A web based intelegent decision support system for early diagnosis of different classes of hepatitis

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The liver is a vital organ in the human body that processes nutrients, filters the blood and fights against infections. In a situation where the liver can no longer performs its functions, may result to various health issues, and by extension lead to hepatitis (A, B, C, D and E) virus. The hepatitis infections are the relative incidence of disease induced death worldwide. Based on this global health challenge, different decision support systems have been developed for prompt diagnosis. However, existing decision support systems do not take into account a centralized system for the early diagnosis of the various classes of hepatitis (A, B, C, D and E). The new system addresses the shortcomings of existing systems via a centralized (web-based) diagnostic decision support system for early detection of the disease. Additionally, the centralized decision support system is enhanced for prompt diagnosis of the disease if a permissible trenched-hood limit is exceeded, then, the individual can seek medical attention and treatment quickly inferred. The centralized system was developed using Hypertext Preprocessing Language (PHP) as front-end with My Structured Querry Language (MYSQL) as the back-end.

Key words: Hepatitis, diagnosis, decision support, virus, and prompt.

INTRODUCTION

According to Iezzi et al. (2017) hepatitis is an inflammation of the liver. This may be caused by drugs, alcohol use, or certain medical conditions. However, in most cases it is caused by a virus. This is known as viral hepatitis. The condition of hepatitis can be self-limiting or it can cause fibrosis that is, scarring, cirrhosis or liver cancer. Hepatitis is the most common type of disease that occurs in the world. Along with the virus, other infection and toxic substances such as alcohol, certain drugs, and auto-immune disease can also cause hepatitis. Autoimmune hepatitis is a disease that occurs when the body produces antibodies against the liver tissues. The liver performs many functions that affect metabolism, which include:

(i) bile production, which is essential to digestion
(ii) filtering of toxins from the body
(iii) excretion of bilirubin (a product of broken-down red blood cells), cholesterol, hormones, and drugs
(iv) breakdown of carbohydrates, fats, and proteins
(v) activation of enzymes, which are specialized proteins essential to body functions
(vi) storage of glycogen (a form of sugar), minerals, and vitamins (A, D, E, and K)
(vii) synthesis of blood proteins, such as albumin
(viii) synthesis of clotting factors

According to the Centers for Disease Control and Prevention (CDC, 2017), approximately 4.4 million Americans are currently living with chronic hepatitis B and C.

LITERATURE REVIEW

The challenges involve in the detection of hepatitis virus is vital in the medical science research for the past thirty years. In this paper, we intend to exploit the detailed survey for the improvement of hepatitis detection in the medical sector. Application of computer based detection of hepatitis contains several process such as, determination of most significant features, attributes filtering, training the neural network, detecting the accuracy level and finally classifying the hepatitis virus and so on. This section briefly gives the description of the survey made in the literature.

Hepatitis is an inflammation of the liver which can result from a range of causes, both infectious and noninfectious. Infective agents that cause hepatitis include viruses and parasites. Noninfectious sources include certain drugs and poisonous agents. In certain occurrences, hepatitis can also results from an autoimmune reaction directed against the liver cells of the body.

Classes of hepatitis and their viral causes

The main causes of hepatitis are as a result of viral infection. These viruses give rise to liver infection which include cytomegalovirus, yellow-fever virus, Epstein-Barr virus, herpes simplex viruses, measles, mumps, and chickenpox viruses; and a number of hepatitis viruses. Viral hepatitis, applies only to those cases of liver disease, which are caused by the hepatitis viruses, (Jordan et al., 2017).

Hepatitis viruses are of seven types, they are categorized as A, B, C, D, E, F, and G. Hepatitis A, E, and F viruses can be spread through ingestion of polluted food or water (called the fecal-oral path); the spread of these causative agents are further worsened by congested environments and poor sanitation. The B, C, D, and G viruses are spread mainly by blood or bodily fluids; sexual contact or exposure to contaminated blood are also common means of spread (Jordan et al., 2017).

