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Original Research Article

Expert System for Medical Predictions of Hepatitis B

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Abstract: Hepatitis B virus has been a major concern to the world as it has been a killer infection for many years. It is an infection that has adverse effects on the human liver causing cirrhosis, and hepatocellular carcinoma. In many countries, many persons had been infected in the past with this deadly disease, and it resulted in many deaths. This has been so, due to the high cost and time required to undergo laboratory checks and consult a medical doctor. Not so many people could afford the medical bills required for early detection of the virus. The researchers seek to curb the challenge with the development of an Expert System for Medical Predictions of Hepatitis B. The software is meant to accurately predict if a patient has hepatitis B or not, the extent of the infection if any, and also suggest treatment. This is to enable for early detection and treatment of infected patients. This reduces the cost and time required to get treatment for hepatitis B. The methodology adopted for the analysis of this work is Object Oriented Analysis and Design (OOAD) and Unified Modeling Language (UML). The program is written using JavaScript alongside HTML5 (Hyper Text Markup Language), CSS (Cascading Style Sheets) and bootstrap framework. The database is implemented using MySQL and the program is implemented using PHP (Hypertext Preprocessor). From the results, the Expert system has accurately diagnosed if a patient has chronic or acute hepatitis B and also prescribed suitable treatment.

Keywords: Hepatitis B, virus, Expert system, liver, infection, predictions, treatment.

INTRODUCTION

Approximately 2 billion people worldwide have hepatitis B virus (HBV), this is a third of the universe. 350 million people i.e. between 5 and 7 percent of the world population are severely infected (Lavanchy D. 2004). Cirrhosis, liver failure, and hepatocellular carcinoma (HCC) are serious disease that befalls up to 40 percent of persons having hepatitis B. This contamination is one out of ten source of demise globally, resulting in One million, two thousand deaths (1,002,000) yearly. Presently the 5th most dominant cancer in the globe is Hepatocellular carcinoma, resulting in 500 thousand deaths yearly. (Lavanchy D. 2004). The African region comprises a wide geographical space with great inhabitants and little income. Nigeria consists of about 150 million, 700 thousand people. The inhabitants increase by 2.3 percent yearly. https://go.worldbank.org/HREMVJ8T90. In Nigeria, there have been a number of studies in several people. More than 70 percent of the populace displays sign of previous contamination with the disease between 7.3–24 percent of the populace has recent contamination (mean of 13.7 percent). A current research proved that the average general danger of becoming infested with HBV from a body fluid exchange in this region was 4.3 out of 1000 units (Jayaraman S. *et al.*, 2010). This number is much, as it transforms to 28,595 fresh HBV infections yearly. A somewhat high incidence was tested in a collection of female government workers, a result likely related to female circumcision. A survey from Northern Nigeria confirms that unprotected sexual relationship also contribute in HBV spread. (Sirisena ND *et al.* 2002).

An intelligent system i.e. expert system is a program which uses non-natural intellect to mimic the conclusion and conduct of a mortal professional or an organization's experience in a particular field. Expert systems are usually intended to complement mortal professional, they do not replace them. https://www.techtarget.com › searchenterpriseai › expert-s... The ability of a machine to imitate human

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expert is a branch of artificial intelligence, known as expert system. Intelligent system through if-then rules not conventional procedure solve complex problems through bodies of knowledge. https://en.wikipedia.org/wiki/Expert_system

BACKGROUND AND RELATED WORK

The researchers have reviewed previous work on expert system for medical prediction of hepatitis B by other researchers and scholars. They looked at identification and management of hepatitis B. Furthermore, the various approaches, methodologies, implementations and findings in this area of study have been analyzed. Setbacks and limitations of each implementation approach, as well as recent improvements over previous work are also reviewed. (Ahmad *et al.*, 2019) proposed Automated Diagnosis of Hepatitis B Using Multilayer Mamdani Fuzzy Inference System that diagnoses hepatitis B and also reveals diverse stages of hepatitis B like acute, chronic, etc. If level I identifies that there is hepatitis and level II identifies that there is no hepatitis B, it implies that there may be other forms of hepatitis. Their research was mainly development of an expert system that diagnoses hepatitis B through blood investigation information gotten from a unit in a hospital. Medical and non-medical professionals can use the expert system. By providing the required inputs any person can also detect the status of hepatitis. Computational intelligence techniques such as neural network and neurofuzzy systems can be used to improve the efficiency of the system. This study can be stretched to other categories of hepatitis like A, C, D, and E. (Ahmad *et al.*, 2019).

