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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. Data Mining is quickly expanding in a wide range of applications nowadays. Medical data mining is an important data mining field. In healthcare, there is a multitude of data available, but no effective analysis tool exists to uncover hidden links in data. Despite the fact that millions of people die from heart disease each year, the use of data mining techniques in heart disease diagnostics appears to be critical. Discovering knowledge can aid doctors in the diagnosis of cardiac disease. The objective of this study is to "Design and implement Heart Disease Prediction System using Expert System and Data Mining". The software is an expert system with database containing an expert knowledge. The study was guided by five specific objectives. The proposed 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 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. I am motivated to create an expert system to identify heart disease in this research work since we need such a crucial tool. 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. The database was designed and implemented using MySQL as database platform for storing the knowledge. HTML, CSS and JavaScript were used to develop both the user and administrator interfaces of the system while PHP was used as the server side scripting language to implement the functionality of the system.

Keywords: Design, Implementation, Heart, Disease, Prediction System and Expert System

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, genetic algorithms and machine learning have been created.

The many and ambiguous risk factors for heart disease might make it challenging for doctors to diagnose the condition. The physician's work is challenging since there are so many variables to consider while analysing and diagnosing the patient's problem. Therefore, specialist needs a precise instrument that takes these risk variables into account and produces prediction results over a wide range of time. Computer-based methods are increasingly used to improve the quality of medical services. Artificial Intelligence (AI) is the area of computer science focusing on, creating machine that can engage on behaviours that humans consider intelligent. The proposed system is dealing with problem of heart disease diagnosis as an expert system. An expert system is that employs human knowledge captured in a computer to solve problems that ordinarily required human expertise. Expert system seeks and utilizes relevant information from their human users and available knowledge based in order to make recommendations. Recently, Machine learning has increasingly important in the field of healthcare Beguma, Siddiqueb and Tiwaric (2021). It is a technique that allows machine to mimic human behaviour by repeating it. It enables machine to learn from their experiences (training data) without being programmed, allowing them to predict desired elements. Remote Healthcare technologies can also be utilized to integrate decision making tools onto mobile devices. It can collect data from patients in real-time and provide health services efficiently. It allows patients to be monitored without having to attend hospitals or health clinics Rani, Kuma, Sid Ahmed and Jain (2021). The health is an important part of the human body because it supplies pure blood to all regions of the body. People cannot live for a second if their hearts are not in good operating order. Heart failure typically happens when the heart is unable to send the necessary amount of blood to other regions of the human body in order for the body to function normally. According to a survey conducted by the World Health Organization, 80% of persons died as a result of a health attack each year (WHO). Heart disease has becomes one of the world's most dangerous human ailments Sharmaa, Shambhub, Dash and Sakshid (2021). 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:

- Having diabetes which is a strong risk for heart disease.
- Substance abuse such as a cocaine
- Being overweight
- Not getting enough exercise and fee depressed or having excess stress
- Smoking
- High blood pressure increases the risks of heart disease and heart failure
- Excess cholesterol in blood builds up inside walls of heart's arteries (blood vessels).

Aim

The aim of this project is to design and implement Heart Disease Prediction using expert system and data mining

METHODOLOGY AND SYSTEM ANALYSIS

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

ANALYSIS OF THE SYSTEM

Prediction is very tough, which is one of the main challenges faced by doctors or medical professionals. Prediction is unnecessary if a doctor does not have extensive understanding of heart illness and heart symptoms. The manual techniques of prediction that are performed in order, meaning that if someone arrives at the hospital after registering, the patient must wait until the doctor arrives. When a patient visits the doctor, the doctor listens to their symptoms and determines the sort of heart condition they are experiencing based on those symptoms. For instance, a medical professional may determine that a patient has coronary disease if the patient

reports having some of the symptoms of wheezing, chest discomfort, shortness of breath, diabetes, exhaustion, and obesity.

PROBLEMS OF THE EXISTING SYSTEM

A. How well the doctor and patient know one another. When a patient does not know the doctor well, it may not be difficult for him or her to confide in the doctor and divulge some information.

B. How much knowledge the physicians have in their fields. A doctor's past knowledge greatly influences how well they will be able to diagnose a patient disease. For instance, a doctor with extensive knowledge of many illnesses including heart disease would be better able to identify a patient who has heart disease.

C. The patient's mental condition will decide whether or not he or she will divulge the accurate information required for the diagnosis.

D. There is a significant wait time to see a doctor because of manual hospital procedures including patient registration, card issuance, etc.

THE PROPOSED SYSTEM

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.

ADVANTAGES OF THE PROPOSED SYSTEM

The proposed system should have the following;

i. Information retrieval that is completed quickly thanks to computers, which can do this in only a few seconds.

ii. Time is saved since a large number of patients may be diagnosed in a short period of time.

