



DESIGN AND IMPLEMENTATION OF HEART DISEASE PREDICTION SYSTEM USING EXPERT SYSTEM AND DATA MINING

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ABSTRACT

Heart Disease is a class of disease that involves the heart or the blood vessels. It is the second leading cause of death in world for men and women. In order to predict/ diagnose any disease, the expert system designed by human may be a cheering way out to diminish cost, time, human efforts and medical error. This work, Heart Disease Prediction system using Expert System and Data Mining is considered to be one of the most powerful tools for assistance in the hospital and healthcare facility. The methodology adopted in analysis of the system is Extreme Programming (XP) Model. XP is a disciplined approach to delivering high-quality software quickly and continuously. We developed this system using the combination of JavaScript, HTML, CSS to provide friendly user interface, PHP as the server side scripting language to implement the functionality of the system and MySQL as a database platform for storing the knowledge. The Heart Disease Prediction System using Expert System and Data Mining has been able to accurately diagnose the patients for ailment such as Coronary Artery.

Keywords: Heart Disease Prediction, Computer Expert System, Medical Expert, Data mining, Expert System Diagnosis.

INTRODUCTION

People nowadays work really hard to make a lot of money in order to live lavish lives. As a result, people neglect to care for their health. Because of this, the food that they eat has changed. Their alterations in lifestyle ultimately result in early onset diabetes, hypertension, and other ailments. All of these factors cause people to neglect their health, which raises the

risk of heart disease. The heart is the most important organ in the human body, and when it is harmed, the other main organs of the body are also impacted. Consequently, there has been a significant growth in the use of computer technology in the medical industry for disease diagnosis and patient care. Despite the enormous complexity and unpredictability of these sectors, which involve computers, intelligent systems like artificial neural networks and genetic algorithms have been created. Novruz Allah Verdiet (2007). The primary risk factors for heart disease include smoking, high blood pressure, diabetes, sex, and age. M.NikravesJanusz, Lotfi A. Zadeh (2007). The many and ambiguous risk factors for heart disease might make it challenging for doctors to diagnose the condition. In other words, there is no clear line dividing what is healthy from what is unhealthy, making it difficult to discriminate between the two. (2007) Kemal Polataat el. The physician's work is challenging since there are so many variables to consider while analysing and diagnosing the patient's problem. Therefore, specialists need a precise instrument that takes these risk variables into account and produces predictable results over a wide range of time. I am motivated to create an expert system to identify heart disease in this project since we need such a crucial tool. Building medical expert systems has a number of issues, including handling uncertainty, To solve these issues, Expert systems made it possible to combine many inference techniques in a way that increased their strength and reduced their weaknesses. (2007) Hatzilgeroudis, J. Prentzas, D.E. Brown, et al (2007). If the knowledge of the human expert can be incorporated into a computer system, dependence on the human expert may be reduced. An expert system has been presented to address the issue of heart disease prediction.

A group of illnesses known as cardiac diseases affect the heart or blood vessels. The second largest cause of mortality worldwide for both men and women is heart disease. Heart disease comes in a variety of shapes and sizes. The blood channels that provide blood to the heart itself, known as the coronary arteries, are the most prevalent site of heart disease. This condition is known as coronary artery disease, and it develops gradually over time. It is the primary cause of heart attacks in humans. The heart's valves may experience other forms of issues, or the heart may not pump effectively, leading to heart failure. Some individuals are predisposed to heart disease from birth. Many variables raise the chance of developing heart disease, and most individuals seek to lower those risks. The elements in this situation are:

- i. Having diabetes which is a strong risk for heart disease.
- ii. Substance abuse such as cocaine
- iii. Being overweight
- iv. Not getting enough exercise and feel depressed or having excess stress
- v. Smoking

- vi. High blood pressure increases the risks of heart disease and heart failure
- vii. Excess cholesterol in blood builds up inside the walls of heart's arteries (blood vessels).

Statement of the Problem

The statement of the problem is stated below;

- a. Inadequate facilities for prediction of heart diseases in human beings.
- b. More cases of heart issues arise due to lack of proper health management.
- c. Too much dependence on human expertise which are limited in some areas.
- d. Human errors in prediction, most cases lead to death.