Jena *et al.*, (2021) proposed Clinical Decision Support System (CDSS) using an expert system which is a twin to Machine Learning (ML) to be a better way for diagnosis. In rural and isolated areas where experienced doctors are lacking, it can help health personnel to predict the disease. Dakshata and Seema, (2011) developed Expert System based Artificial Intelligence for Hepatitis B Diagnosis. Their work showed that Generalized Regression Neural Network will be the main appropriate Neural Network for Hepatitis B identification which will aid in decreasing additional period used in management. Even if there are limitations in blood test, the identification will be made with artificial intelligence using general regression neural networks. Agizew, (2019) designed an Expert System for Diagnosis and Management of Viral Hepatitis using Adaptive Learning. It is demonstrated and denoted using rulebased reasoning techniques. It provides proper advices in the technologically advanced expert system by inferring the rule, both forward and backward chaining is used. SWI-prolog editor is used for creating the ideal expert system. Without any assistance from the knowledge engineer, the proposed structure get used to dynamic information by generalizing rules and realizing fresh procedures by getting to know the current knowledge from field experts.

Kumar *et al.*, (2012) developed Hepatitis Prediction Model based on Data Mining Algorithm and Optimal Feature Selection to Increase Predictive Accuracy. Classification and prediction for Hepatitis patients are done using machine learning skills. Tana *et al., (*2020) Predicts a clinical severity in alcohol-associated hepatitis patients. Alcohol-Associated Hepatitis (AAH) patients were 34 and control subjects were 35 in their study, in other to remove texture structures from work out tomography imageries using random forest as well as deep learning convolutional neural network procedures. Recursive feature eradication by means of arbitrary forest recognized 23 topmost features for AAH categorizing, the percentage for the validation set of deep learning for diagnosing AAH was 70%. Addisalem, (2022) Used Supervised Machine Learning Technique to develop a Classification Model for Hepatitis B Disease. To determine that patient has chronic or acute hepatitis B disease a machine learning tool and algorithm model was trained. A dataset with 14 selected attributes and 5,032 datasets was carefully chosen to bearing experiments using diverse classifiers in this machine learning tool and procedure model. The experimented class was verified to be better than outdated data.

Aminat *et al.*, (2021) researched on Hepatitis Diseases Prediction using Machine-Learning Techniques. Analysis of the hepatitis dataset aims to correctly forecast result correctness and reliability. Six machine learning classification methods are used to test hepatitis dataset and a confusion matrix was plotted for each of the grouping models, they are Logistic Regression, Gaussian Naive Bayes, Support Vector Machines, Decision Tree, Multiplayer Perceptron, and K Nearest Neighbors. With the aid of Artificial Neural Network Based Expert System, Mahesh *et al.*, (2014) researched on Diagnosing Hepatitis B. Artificial intelligence methods especially aided with computer diagnosis to simplify the diagnostic process in daily routine and avoid misdiagnosis is achieved through non-natural neural networks. These procedures take care of different kinds of health facts and incorporate them into classified results. In the medical diagnosis application, non-natural neural networks are applied in many areas. Patients are categorizes into infected and non-infected by the system. This research work aims to develop an expert system for medical predictions of Hepatitis B. Different software that will help in diagnosing people with Chronic Hepatitis B (CHB) with ease is reviewed in this research work. Some improvement of Expert systems for decision making in medical diagnosis as well as treatment will be presented. With the help of this thesis, people who have HBV and cannot visit a health practitioner, can use non-natural skill to detect the disease. The proposed system

has used expert system and AdaBoost Algorithm to predict if a patient has Hepatitis B or not and also proffer treatments if positive. So, in addition to what other researchers have done, prescription of treatment for different categories of patients diagnosed with hepatitis B has been added.