Hepatitis A

Hepatitis A is the most common viral infections, globally. Some patients may recover within two months; the disease can produce significant morbidity, it can be greatly prevented with suitable immunization approaches. Hepatitis A virus (HAV) is an enveloped RNA agent classified as a picornavirus that can produce symptomatic or asymptomatic infection in humans. It is the major cause of nearly one-half of all the reported cases of viral hepatitis in the United States, although the prevalence of HAV infections has declined by 92% since the introduction of a vaccine, (Jordan et al., 2017).

Hepatitis B

Hepatitis B is more severe and lasting longer, compared to hepatitis A. It can materialize as a serious disease, or, approximately 5 to 10% of cases, the infection may become chronic, which can lead to perpetual liver damage. The signs generally appear from 40 days to 6 months after contact with the hepatitis B virus (HBV). People at greater risk at contracting hepatitis B, includes intravenous drug consumers, sexual partners of individuals with the disease, health care givers who are not adequately inoculated, and receivers of organ transplants or blood transfusions. HBV and HDV transmission are due to the presence of the virus in biological fluids (blood, semen, and vaginal secretions) of the infected individual, (Nelson et al., 2016). In pregnancy, mother to child transmission can be prevented by health education through antenatal care, immunization and for infected mother, the baby are given immunization at birth.

Hepatitis C

According to the work of Louie et al. (2012), Hepatitis C virus is a major causes of viral hepatitis, and different studies have shown that there is strong connection between hepatitis C infection and various other infections, co-morbidities, and increased death rates.

Hepatitis D

Hepatitis D Virus (HDV) infection, which is also referred to as delta agent, may occur merely in relation with HBV contamination, since HDV needs HBV to reproduce. Contamination with HDV may happen at the same time of infection with which HBV occurs, or HDV may contaminate a person previously infested with HBV. The latter condition seems to increase to a further severe situation, leading to cirrhosis or

chronic liver disease. Alpha interferon is the only treatment for HDV infection. HBV and HDV transmission are due to the presence of the virus in biological fluids (blood, semen, and vaginal secretions) of the infected individual (Nelson et al., 2016). Hepatitis viruses are responsible for 96% of the 1.34 million deaths related to cirrhosis and liver cancer (WHO, 2017).

Hepatitis E
The hepatitis E virus (HEV), which is similar to HAV, was discovered in the 1980s. In a research conducted by Ahmed et al. (2013), infection with the hepatitis E virus (HEV) is the most frequent cause of acute hepatitis among adults in developing countries with poor sanitation and hygiene. According to Hoofnagle et al. (2012) there are four genotypes of the virus that have been identified with different epidemiological and clinical characteristics and are capable of infecting and causing disease in human. HEV genotype 1 and 2 are restricted to human and is associated with consumption of contaminated water, which consequently leads to occasional outbreaks or sporadic acute hepatitis cases in developing countries.

Causes of hepatitis
The major cases of chronic hepatitis are caused by the hepatitis viruses B, C, and D, but some other factors such as alcoholism, reaction to certain medications, and autoimmune reactions may lead to the development of this ailment. Chronic hepatitis can likewise be connected with certain illnesses, such as Wilson disease and alpha-1-antitrypsin deficiency. Chronic hepatitis B mainly affects males, while chronic hepatitis C arises in equal numbers in both sexes. Autoimmune hepatitis, an ailment connected with the malfunction of the immune system, it usually happens in young women. Treatment for autoimmune hepatitis includes corticosteroids; this can help to reduce the symptoms (Jordan et al., 2017).

Mode of transmission
Hepatitis B is transmitted through contaminated bodily fluids like: Blood, Sweat, Tears, Saliva, Semen, Vaginal secretions,

Menstrual blood, Breast milk, or other body fluids infected with the virus enters the body of a person who is not infected. Chronically-infected people can spread Hepatitis B virus to others, even if they do not feel or look sick themselves. The Hepatitis B virus is passed easily through breaks in the skin or in soft tissues such as the nose, mouth, and eyes. People can become infected during activities such as:

(i) Birth (spread from an infected mother to her baby during birth)
(ii) Sex with an infected partner
(iii) Sharing needles, syringes, or other drug-injection equipment
(iv) Sharing items such as razors or toothbrushes with an infected person
(v) Direct contact with the blood or open sores of an infected person
(i) Exposure to blood from needle sticks or other sharp instruments

Hepatitis B virus can survive outside of the body on objects for at least 7 days. During that time, the virus can still cause infection if it enters the body of a person who is not infected. Hepatitis B virus is not spread through food or water, sharing eating utensils, breastfeeding, hugging, kissing, hand holding, coughing, or sneezing.