Objectives

- i. To develop a software Implementation for prediction of heart disease in human beings.
- ii. To minimize dependence on human expertise which are limited in some areas.
- iii. Solve the problem that affects the manual methods of diagnosis, for example considering time and cost.
- iv. To develop a system that will provide recommendation for heart disease in human beings.
- v. To develop a user-friendly web-based Heart Disease Prediction System using Expert System and Data Mining.

LITERATURE REVIEW

In case you were unaware, detecting a heart issue is a difficult process. This project's goal is to help people and medical professionals detect cardiac disorders and provide the right medications for treating them. A piece of literature is a work written by a scholar that contains the most recent information on a subject, including both substantive results and theoretical and methodological contributions. Reviews of the literature are secondary sources; they do not include fresh or unique experimental work. For research in almost every academic discipline, literature reviews are essential. L. Baglione (2012). The study would include an examination of the theories that underlie the creation of various expert system applications. The results of the research and reviews that have been conducted have been very helpful in providing the idea and insight to the development on the existing application of expert systems to be implemented in this system, which makes this phase quite important because we learned how well expert systems perform in their ability to assist and replace the human expert as well as the user.

Expert System

An Expert System is computer system that emulates the decision making ability of a human expert. Ikechukwu Nkuma-Udah, K., Azogini Chukwudebe, G., and Nwabueze Ekwonwune, E, (2018). By so doing, it acts in all respects like a human expert, using human knowledge to solve problem that would require human intelligence. Human experts solve problems by using a combination of factual knowledge and reasoning ability. In an expert system, these two essentials are contained in two separate but related components, a knowledge base and an inference engine. The knowledge base provides specific facts and rules about the subject, and the inference engine provides the reasoning ability that enables the expert system to form conclusions. Expert systems also provide additional tools in the form of user interfaces and explanation facilities. User interfaces, as with any application, enable people to form queries, provide information, and otherwise interact with the system.

Types of Expert System

The following are the main types of expert system:

(a) Rule-based

A rule-based expert system is defined as one which contains information obtained from human expert, and represents that information in the form of rules. The rule can then be used to perform operations on data to inference in order to reach appropriate conclusion. These inferences are essentially a computer program that provides a methodology for reasoning about information in the rule base or knowledge base, and for formulation conclusions.

Application of rule-based systems on expert systems includes: State transition analysis, psychiatric treatment, production planning, advisory system, and teaching, electronic power planning, automobile process plans etc. (Turban & Aronson.2004).

(b) Case- Based Reasoning

The basic idea of case-based reasoning is to adapt solutions that were used to solve previous problems and use them to solve new problems. In CBR, descriptions of past experience of human specialists, represented as cases, are stored in a database for later retrieval when the user encounters a new case with similar parameters. The system searches for stored cases with problem characteristics similar to the new case similar to the new one, finds closest fit, and applies the solutions of the old case to the new case. Successful solutions are tagged to the new case and both are stored together with the other case base along with explanations as to why the solutions did not work (Kolonder, 1994).

Some of the applications implemented by CBR include: manufacturing process design, knowledge management, power system restoration training, ultrasonic inspection, fault diagnosis-learning etc.

Type of Heart Disease

1. Coronary Heart Disease

Coronary Heart Disease is a chronic illness in which the coronary arteries, the vessels that supply oxygen-carrying blood to the heart, become narrowed and unable to carry a normal amount of blood. Most often, the coronary arteries become narrowed because of atherosclerosis, a process in which fatty deposits called plaque build-up on the inside wall of an artery (*see Arteriosclerosis*).

2. Heart Attack

A heart attack, also known as a myocardial infarction, usually occurs when a blood clot forms inside a coronary artery at the site of an atherosclerotic plaque. The blood clot severely limits or completely cuts off blood flow to part of the heart. In a small percentage of cases, blood flow is cut off when the muscles in the artery wall contract suddenly, constricting the artery. This constriction, called vasospasm, can occur in an artery that is only slightly narrowed by atherosclerosis or even in a healthy artery.