MATERIAL AND METHODS

In this work, the researchers applied a methodology known as Object Oriented Analysis and Design together with Unified Modeling Language. Organizing and designing what the model's code will really look like is the process of Object-oriented modeling. All through the building or program design phase, the modeling procedures are implemented by using a language that supports the object-oriented software development. The creation of application and database development as well as transformation into an integrated data model and language environment is done with object-oriented modeling approach. It has the following characteristics: data abstraction, encapsulation, Object identification, message passing and inheritance. Diagrams are used to keep information about object-based analysis of the systems and reveal the communication amongst these objects and the varying features they possess. Unified Modeling Language (UML) is a graphical language for Object Oriented Analysis and Design that gives a normal approach to note down a software system's proposal. The objects of an object-oriented system are pictured, stated, built, and documented. It depicts the organizations and the associations in a multifaceted system. Two branches of artificial intelligence are applied in this system:

Expert systems that is based on logical inference known as the traditional part

Expert systems are implemented through two foremost likelihoods: they are rational inference and by numerical inference. Some predictions regarding the hepatitis B diagnosis in a patient is made in this study using logical inference. An expert system uses some rules to implement human reasoning. This is referred to as rules based expert system which is mostly used for medical diagnosis implementation. Logical inference can be applied in medicine to build expert systems that will make diagnosis using some principles. Machine learning, represented by Adaboost (Adaptive Boosting) algorithm. The algorithm transforms a number of weak learners to strong learners thereby improving its prediction power. Boosting algorithms has two principles: A model is built on the training dataset and another to fix the errors present in the first model. The dataset predicts properly when its procedure continues so that errors are minimized.

In building the proposed system, we first decide using logical inference whether Hepatitis B virus is present in a patient. If the virus is present, more facts about the virus need to be ascertain. Adaptive Boosting (Adaboost) algorithm will be used to decide the level of correctness of the prediction. This is because it is easy to use this algorithm as we do not have to do many hyper parameters modification as compared to other algorithms. It also has struggle from over fitting of data as it runs each model in a system and has a weight associated with them. Human experts will not be replaced by this system. It is a tool that suggests decision with evidences gotten from other resolved cases so as to obtain experience. The proposed system will provide a hybrid approach to predicting hepatitis B, as well as offer higher prediction accuracy than the existing system.

Use Case Diagram of the proposed System

In order for the proposed system to function according to its standard design specifications every actor must play its respective role as shown in the use case diagram of the proposed system. A use case is a function an actor of the anticipated system has to achieve in its particular area of coverage. The figure below presents that of the system proposed.

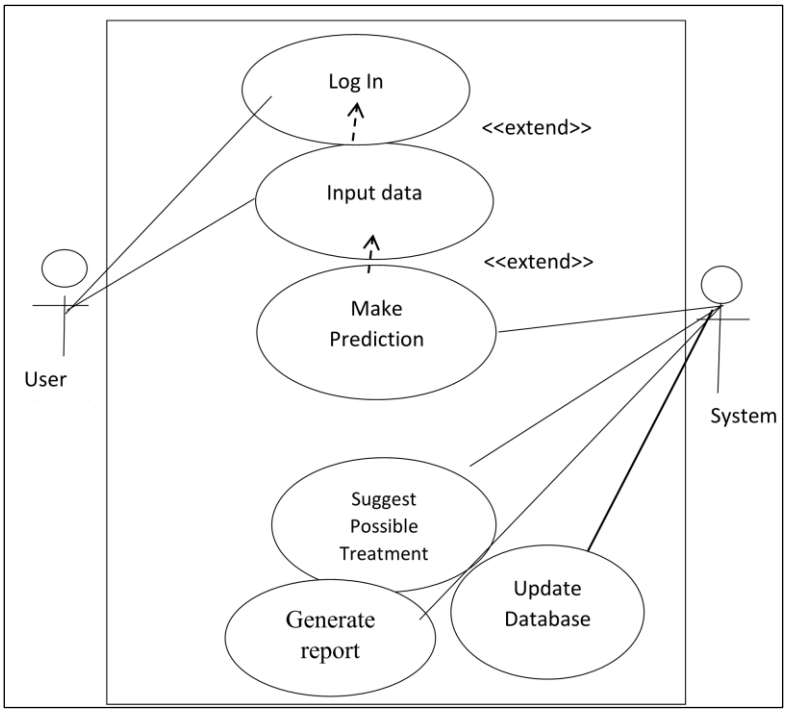

Figure 1: Use case illustration of system proposed

Two actors are shown in the proposed system: user and the expert system. Data is inputted in the form of symptoms by the user and the system uses the data to make prediction and suggest possible treatment.