Signs and symptoms
The signs and symptoms of acute viral hepatitis result from damage to the liver and are similar regardless of the hepatitis virus responsible. Patients may experience a flulike illness, and general symptoms include nausea, vomiting, abdominal pain, fever, fatigue, loss of appetite, and, less commonly, rash and joint pain. Sometimes jaundice, a yellowing of the skin and eyes, will develop. The acute symptomatic phase of viral hepatitis usually lasts from a few days to several weeks; the period of jaundice that may follow can persist from one to three weeks. Complications of acute viral hepatitis include fulminant hepatitis, which is a very severe, rapidly developing form of the disease that results in severe liver failure, impaired kidney function, difficulty in the clotting of blood, and marked changes in neurological function. Such patients rapidly become comatose; mortality is as high as 90%. Another

complication is chronic hepatitis, which is characterized by liver cell death and inflammation over a period greater than six months, (CDCP, 2012). On average, symptoms appear 3 months after exposure, but they can appear any time between 6 weeks and 6 months after exposure. Symptoms usually last a few weeks, but some people can be ill for as long as 6 months.

Testing for hbv infection

To diagnose hepatitis, first the doctor will take the patients history to determine any risk factors you may have for infectious or noninfectious hepatitis. During a physical examination, the doctor may press down gently on the abdomen of the patient to see if there's tenderness. The doctor may also feel to see if the liver is enlarged. If the skin or eyes are yellow, the doctor will note this during the examination.

Liver function tests

Liver function tests use blood samples to determine how efficiently the patients' liver works. Abnormal results of these tests may be the first indication that there is a problem, especially if the patient does not show any signs on a physical examination of liver disease. High liver enzyme levels may indicate that liver is stressed, damaged, or not functioning properly.

Care And Lifestyle Advice

Smoking and excessive alcohol consumption is associated with a poorer prognosis in chronic HBV infection, and patients should be offered lifestyle advice accordingly. Patients should be advised on the prevention of other blood-borne viruses, and vaccination against hepatitis A should be offered to those not already protected as a result of previous immunization or infection (Salisbury, 2006). Ongoing review of patients in Phases 1 to 4 is required in order to monitor changes in disease phase or the development of liver complications.

Treatments available

Treatment options are determined by which type of hepatitis you have and whether the infection is acute or chronic.

Hepatitis A

The vaccine can also be recommended for persons who travel to parts where HAV is predominately common, homosexuals, persons with chronic liver disease, hemophiliacs, and people who have work-related risk of be infected. The hepatitis A vaccine is available to prevent this infection. Most children begin vaccination between ages 12 and 18 months. It is a series of two vaccines. Vaccination for hepatitis A is also available for adults and can be combined with the hepatitis B vaccine.

Hepatitis B

Chronic hepatitis B is treated with antiviral medications. This form of treatment can be costly because it must be continued for several months or years. Treatment for chronic hepatitis B also requires regular medical evaluations and monitoring to determine if the virus is responding to treatment.

Hepatitis B can be prevented with vaccination. The CDC recommends hepatitis B vaccinations for all newborns. The series of three vaccines is typically completed over the first six months of childhood. The vaccine is also recommended for all healthcare and medical personnel.

Hepatitis C

Hepatitis C virus (HCV) is a positive-strand RNA virus of the genus Hepacivirus within the Flaviviridae family infection (Galdino et al., 2016). It is a well-known causative agent of a serious, contagious, and inflammatory disease, which affects the normal function of the liver, predominantly as chronic infection (Supram et al., 2015). People who develop cirrhosis (scarring of the liver) or liver disease as a result of chronic hepatitis C may be candidates for a liver transplant, there is no current vaccination for hepatitis C.

Hepatitis D

No antiviral medications exist for the treatment of hepatitis D at this time. According to a 2013 study, a drug called alpha interferon can be used to treat hepatitis D, but it only shows improvement in about 25 to 30% of people.