3. Stroke

Stroke is a disease that affects the arteries leading to and within the brain. It is the No. 5 cause of death and a leading cause of disability in the United States. A stroke occurs when a blood vessel that carries oxygen and nutrients to the brain is either blocked by a clot or bursts (or ruptures).

4. CorPulmonale

Corpulmonale is defined as an alteration in the structure and function of the right ventricle (RV) of the heart caused by a primary disorder of the respiratory system.

[Pulmonary hypertension](#) is often the common link between lung dysfunction and the heart in corpulmonale. Right-sided ventricular disease caused by a primary abnormality of the left side of the heart or congenital heart disease is not considered corpulmonale, but corpulmonale can develop secondary to a wide variety of cardiopulmonary disease

processes. Although cor pulmonale commonly has a chronic and slowly progressive course, acute onset or worsening cor pulmonale with life-threatening complications can occur.

5. Cardiac Dysrhythmia

A cardiac dysrhythmia is an abnormal heart beat: the rhythm may be irregular in its pacing or the heart rate may be low or high. Some dysrhythmias are potentially life threatening while other dysrhythmias (such as sinus arrhythmia) are normal. Includes Diseases: Bradycardia

Data Mining

Definition: In simple words, data mining is defined as a process used to extract usable data from a larger set of any raw data. It implies analysing data patterns in large batches of data using one or more software. Data mining has applications in multiple fields, like science and research. As an application of data mining, businesses can learn more about their customers and develop more effective strategies related to various business functions and in turn leverage resources in a more optimal and insightful manner. This helps businesses be closer to their objective and make better decisions. Data mining involves effective data collection and warehousing as well as computer processing. For segmenting the data and evaluating the probability of future events, data mining uses sophisticated mathematical algorithms. Data mining is also known as Knowledge Discovery in Data (KDD).

Description: Key features of data mining:

- Automatic pattern predictions based on trend and behaviour analysis.
- Prediction based on likely outcomes.
- Creation of decision-oriented information.
- Focus on large data sets and databases for analysis.
- Clustering based on finding and visually documented groups of facts not previously known.

The Data Mining Process: Technological Infrastructure Required:

1. Database Size: For creating a more powerful system more data is required to be processed and maintained.
2. Query complexity: For querying or processing more complex queries and the greater the number of queries, the more powerful system is required. Uses:
 1. Data mining techniques are useful in many research projects, including mathematics, cybernetics, genetics and marketing.

2. With data mining, a retailer could manage and use point-of-sale records of customer purchases to send targeted promotions based on an individual's purchase history. The retailer could also develop products and promotions to appeal to specific customer segments based on mining demographic data from comment or warranty cards.

PROPOSED SYSTEM AND IMPLEMENTATION

The suggested system is a web-based application system for heart disease prediction that has the potential to address the issue of the linked heart disease. This will be made feasible by the system's interactive nature; as a result, patient-computer interaction will take the place of patient-doctor engagement in this system. The username and password are sent by the web application to the server, where they are then processed to authenticate the application's credentials by verifying the username and password that have been registered with the server. If the destination exists, the information is then processed and delivered there. The user is supposed to choose from a list of heart disease symptoms when the system is consulted, including wheezing, chest discomfort, shortness of breath, diabetes, weariness, and obesity. It performs a diagnosis by consulting its knowledge base, which has certain pre-programmed indications and symptoms linked to particular specific illnesses, helpful resources, the name of the illness, and a medication prescription for it.

PROPOSED SYSTEM METHODOLOGY

A **methodology** is a collection of Procedures, Tools and Documentation aids in Software Process model. The relevance of expert system software in the healthcare industry is continually expanding, and with that rise comes an increase in the size of the software systems and the impacts of their growth. These factors have an impact on the methods that may be used to produce it. Software development for expert system projects requires a great deal of skill and time, both of which must be precisely used to provide the finished result at the lowest possible cost with the advancement of software development.