OBJECTIVE OF THE PROPOSED SYSTEM

This programme was created despite the fact that there are already expert systems in place since none of them specifically address heart disease, as opposed to other expert systems that concentrate on other diseases like malaria, for example. Additionally, a mechanism must be implemented that will help doctors and other medical professionals anticipate cardiac problems. Patients may inform the system of the signs and symptoms related to a certain illness.

Furthermore, as the patient would be communicating with his computer rather than the medical staff, I also want to make sure that human error in prediction is decreased, such as mistake caused by patient insincerity, which the computer would be able to handle. This lessens, if not completely eliminates, the timidity that might be present when a male patient approaches a female healthcare provider or vice versa. Due of the computer's ability to diagnose a patient as rapidly as possible, the technology will also help to eliminate the delays that patients encounter in medical facilities.

FEASIBILITY STUDY

Feasibility study is referred to as the process through which a project's viability or prospective outcomes are assessed. The value of developing an information system to an organization or society was judged by its feasibility. A system is considered to be viable if objectives and needs can be fulfilled using a certain approach within the constraints of the available resources and technology. Four key feasibility tests were conducted in order to determine the viability of this project, as

FEASIBILITY TEST

a. Technical Feasibility Study
b. Operational Feasibility Study
c. Economic Feasibility Study
d. Schedule Feasibility Study

Technical Feasibility Study

An overview design of the system's requirements in terms of input, output, files, programmes, and processes must serve as the foundation for the technical feasibility study. It assesses the viability of a given technological solution as well as the accessibility of technical resources and know-how. Technically speaking, the project is doable since the Organization has the necessary professional and technical resources on hand, allowing for the provision of technological solutions to any issues.

Operational Feasibility Study

This test examines the system's functionality after installation and the testing environment in which it is used. It assesses how effectively the solution will function inside the specified organization and how the user will perceive it. The project would be practical in terms of operations since it has been determined that the user of the system believes it would be useful to him or her. Using the acronym PIECES, the following inquiries were made during the operational feasibility test to determine the project's viability:

Performance: Will the throughput and time responsiveness of this new system be adequate?

Information: Would this system provide consumers fast, reliable, and relevant information they could utilize at all times?

Economy: Was this system intended to provide acceptable service, such as cost reduction and profit growth via serving as a source of income for the developer?

Control: Would the control of data and information be included into this new system?

Efficiency: Would this new system aim to maximize speed while minimizing latency in data processing?

Services: Would this new system be flexible and expandable enough to provide services as needed?

a. Economic Feasibility Test

This gauges the project's or the solutions' cost-effectiveness. The initiative is economically possible since, even if hosting is required, it will only cost people what they can afford and will only happen yearly or biannually, as the case may be.

b. Schedule Feasibility Test

This indicates how realistic the project schedule will be. Is the planned project's time period realistic? For the purposes of this project, the period specified defines the project's viability. After taking into account and putting the proposed idea through the four primary feasibility tests outlined above, we can now say the project is viable.

NEW SYSTEM DESIGN

The stage of system development that is concerned with system design establishes the functions and methods of the new system. System design focuses on defining customer needs.

In order to address the shortcomings of the current technique, a new automated method for performing system tasks that outlines how information and data are saved, retrieved, processed, and used to diagnose illness has been developed. The new system design's objectives are;