Hepatitis E

Currently, no specific medical therapies are

available to treat hepatitis E. Because the infection is often acute, it typically resolves on its own. People with this type of infection are often advised to get adequate rest, drink plenty of fluids, get enough nutrients, and avoid alcohol. However, pregnant women who develop this infection require close monitoring and care. The use of interferon is therefore restricted to patients who are most likely to benefit; in particular, younger patients who have more potential years in which to develop complications

Prevention of hepatitis infection
Practicing good hygiene is one key way to avoid contracting hepatitis A and E. If you're traveling to a developing country, you should avoid: local water, ice, raw or undercooked shellfish and oysters, raw fruit and vegetables. Hepatitis B, C, and D contracted through contaminated blood can be prevented by: not sharing drug needles, not sharing razors, not using someone else's toothbrush, not touching spilled blood. Hepatitis B and C can also be contracted through sexual intercourse and intimate sexual contact. Practicing safe sex by using condoms and dental dams can help decrease the risk of infection.

Complications of hepatitis
Chronic hepatitis B or C can often lead to more serious health problems. Because the virus affects the liver, people with chronic hepatitis B or C are at risk for: chronic liver disease, cirrhosis, liver cancer.
People with chronic hepatitis B and C are encouraged to avoid alcohol because it can accelerate liver disease and failure. Certain supplements and medications can also affect liver function. If you have chronic hepatitis B or C, check with your doctor before taking any new medications. After the age of 40 years, the proportion of persons who have a protective antibody response following vaccination declines to, 90% and to 75% in those vaccinated over the age of 60 years (Nguyen and Tran, 2009). Hepatitis is a major cause of mortality and morbidity globally. Without intervention, 15% to 40% will develop chronic hepatitis which may lead to liver cirrhosis, and end as liver disease, which may finally require

liver transplant, (CDCP, 2012). Prompt diagnosis and effective treatment is the only solution. When hepatitis is not diagnose at an early stage and promptly treated it may lead to acute or the risk of long-term liver damage.

System design approach
The system is a web-based medical pre-diagnostic system. The system is designed to handle the problems of the existing system which does not have a centralized system, to handle different classes of hepatitis (A, B, C, D and E) which will ease the work of health care providers and also give the general public a means to know their health status early. The system is easy to use and has user friendly interface, for easy communication between users and the system. The users will reply to each question asked by the system by ranking the symptoms on a scale of 1-20, and if above that scale, the individual is advice to seek medical attention, as it relates to them. After this is done, the system will now use these inputs to conclude the presence or absence of any of the classes of Hepatitis (A, B, C, D and E) in them.

Benefits of this system
The system we proposes, is a centralized (web-based) pre-diagnostic decision support system that will help in prompt diagnosis of the classes of Hepatitis (A, B, C, D and E) some of the advantages are as follows:

(i) It ensures that Hepatitis is detected at an early stage and treatment can be effected early, this will helps in reducing mortality.
(ii) The system will also help individuals to do pre-diagnosis on their own before going for laboratory test, as it provides a scale of tolerable, and if exceeded, there is likelihood of hepatitis disease.
(iii) The system can be used at anytime and anywhere for users both in rural and urban areas.
(iv) The system is user friendly and easy to use
(v) The system is cost effective; it can be easily downloaded from the internet.

Architectural diagram of the system
It gives a high level view of the new system with the main components of the system and the services they provide and how they communicate.

The system is implemented using a three architecture that comprises of user interface, process management and DBMS (Figure 1).

System design
System design contains Logical Design and Physical designing; logical designing describes the structure and characteristics, like output, input, files, database and procedures. The physical design, which follows the logical design, actual software and working system, constraints like Hardware, Software, Cost, Time, and Interfaces. The algorithm of our system design can be found in Appendix 1.
The tools which are employed in the methodology stage were majorly tables, Data Flow Diagram (DFDs) and Entity Relationship Diagram (ERDs). The design allows only authorized users to access the system's information. System analysis is the process of analyzing a system with a view of bringing out problems in the existing system and proffering

an alternative solution, most usually a computerized system. In this research project, most existing decision support system lack centralized process of pretest (early-diagnostic) to addressing the different classes of hepatitis virus (A, B, C, D and E). It was broken down into two major activities:

i). Data gathering /System investigation, and
ii). Data analysis/Documentation of findings (Figure 2)

Use case diagrams
Unified Modeling Language (UML), it is a standard language, that is for specifying, visualizing, constructing, and documenting the artifacts of a software systems. The use case diagram for the system is given in Figure 3.