Extreme Programming (XP) Model is the methodology chosen for the system analysis. XP is a methodical strategy for producing high-quality software fast and consistently. It encourages intimate cooperation, strong customer participation, quick feedback loops, continuous testing, continuous planning, and frequent software delivery—typically every 1-3 weeks (Maurer and Martel, 2019). It is appropriate for small- to medium-sized projects and development teams that prioritise the finished result. XP, first introduced by Kent Beck, has become one of the most well-known and contentious agile approaches.

Some attributes Extreme Programming (XP) Model

| SN | Phases | Features |
|----|--|-------------------|
| 1 | Requirement Analysis: Requirement Specification | Frequently change |
| 2 | Planning: Cost | Expensive |
| 3 | Design : Overlapping Phases | Yes |
| 4 | Implementation: Time required | Short |
| 5 | Maintenance phase: | Easily |

Table 1: Some attributes Extreme Programming (XP) Model

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DESIGN

System Design- The data flow diagram below depicts the detailed flow of events in the system.

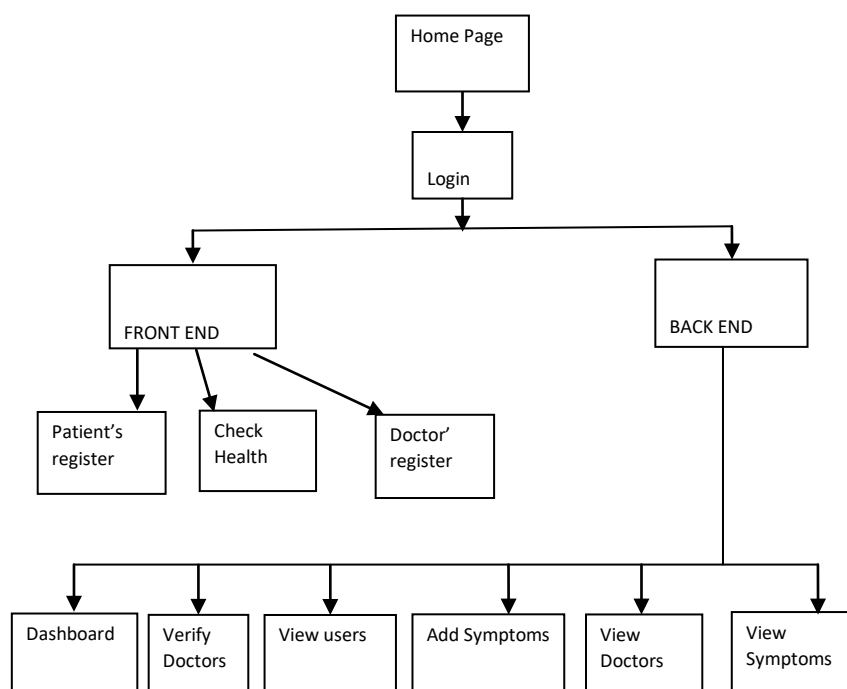


Figure:-1 Top-down design of the system.

SYSTEM IMPLEMENTATION

The new System offers people a simple setting for diagnosing illnesses related to their heart function or other health issues. The system determines the patient's condition based on their symptoms, identifies the disease that goes along with those symptoms, and provides contact and address information for the medical doctor who can treat the condition. The system also suggests a temporary fix (First Aid) before the patient can see the doctor, allowing medical professionals to make an accurate diagnosis even from previous medical records, providing them a good understanding of how to provide medical advice or treatment

Here this my proposed Heart Disease Prediction System using Expert System is divided into three (3) main Modules

Patient Module

The patient needs to register and login. The system requires a new patient to register and an existing patient to login using his/her username and password. The patient goes for Check Health and select symptom. The patient after registration is prompted to select symptoms the patient is having and click on search thereafter.

Doctor Module:

Doctor needs to register by clicking “Are you a Doctor?” and then fill in the form and submit. The doctor will be consulted by patient if suspected health disorder persists after first aid treatment by Expert System.

