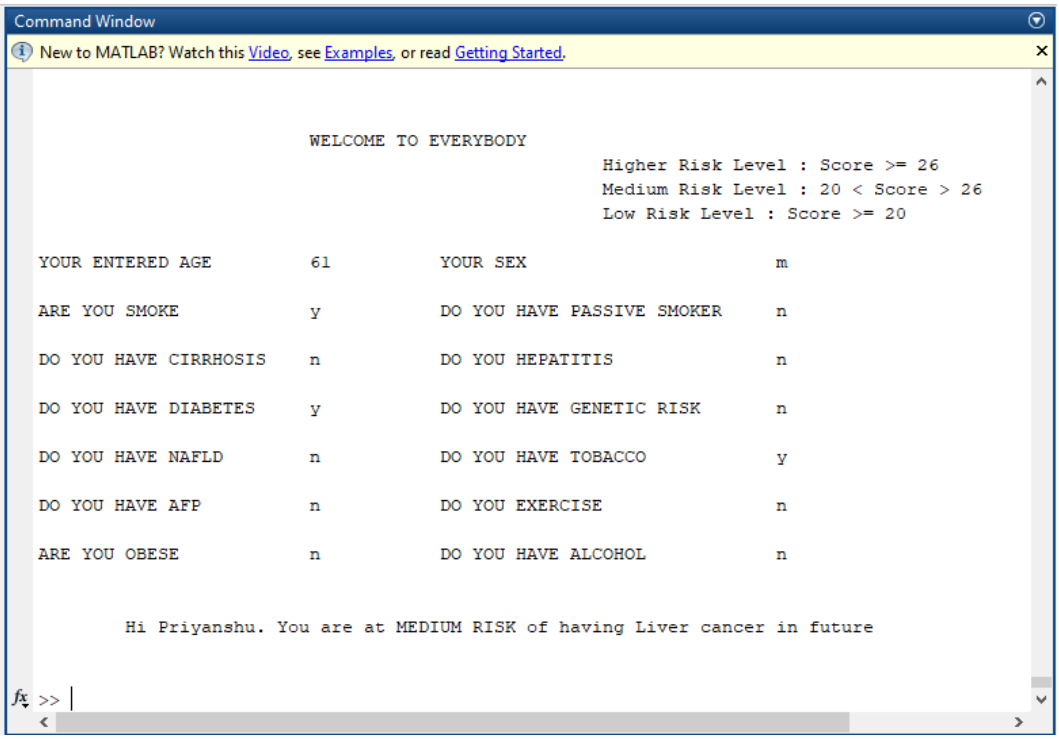

Figure 5: Prediction of Liver Cancer with a level of Medium Low Risk.