State diagram
A state diagram is a diagram showing the life of an object in states and transition. Figure 4 show the state diagram of the proposed system.
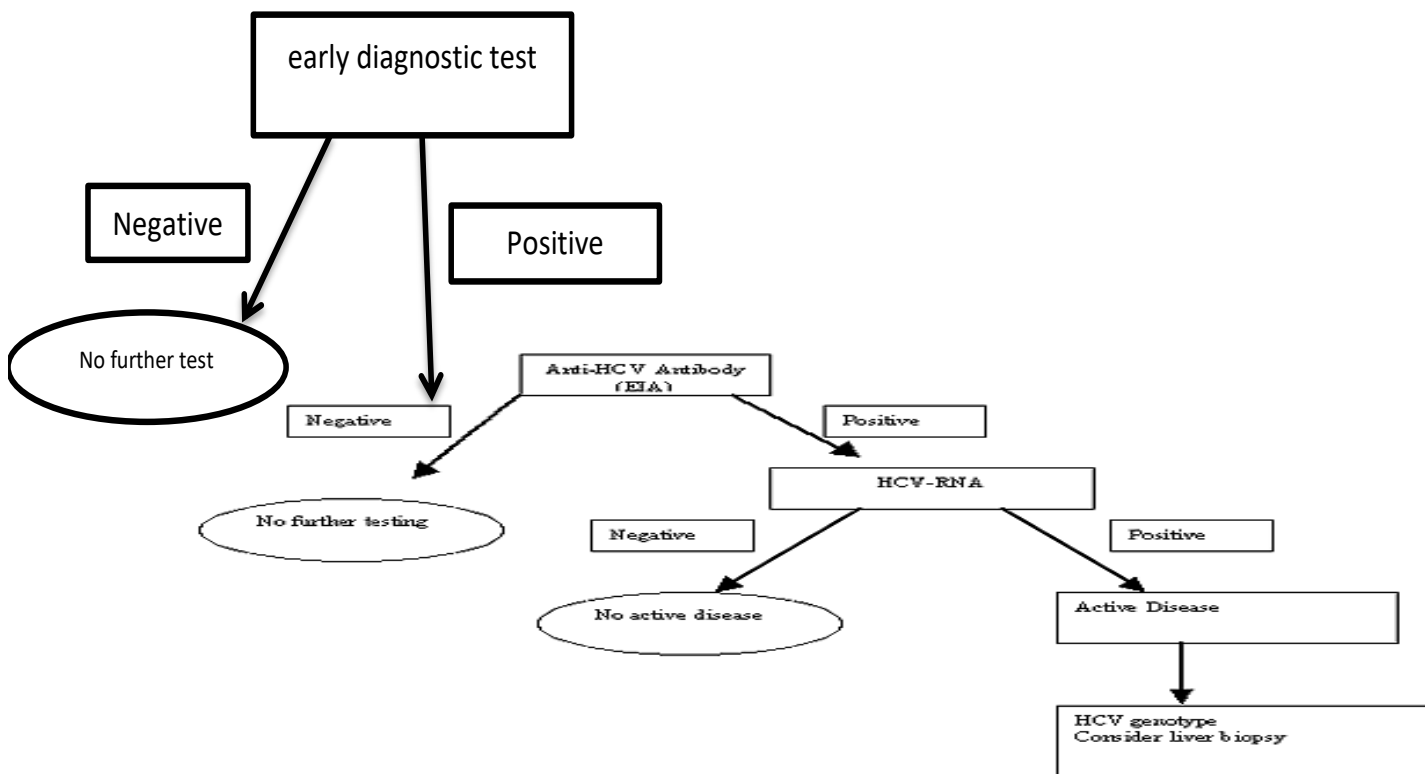
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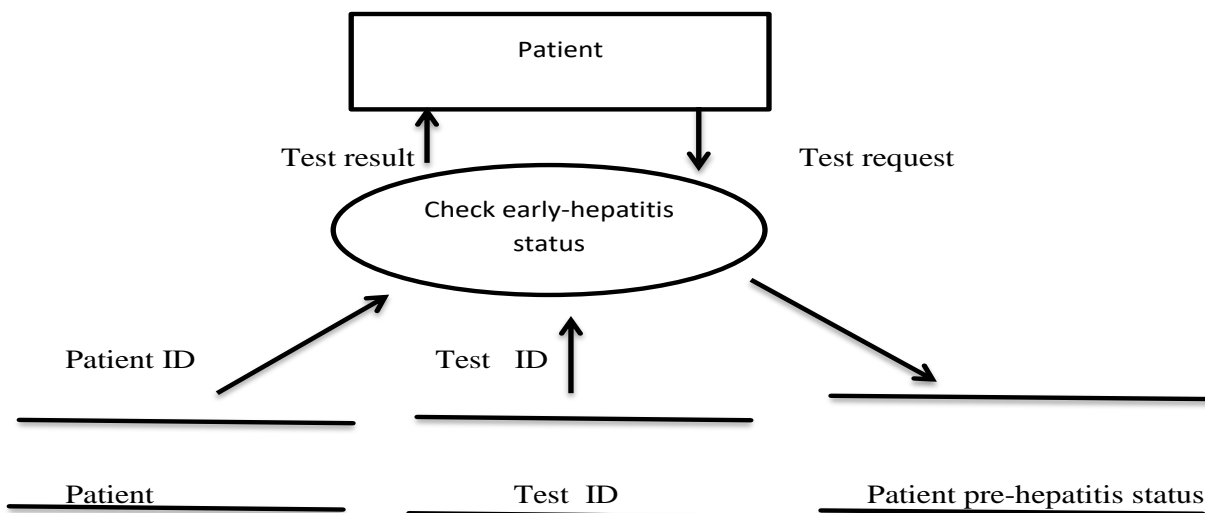