Admin Module

Admin can login to view all the registered and verified doctors. Admin also manage Doctors, patient and other services

RESULT AND CONCLUSION

The Heart Disease Prediction System using Expert System and Data Mining has been developed to have a user-friendly interface. It employed user interface to communicate between the user and the Expert System. The interface is the technique by which the user interacts through the Expert System. The user can easily access all the application from the home page where there is a menu bar from which he/she can perform his/her desired functions. Below are some of results obtained after testing the system

Home Page

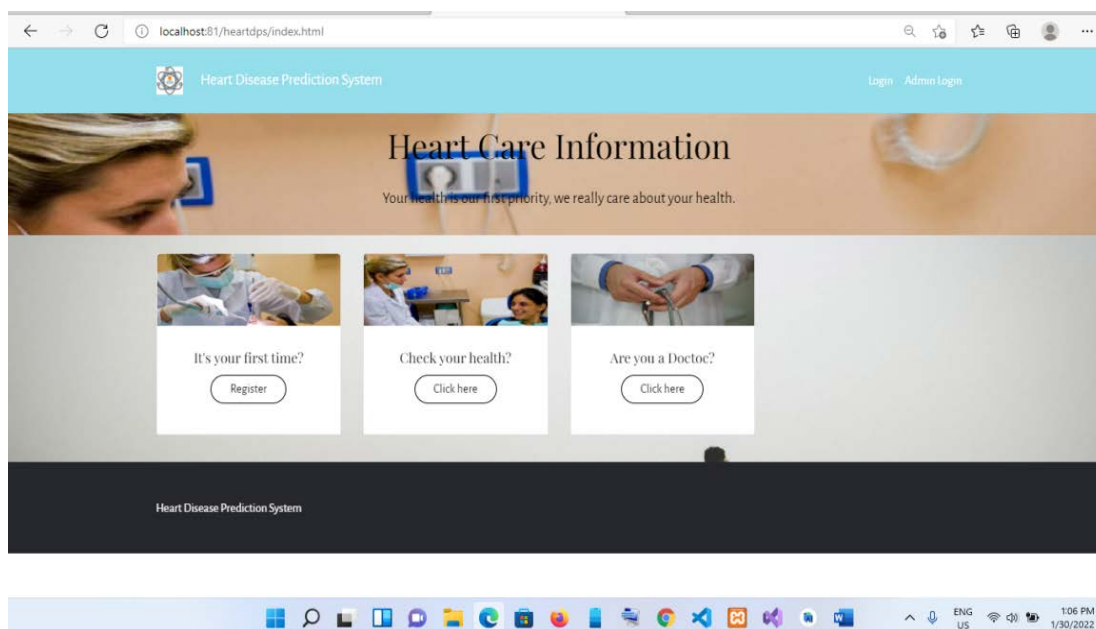


Fig 2: Heart Disease Prediction System Using Expert System and Data Mining Home Page

User's Registration

This is a platform or an Interface where a new user can be registered

The screenshot shows a web browser window with the address bar displaying 'localhost:81/heartdps/registration.php'. The page has a yellow header with a heart icon and the text 'HOME ***'. Below the header, the title 'Registration' is centered. A copyright notice '© Copyright HDPS' is visible on the left. The main content area is titled 'Your Details' and contains the instruction 'Fill out all required Field'. There are three input fields labeled 'Your name', 'Username', and 'Password', followed by a 'Submit' button. At the bottom of the page, there are social media icons for Facebook, Twitter, YouTube, and LinkedIn. The Windows taskbar is visible at the bottom of the browser window.

Fig 3: User's Registration

Doctor's Registration

This is an interface for a doctor can be registered.

The screenshot shows a web browser window with multiple tabs open: 'Admin Dashboard', 'Heart disease - Symptoms and...', and 'Registration'. The address bar displays 'localhost:81/heartdps/register.php'. The page has a yellow header with the 'HDPS' logo and the text 'HOME ADMIN LOGIN ***'. Below the header, the title 'Registration' is centered, and a breadcrumb trail shows 'You are here / HOME / REGISTRATION'. The main content area contains the instruction 'Fill out all required Field. Please don't spam.Thank you!'. There are five input fields: 'Your name', 'Email address', 'Profession', a gender dropdown menu currently set to 'Male', and a large 'Hospital Address' text area. At the bottom, there is a 'Choose File' button with the text 'No file chosen' next to it. The Windows taskbar is visible at the bottom of the browser window.