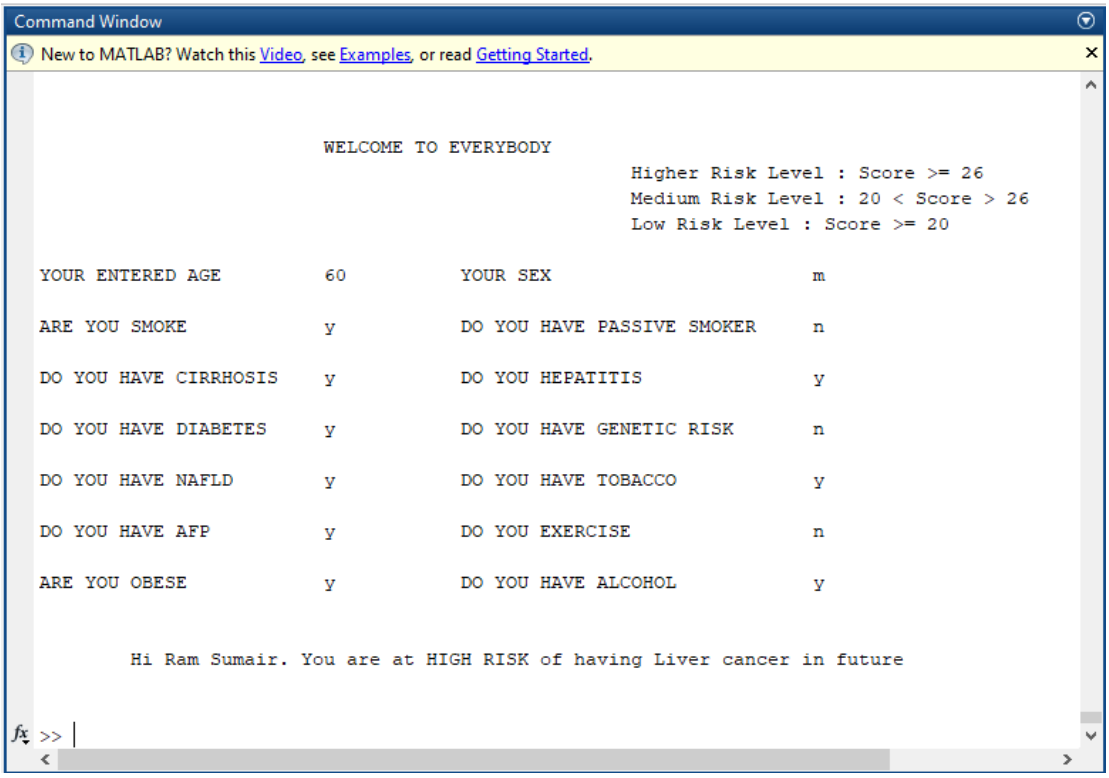

Figure 6: Prediction of Liver Cancer with a level of High Risk.

Table-II: Collected data of Liver Cancer patients from various Diagnostic Centres. In this Table C in Patient ID column represent Cancerous patient.