Figure 1. Architecture of the proposed system.
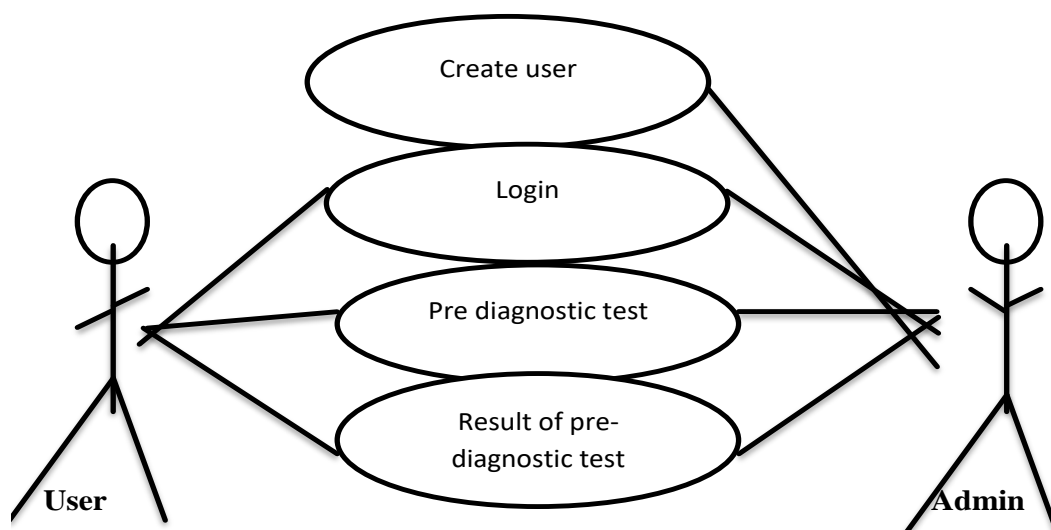
Figure 2. Block diagram for early-diagnosis.