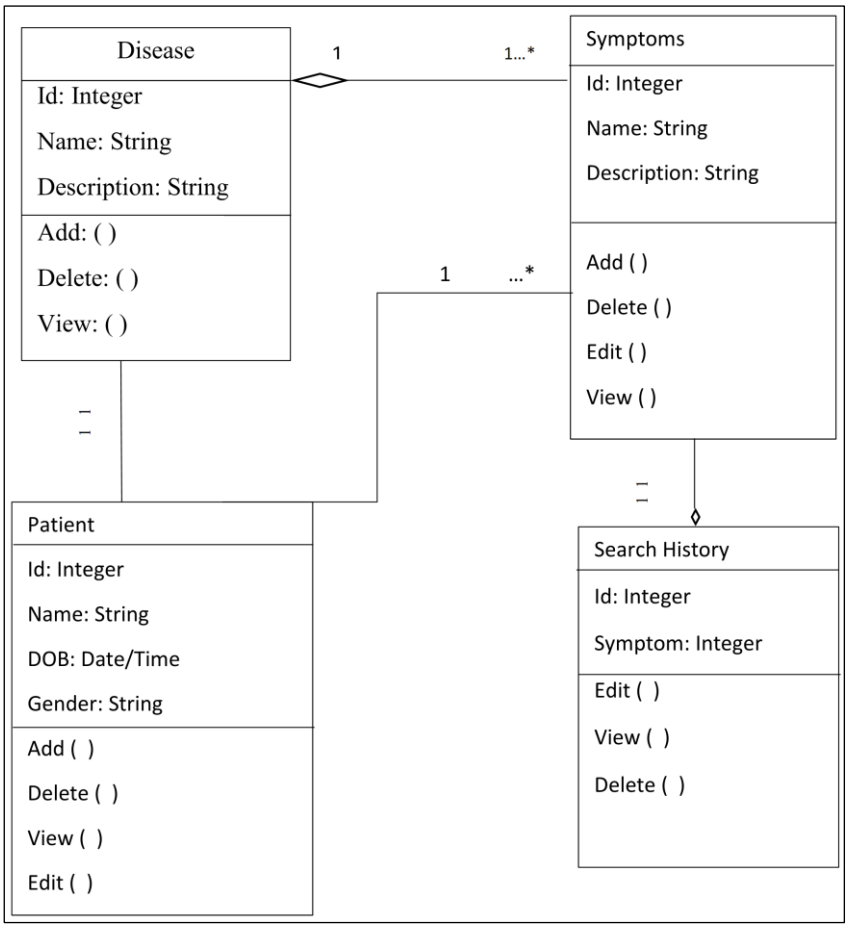

Figure 2: The proposed system class diagram

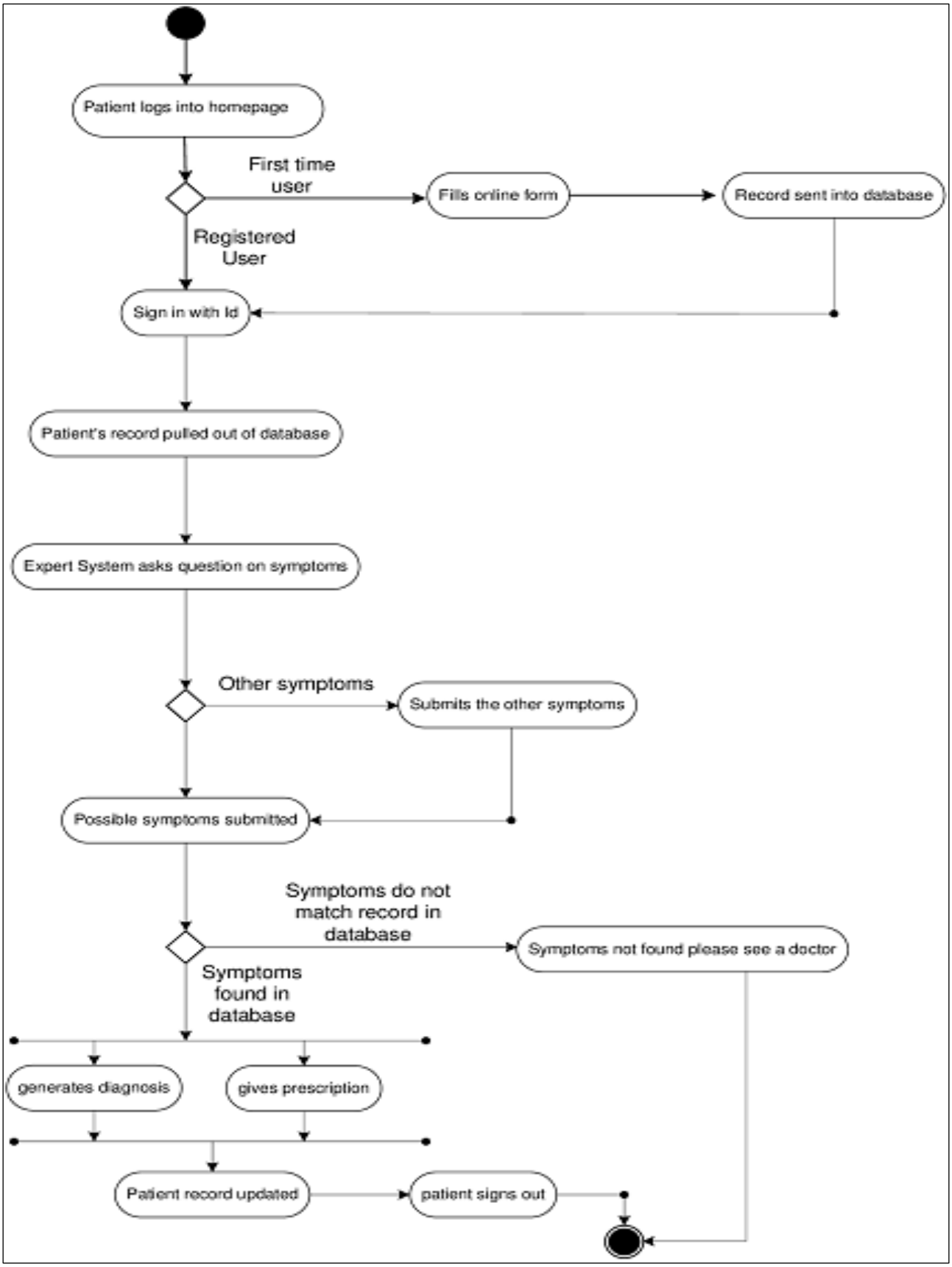

Figure 3: The proposed system activity diagram

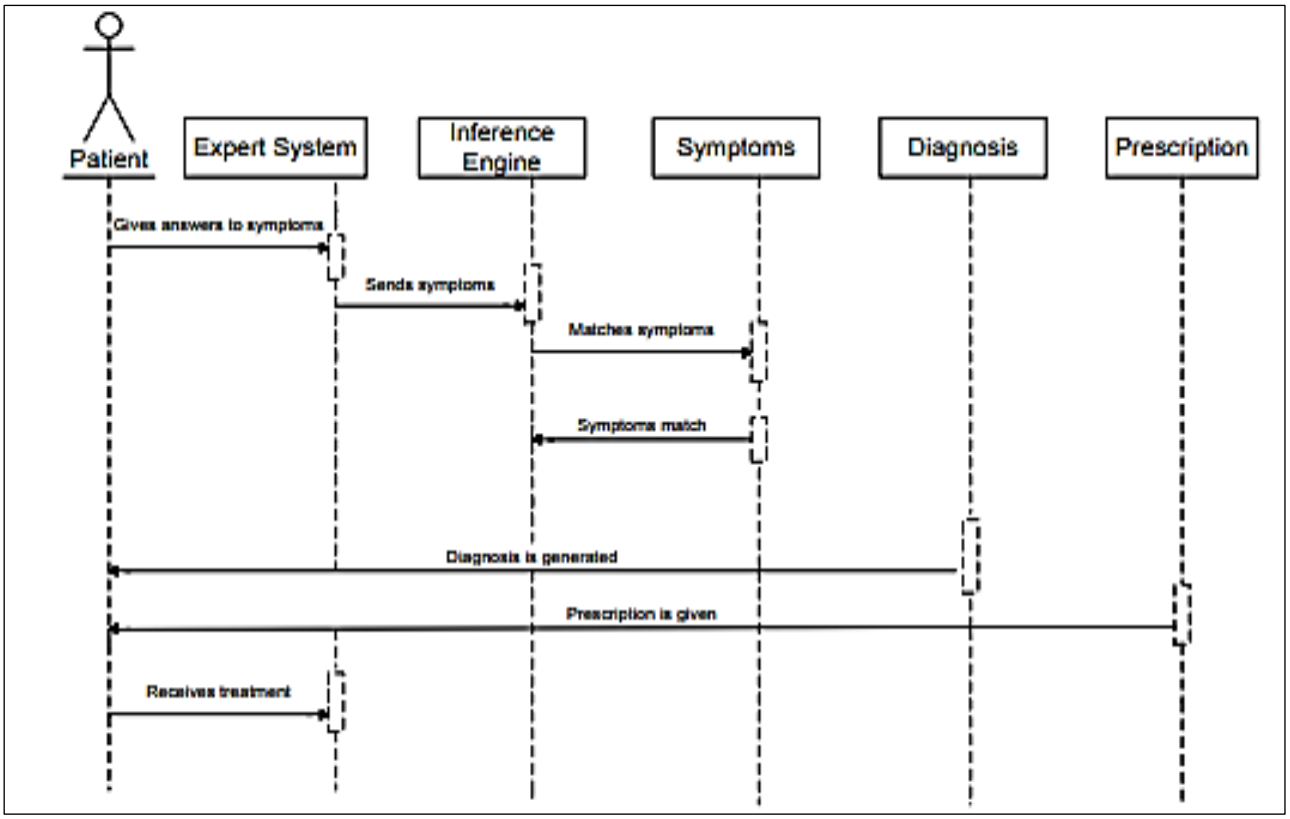

Figure 4: Sequence diagram of the 'Make Prediction' Use Case

The Sequence diagram demonstrates the behavior of objects in the use case above by labeling the objects with the communication they make. The objects communicates through their life lines and the messages they interchange are organized in a periodic sequence. The elements of a sequence diagram are the Objects, represented at the upper part of the diagram using boxes, Life line is the period an object remains, Messages are the ways objects interconnect, and Activation is the period during which an object executes a process. The Sequence diagram above, shows the way user process data from module to module similar to user, application proposed and database systems modules in turn.

RESULTS