I. Preliminary forecast of heart disease in people.
II. Recommendation for human heart disease that is said to exist.

System Flow chart

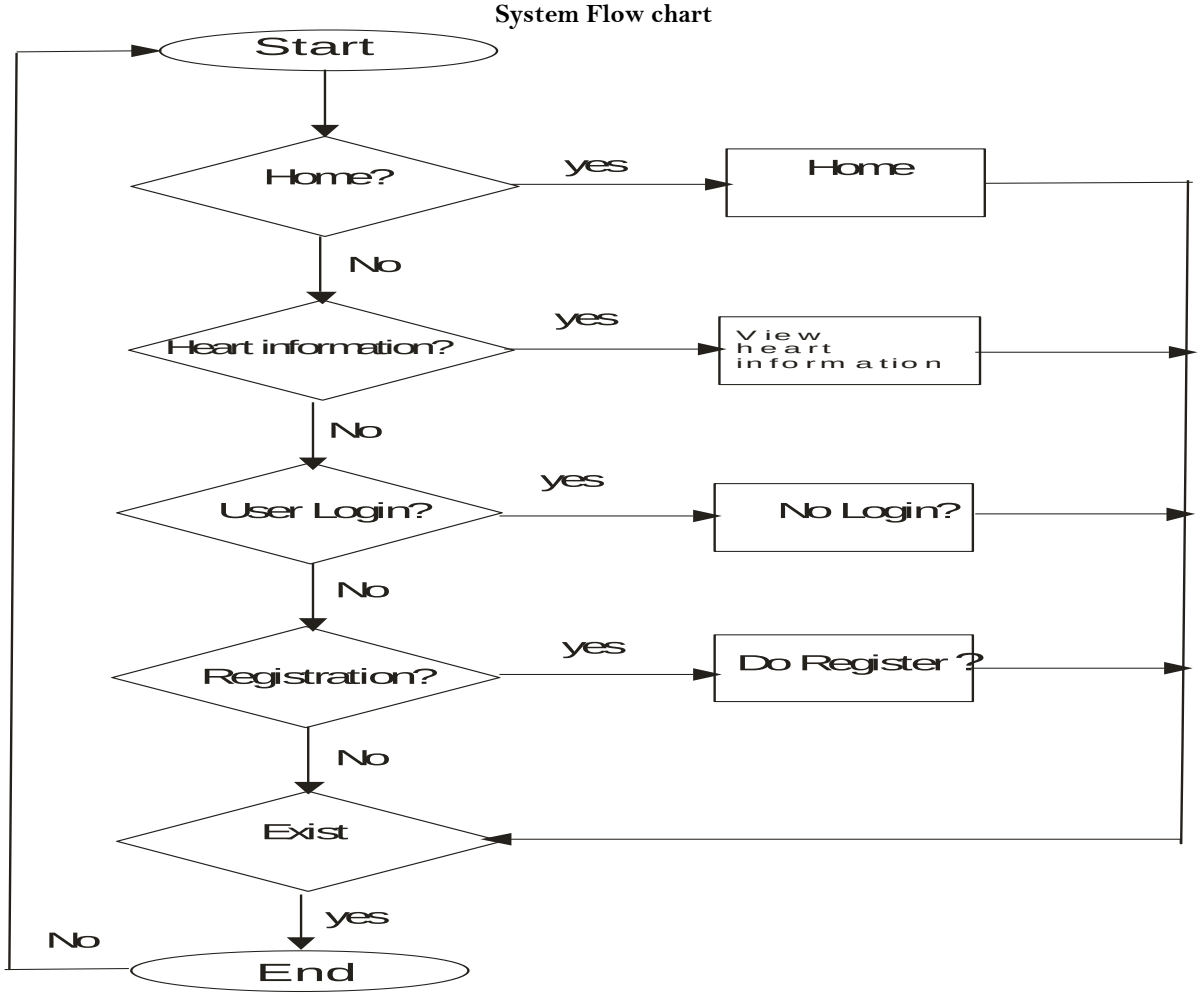

Figure 1: Program Flow chart

Diagnose Flow Chart

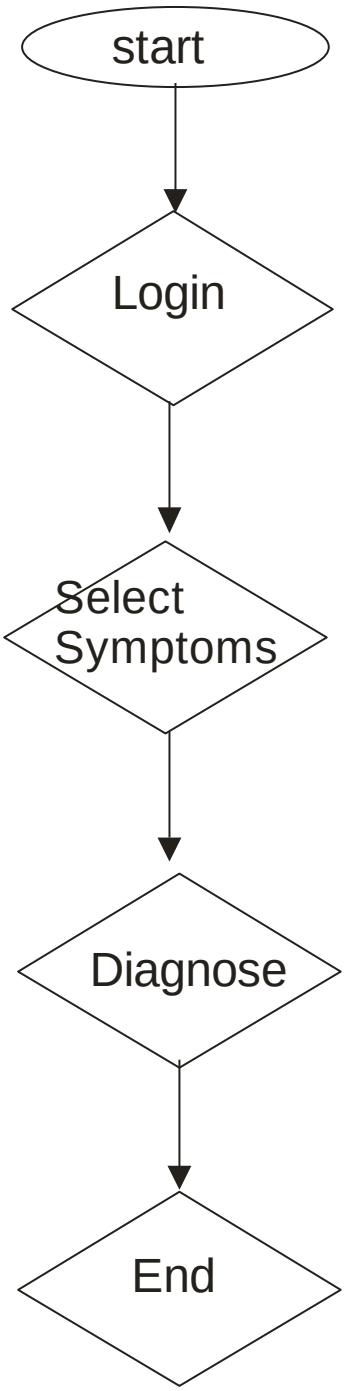

Figure 2: Prediction flow chart

INPUT SPECIFICATION

The input to the system is the information collected from each personnel which are personnel information such as name, other name, address, email, username, and password and so on. This is collected through filing of personal information form given to each personnel by the user

S/N	Field	Data Type	Field Width
1	Surname	Varchar	50
2	Other names	Varchar	50
3	Address	Varchar	200
4	Email	Varchar	200
5	Username	Varchar	200
6	Password	Varchar	200

Table 2: Input specifications

OUTPUT SPECIFICATION

The output from the system is presented for each personnel after input data have been processed stored and queried based on management specification. The outputs are sometimes manipulated to a meaningful report generation concerning each personnel for decision making.