Figure 3. UML diagram for a web based expert system for pre-diagnosis of the of hepatitis.
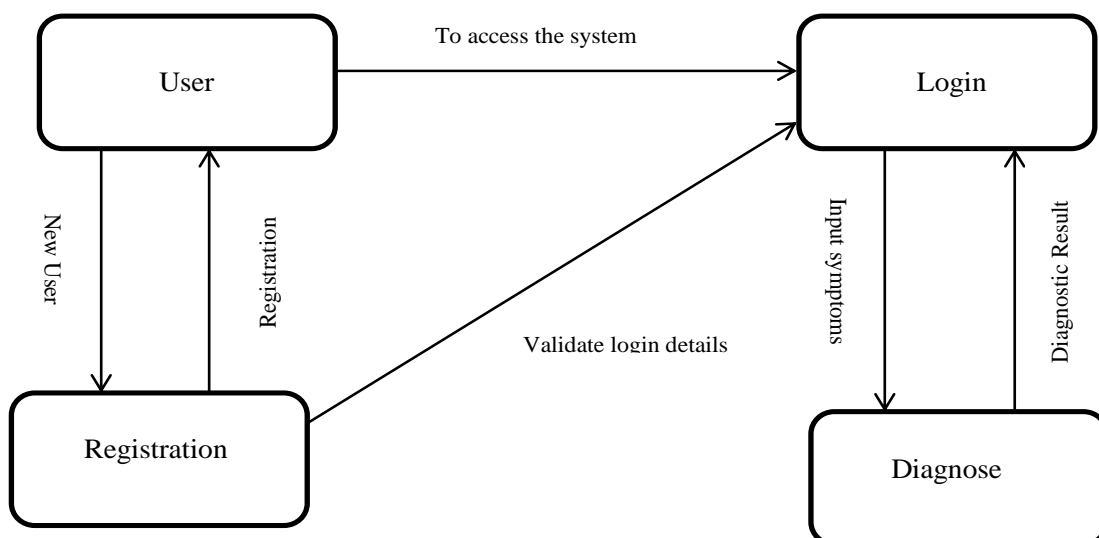
Figure 4. State Diagram of the proposed system.