Patient ID	Age (yr)	Sex	Drinking	Smoking	Passive Smoker	Cirrhosis	Hepatitis	Diabetes	Inheritance	NAFLD	Obesity	Tobacco Use	Blood AFP	Physical activity
C-01	>60	M	No	No	Yes	Yes	Yes	No	No	Yes	Yes	No	Yes	No
C-02	>60	M	No	No	Yes	Yes	Yes	No	No	No	No	No	Yes	No
C-03	>60	M	No	No	No	Yes	Yes	No	No	No	No	No	Yes	No
C-04	>60	F	No	No	No	Yes	Yes	No	No	Yes	Yes	No	No	No
C-05	>60	M	No	No	No	Yes	Yes	No	No	No	No	Yes	No	No
C-06	40-60	M	No	Yes	No	No	No	No	No	No	No	No	No	Yes
C-07	>60	M	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No	No	No
C-08	40-60	M	No	No	No	No	No	No	No	Yes	Yes	No	Yes	Yes
C-09	40-60	F	No	No	Yes	No	No	No	Yes	No	No	No	No	No
C-10	40-60	M	No	Yes	Yes	No	No	Yes	Yes	No	Yes	No	No	Yes
C-11	>60	M	No	No	Yes	Yes	Yes	No	No	Yes	Yes	No	No	No
C-12	40-60	M	No	Yes	Yes	No	No	Yes	No	No	No	No	Yes	No
C-13	40-60	M	No	No	Yes	No	No	No	No	No	No	No	Yes	Yes
C-14	40-60	M	No	Yes	No	No	No	No	Yes	No	No	Yes	Yes	Yes
C-15	>60	F	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
C-16	40-60	F	No	No	Yes	No	No	No	No	Yes	Yes	No	Yes	Yes
C-17	40-60	M	No	No	Yes	No	No	No	Yes	No	No	Yes	No	Yes
C-18	>60	M	Yes	Yes	No	Yes	Yes	Yes	No	Yes	No	Yes	No	No
C-19	40-60	M	No	No	No	No	No	No	No	No	No	Yes	No	Yes
C-20	>60	M	No	No	No	Yes	Yes	No	No	No	No	No	No	No
C-21	>60	M	No	Yes	No	Yes	Yes	Yes	No	No	No	Yes	Yes	No
C-22	>60	M	No	Yes	No	Yes	Yes	No	No	No	No	No	Yes	No
C-23	>60	M	No	No	Yes	Yes	Yes	No	No	No	No	No	No	No
C-24	>60	M	Yes	No	No	Yes	Yes	No	No	No	No	No	Yes	No
C-25	>60	M	No	No	No	Yes	Yes	Yes	No	No	No	Yes	No	No
C-26	40-60	M	No	Yes	No	Yes	No	No	No	No	No	No	No	Yes
C-27	>60	M	No	No	Yes	Yes	Yes	No	Yes	No	No	No	Yes	No
C-28	>60	M	No	No	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No
C-29	>60	M	No	Yes	No	Yes	Yes	No	No	No	No	Yes	Yes	No
C-30	>60	M	No	No	No	Yes	Yes	Yes	No	Yes	No	No	Yes	No
C-31	>60	M	No	No	No	Yes	Yes	Yes	No	No	No	Yes	No	No
C-32	>60	M	Yes	No	No	Yes	Yes	No	No	No	Yes	No	No	No
C-33	>60	M	No	Yes	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes	No
C-34	40-60	F	No	No	No	Yes	No	No	No	No	No	No	No	Yes
C-35	40-60	F	No	No	Yes	No	No	No	Yes	No	No	No	Yes	Yes
C-36	40-60	F	No	No	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
C-37	40-60	F	No	Yes	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
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C-39	>60	F	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
C-40	>60	F	No	No	No	Yes	Yes	No	Yes	No	No	No	Yes	No
C-41	>60	F	No	Yes	Yes	Yes	Yes	No	Yes	No	No	No	No	No
C-42	>60	F	No	No	No	Yes	Yes	No	Yes	No	No	Yes	Yes	No
C-43	>60	F	No	No	No	Yes	Yes	No	Yes	No	No	Yes	Yes	No
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C-50	40-60	F	No	No	No	Yes	No	No	Yes	No	No	No	No	Yes
C-51	40-60	F	No	No	Yes	Yes	No	No	No	No	No	No	No	Yes
C-52	40-60	M	No	Yes	Yes	Yes	No	No	No	No	No	No	No	Yes
C-53	40-60	M	No	Yes	No	Yes	No	No	Yes	Yes	No	No	Yes	Yes
C-54	>60	F	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes	No
C-55	>60	M	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	No
C-56	>60	M	No	No	No	Yes	Yes	Yes	Yes	No	No	No	No	No
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C-60	>60	M	No	Yes	No	Yes	Yes	Yes	Yes	No	Yes	No	No	No
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C-64	>60	M	No	Yes	No	Yes	Yes	No	No	No	No	Yes	No	No
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-80	<40	M	No	No	No	Yes	No	Yes	No	No	No	Yes	No	Yes
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C-82	>60	M	No	No	Yes	Yes	Yes	No	No	No	No	Yes	Yes	No
C-83	>60	M	Yes	No	No	Yes	Yes	No	Yes	Yes	No	No	No	No
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C-85	>60	M	No	No	No	Yes	Yes	No	Yes	No	Yes	No	Yes	No
C-86	40-60	M	No	No	No	Yes	No	No	No	No	No	No	Yes	Yes
C-87	>60	M	No	Yes	No	Yes	Yes	No	No	No	No	No	No	No
C-88	>60	M	No	Yes	No	Yes	Yes	No	Yes	Yes	No	No	No	No
C-89	>60	M	No	Yes	No	Yes	Yes	Yes	No	No	No	No	Yes	No
C-90	>60	M	No	No	No	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No
C-91	>60	M	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No
C-92	>60	M	No	No	No	Yes	Yes	No	No	No	No	No	No	No
C-93	>60	M	No	No	No	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
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C-97	>60	M	No	No	No	Yes	Yes	No	Yes	Yes	No	No	Yes	No
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C-100	>60	M	No	No	No	Yes	Yes	No	No	No	No	Yes	No	No

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