Surname: XXXX
Other names: XXXX
Address: XXXX
Email: XXXX
Username: XXXX
Password: XXX

DATA BASE TABLE

The database is comprised of 5 relations (tables), they include: admin table, disease, treatment, users, users test tables

Admin Table

Field Name	Field Type	Field length
Username	varchar	20
Password	varchar	20

Table 3: Admin Table

Disease Table

Field Name	Field Type	Field length
Id	Integer	11
Symptoms	varchar	200
Disease	Varchar	200
Statue	varchar	50

Table 4: Disease Table

Treatment Table

Filed Name	Field Type	Field
Id Disease	Integer Varchar	11 200
Treatment	Varchar	200
Medications	Varchar	200

Table 5: Treatment

Users Table

Field Name	Field Type	Field Length
Surname	Varchar	50
Other name	Varchar	50
Address	Varchar	200
Email	Varchar	200
Username	Varchar	200

Table 6 User

User's test Table

Field Name	Field Type	Field Length
Id	Integer	11
Username Password	Varchar Varchar	50 50
Disease	Varchar	200
Treatment	Varchar	200

Table 7: User test

SYSTEM DESIGN AND IMPLEMENTATION

SYSTEM DESIGN

The process of moving from a defined set of system requirements to a design that satisfies those needs is known as system design. The process of creating a thorough blueprint of whatever is shape or structure, stressing qualities like its appeal, practicality, and effective operation, may be referred to as system design. System is a diagram that demonstrates how the software may be used in this project. A relational database using MSQL will be created and include the patient's information, including details such as name, other name, etc (Saltzer, J.H et al., 1988).

MAIN MENU

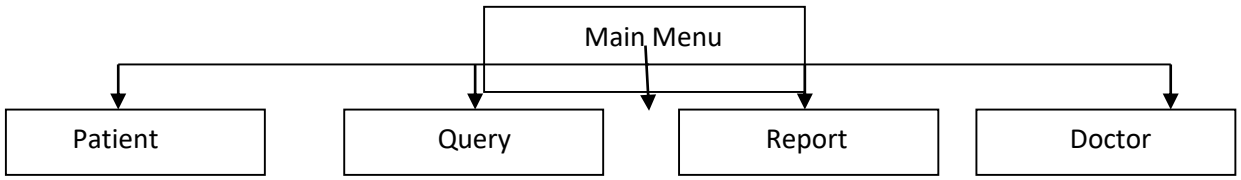

Figure 3: Main Menu

DATABASE SPECIFICATION

The database that holds data for this program is defined using MySQL database. The following modules are stored in the database:

Table:8 Admin

Columns

N	Type	Collation	Attributes	Null	Default	Comments
1	**id**	int(11)			No	*None*
2	**username**	varchar(225)	latin1_swedish_ci		No	*None*
3	**password**	varchar(225)	latin1_swedish_ci		No	*None*
4	**adminrole**	int(225)			No	*None*
5	**datecreated**	Datetime			Yes	*NULL*
6	**lastlogin**	varchar(225)	latin1_swedish_ci		No	*None*
7	**lastlogout**	varchar(225)	latin1_swedish_ci		No	*None*

Table:9 Register
Columns

N	Name	Type	Collation	Attributes	Null	Default	Comments
1	**id**	int(11)			No	*None*	
2	**name**	varchar(225)	latin1_swedish_ci		No	*None*	
3	**email**	varchar(225)	latin1_swedish_ci		No	*None*	
4	**profession**	varchar(225)	latin1_swedish_ci		No	*None*	
5	**sex**	varchar(225)	latin1_swedish_ci		No	*None*	
6	**address**	varchar(225)	latin1_swedish_ci		No	*None*	
7	**mycv**	varchar(225)	latin1_swedish_ci		No	*None*	
8	**mobile**	varchar(225)	latin1_swedish_ci		No	*None*	
9	**disease**	varchar(225)	latin1_swedish_ci		No	*None*	
10	**symtoms1**	varchar(225)	latin1_swedish_ci		No	*None*	
11	**symtoms2**	varchar(100)	latin1_swedish_ci		No	*None*	
12	**symtoms3**	varchar(100)	latin1_swedish_ci		No	*None*	
13	**symtoms4**	varchar(100)	latin1_swedish_ci		No	*None*	
14	**status**	varchar(225)	latin1_swedish_ci		No	*None*	
15	**date_time**	Datetime			Yes	*NULL*	

Table10: symptoms
Columns

N	Name	Type	Collation	Attributes	Null	Default	Comments
1	**id**	int(11)			No	*None*	
2	**profession**	varchar(200)	latin1_swedish_ci		No	*None*	
3	**disease**	varchar(225)	latin1_swedish_ci		No	*None*	
4	**symtoms1**	varchar(225)	latin1_swedish_ci		No	*None*	
5	**symtoms2**	varchar(200)	latin1_swedish_ci		No	*None*	
6	**symtoms3**	varchar(200)	latin1_swedish_ci		No	*None*	
7	**symtoms4**	varchar(200)	latin1_swedish_ci		No	*None*	
8	**FirstAid**	Text	latin1_swedish_ci		No	*None*	
9	**Date Time**	Date			No	*None*	