Expert system which is a prominent application of symbolic Artificial Intelligence, are computer-based systems that captures and utilizes the knowledge and expertise of human specialists in a specific domain. Expert systems employed rule-based reasoning and inference engines to provide advice, diagnosis, or problem-solving assistance to users. This expert system has been applied in this work to predict if a patient has hepatitis B virus or not. It also gives the level of the infection and prescribes treatment. This work has applied the knowledge base of human expert in this area and is efficient in making the prediction and prescribing treatment. This has helped for early detection and treatment. It has reduced the cost and time needed to physically consult human experts like laboratory technicians and medical doctors. Expert system which is a branch of Artificial Intelligence has improved healthcare outcomes and assisted healthcare professionals in decision-making processes. Without good health it will be difficult to achieve much in life, as it is someone with good health that can have soundness of mind to be creative or productive in life. It cannot be over emphasized that early detection of illness, in this case, hepatitis B virus will go a long way in aiding for proper management and prevention of untimely death. So, this work has greatly improved the efficiency of detecting someone with hepatitis B virus infection, the extent of the infection and also suggests treatment. Here the various symptoms of the patient are entered to enable the expert sytem to be able to use them to determine whether he/she is infected, the level of infection and also prescribe the treatments required for that stage. The form design below shows the result of the research. It is easy to understand as it is self-explanatory. It states clearly the results of the inputs made earlier. The patient's level of infection and status is derived and the appropriate treatment for that stage is prescribed here.