Fig 4: Doctor's Registration

User Login

Here is where the user login with registered username and Password.

Fig 5: Users Login

Admin Login

This is where admin can login to add symptoms; view all registered and verified Experts. Admin need to login using username and password.

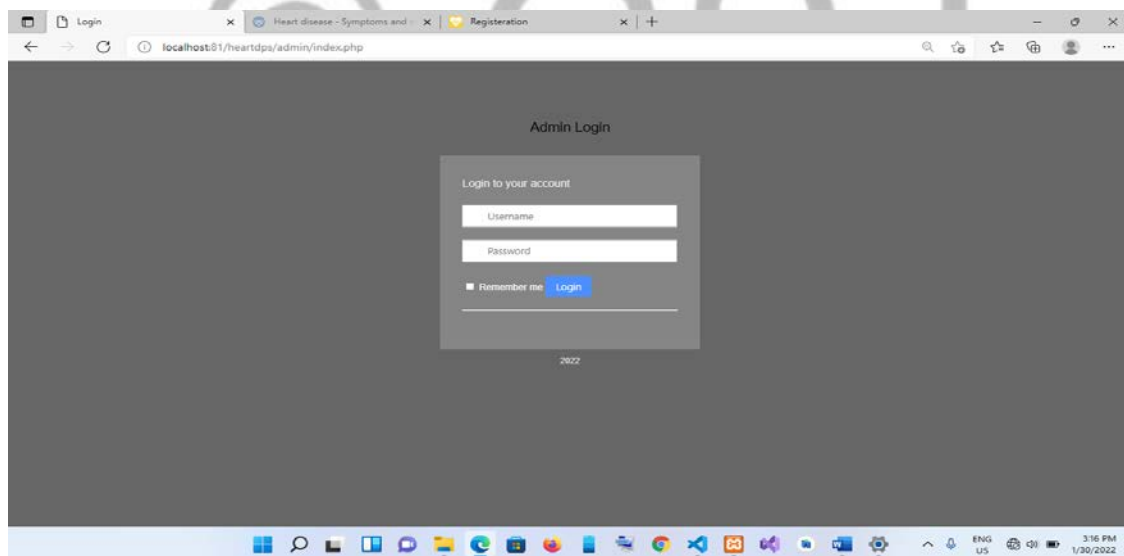


Fig 6: Admin Login

Symptom Selection Page/Diagnosis input Module

This is where the patient can choose from the listed symptoms that he or she is facing. This module provides the user with interface to select desired symptoms for proper diagnosis.

Fig7: Symptom Selection Page

Diagnosis Result Module

The Heart Disease Prediction System using Expert System and Data Mining presents results showing the probability of chances of occurrence based on the knowledge and information entered. After the symptom has been selected, next step is diagnosing and the system has accurately diagnosed the patients for ailment such as Coronary Artery. Figure 8 below is final result obtained from the system after testing the system with various symptoms.

Fig 8: Diagnoses Result Module

CONCLUSIONS

This research is web based application for Heart Disease Prediction System. The system is user friendly, economical and efficient, which allows a patient or user to interact with a computer and mobile application. As a web based application, the designed system is limited and can only be utilized in environment with Internet access. In this system, the

username and password are sent by the web application to the server, where they are then processed to authenticate the application's credentials by verifying the username and password that have been registered with the server. If the destination exists, the information is then processed and delivered there. The user is supposed to choose from a list of heart disease symptoms when the system is consulted, including wheezing, chest discomfort, shortness of breath, diabetes, weariness, and obesity. It performs a diagnosis by consulting its knowledge base, which has certain pre-programmed indications and symptoms linked to particular specific illnesses, helpful resources, the name of the illness, and a medication prescription for it. The system has been able to accurately diagnose common heart disease ailment such as Coronary Artery and can be upgraded to diagnose other disease not presently catered for.

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