Table:11 user
Columns

N	Name	Type	Collation	Attributes	Null	Default	Comments
1	**id**	int(11)			No	*None*	
2	**name**	varchar(200)	latin1_swedish_ci		No	*None*	
3	**username**	varchar(200)	latin1_swedish_ci		No	*None*	
4	**password**	varchar(200)	latin1_swedish_ci		No	*None*	

PROGRAMS IN THE CONTROL CENTER

The modules included in the main page are as follows:

- ✓ Users: this module is used to create and manage users
- ✓ Register: this module is used create and manage doctor's records
- ✓ Admin: this module is used to create and manage admin users
- ✓ Symptoms: this module is used toadd and manages symptoms.

PROGRAM DESIGN SPECIFICATIONS

There are many aspects to consider in the design of a piece of software. The importance of each should reflect the goals the software is trying to achieve.

1) The output specification
2) Processing specification
3) Input specification

The output specification: the output specification produces what the software should achieve for the user. In this case, the program gives information about;

i. Users
ii. Diagnosis result
iii. Registered doctors
iv. symptoms

Processing specification: It focuses on handling each module separately. It makes sure that data contained inside a module is unavailable to modules that do not need it.

Input specification: the software user interface must be usable for its target user/audience. Default parameters must be chosen so that they are a good choice for a majority of users.