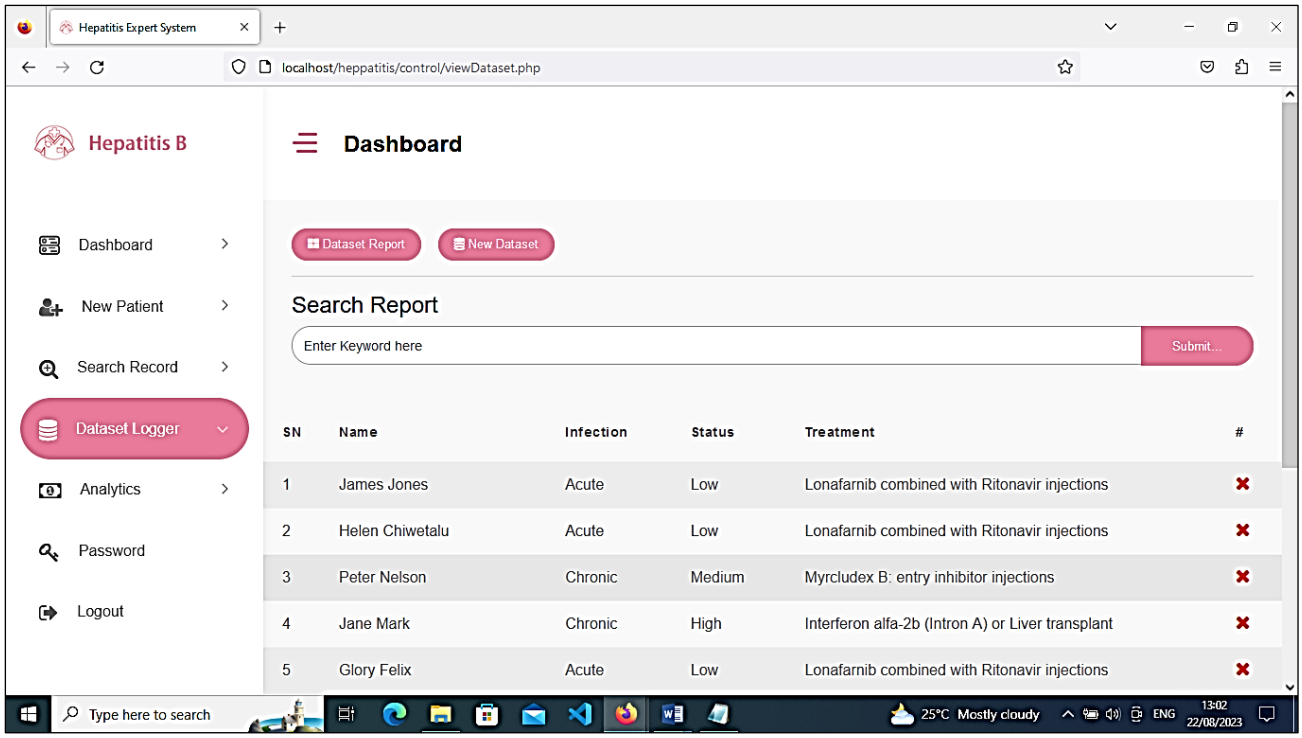

Figure 5: Results
Source: Form file of this work

CONCLUSION AND FURTHER STUDIES

This work is aimed at making sure that patients can easily check their status for hepatitis B virus early enough, so that they can be managed effectively. This will reduced the death rate caused by hepatitis B in our world. This has not replaced the human expert completely, but has helped in reducing their workload as many can resort to using this software to check their status early enough and get treatment if there is need for it. This work would have covered some more areas like other Hepatitis viruses if not for the cost, time and other factors beyond the control of the researchers. The researchers therefore recommend that future work on this topic should encompass other aspects of hepatitis viruses so that more patients will be able to use it for their prediction and early treatment.

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