Conclusion

This paper focuses majorly on a web-based pre-diagnostic diagnostic system for early detection of the different classes of Hepatitis (A, B, C, D and E), which will be shareable, inexpensive, and reliable. The proposed system embodies a permissible threshold limit that serves as a warning signal, if this threshold limit is exceeded, and then adequate attention should be given to such patient. If the decision and policy makers approve the utilization of this system, the prevalent rate of the disease will be curtailed, thereby reducing the induced burden of death as a result of the disease.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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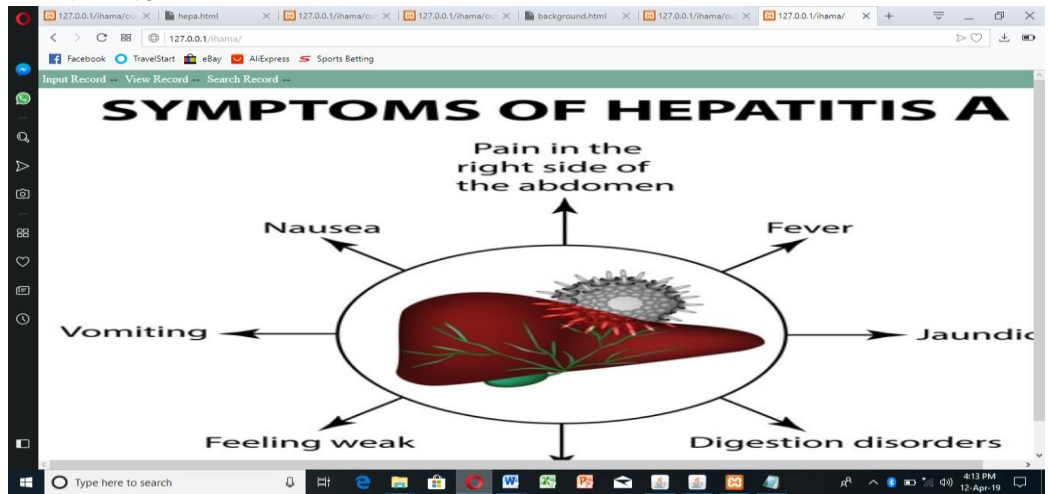
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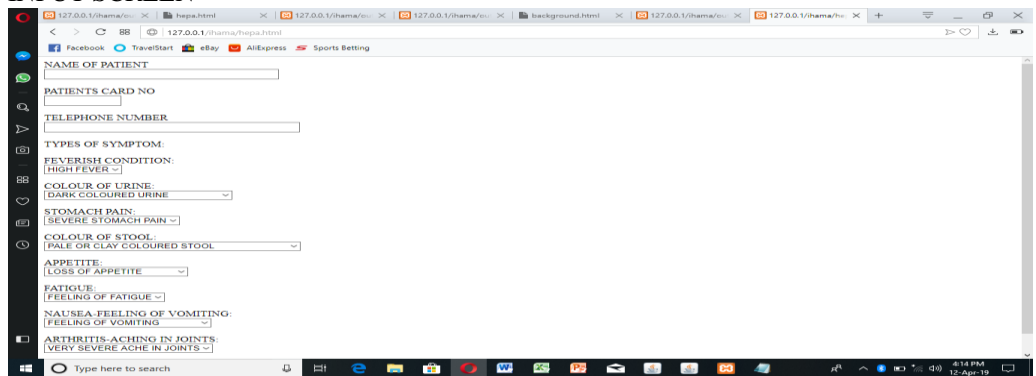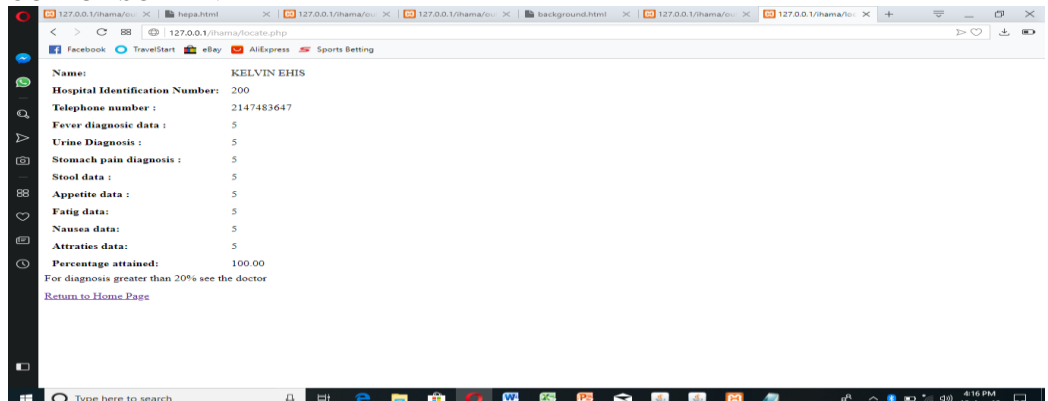
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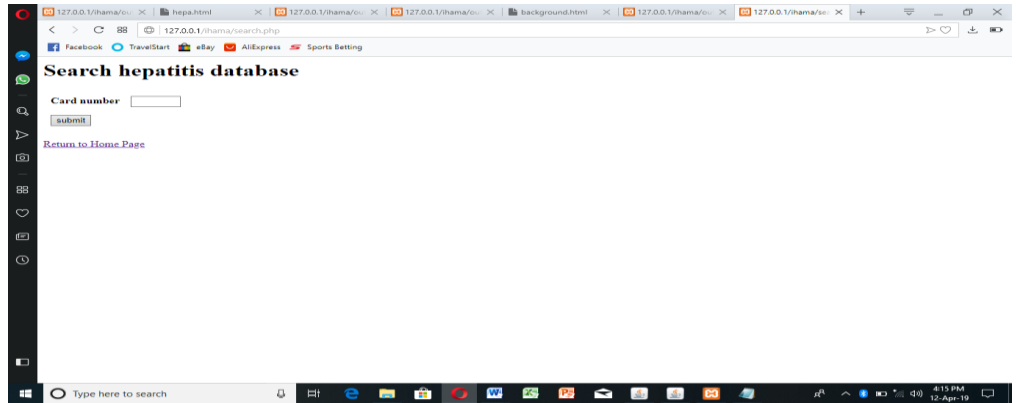
MAIN MENU

INPUT SCREEN

OUTPUT SCREEN

Appendix 1. Algorithm of our system design.