INPUT AND OUTPUT SPECIFICATIONS

INPUT SPECIFICATION

Home Page

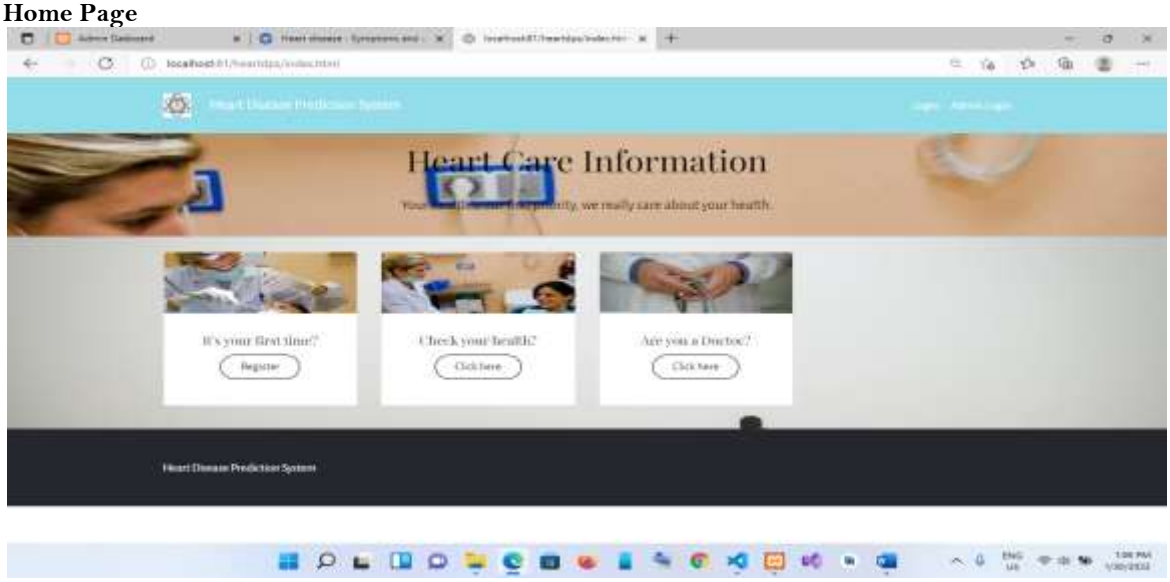

Figure 4: Home Page

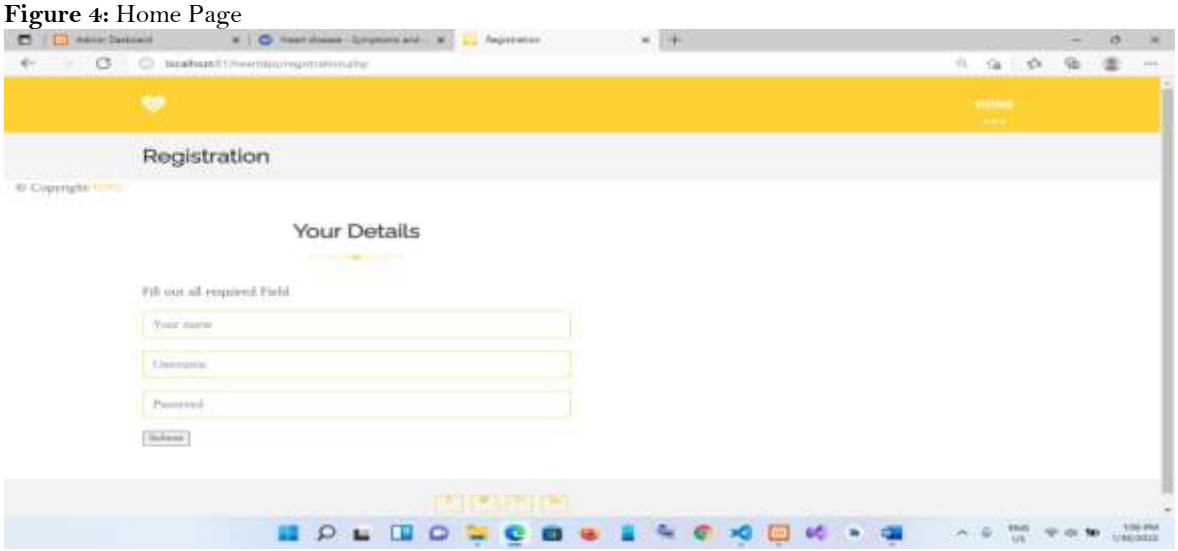

Fig 5: User's Registration

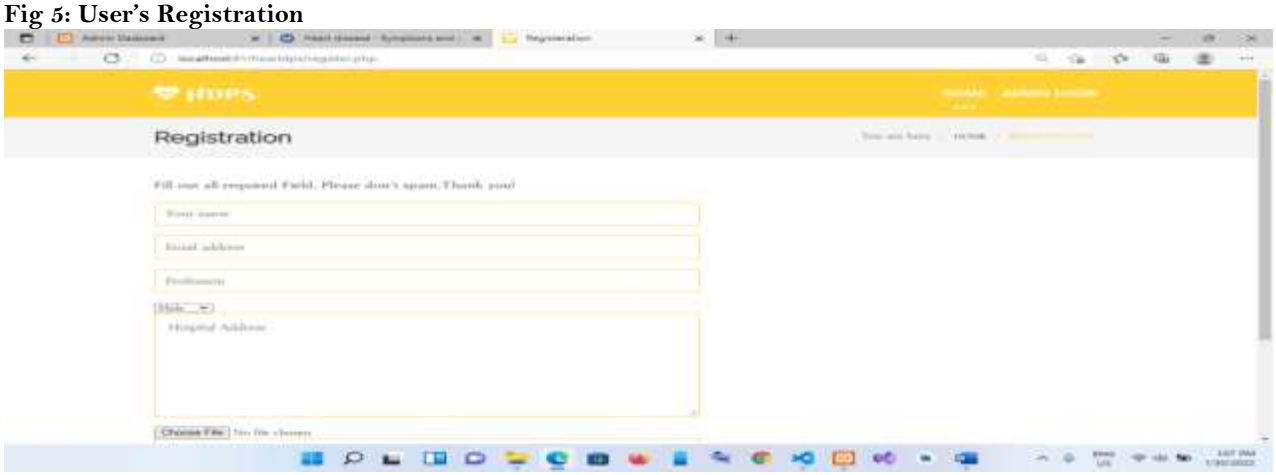

Fig 6: Doctor's Registration

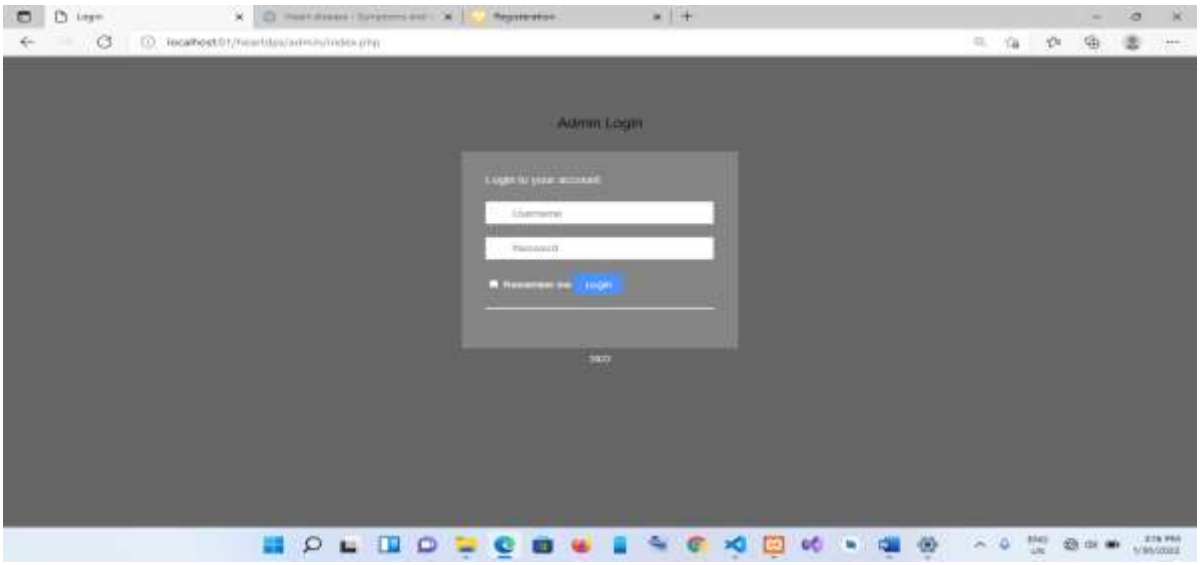

Fig 7: Admin Login

OUTPUT SPECIFICATION:

The input and process format of a programme are determined by its output. Before selecting how to go about building a system, it is important to think about what is expected of it. The system analyst must take into account the format, frequency, and substance of the papers that will be created.

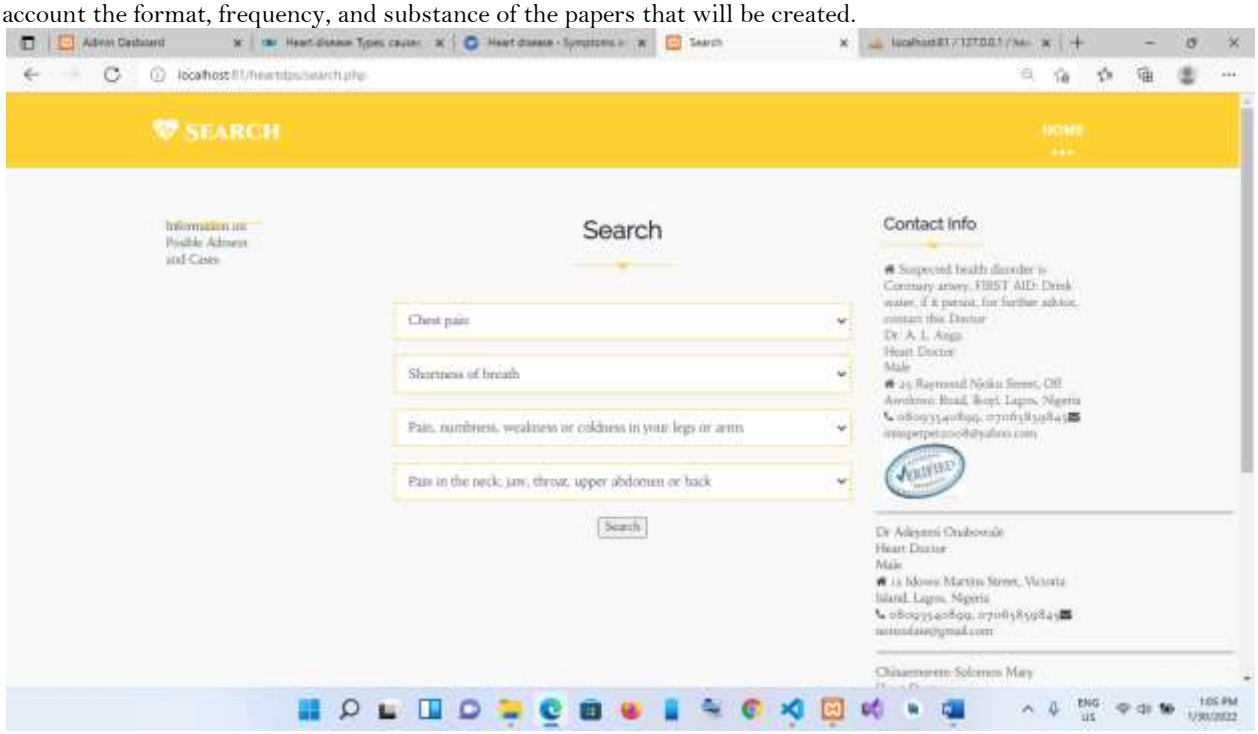

Fig 8: Diagnosis Result

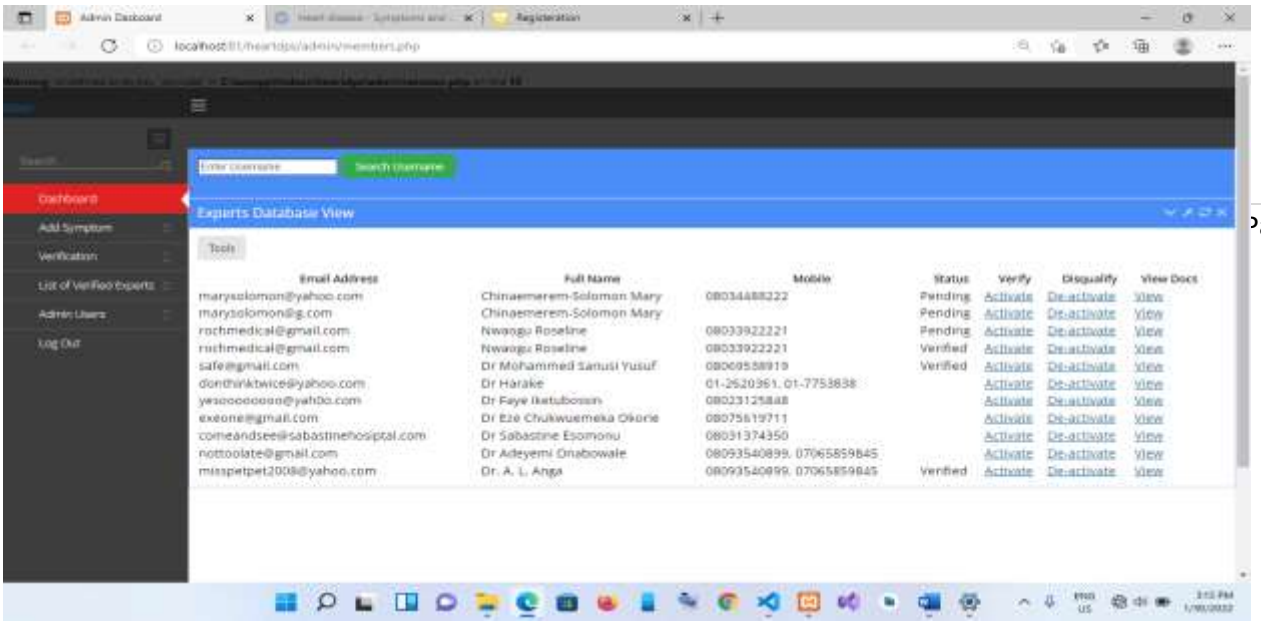

Fig 9: Expert Details View

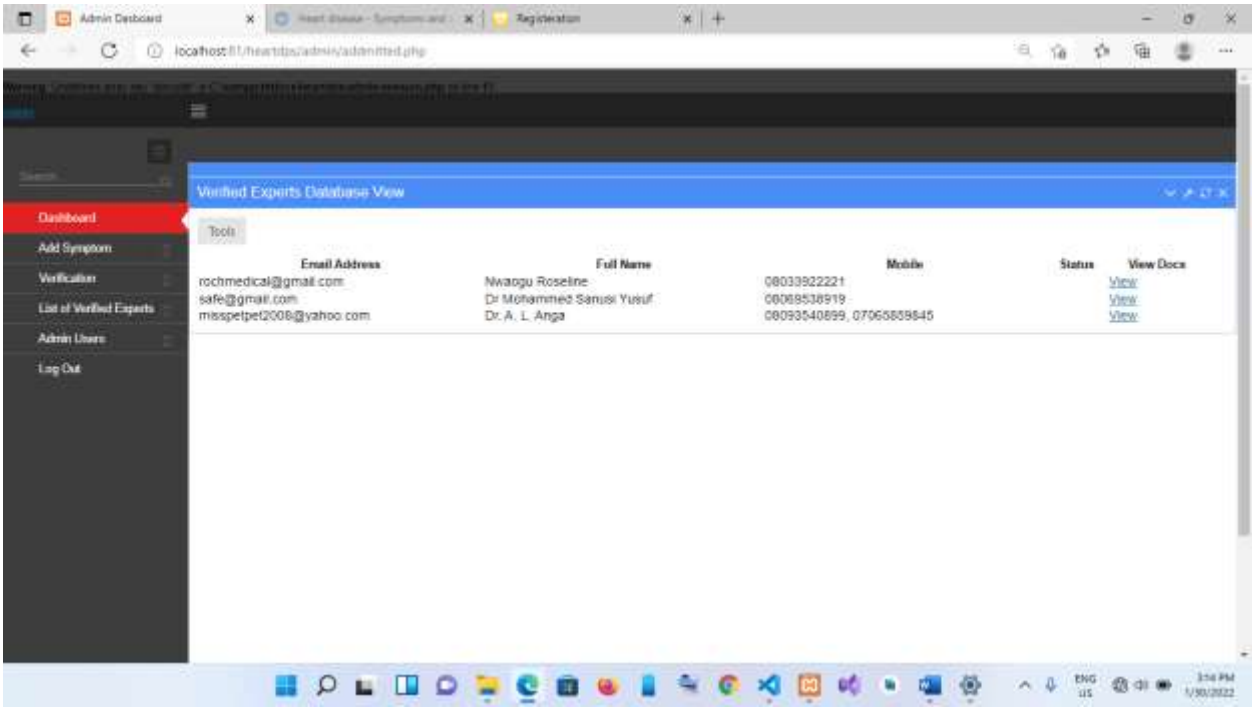

Fig 10: Verified Experts Database View

OVERALL DATA FLOW ALGORITHM OF THE PROPOSED SYSTEM ALGORITHM

1. Open the application
2. Login with your username and password as it is applicable to you
   Respond to other instructions

SYSTEMS FLOWCHART

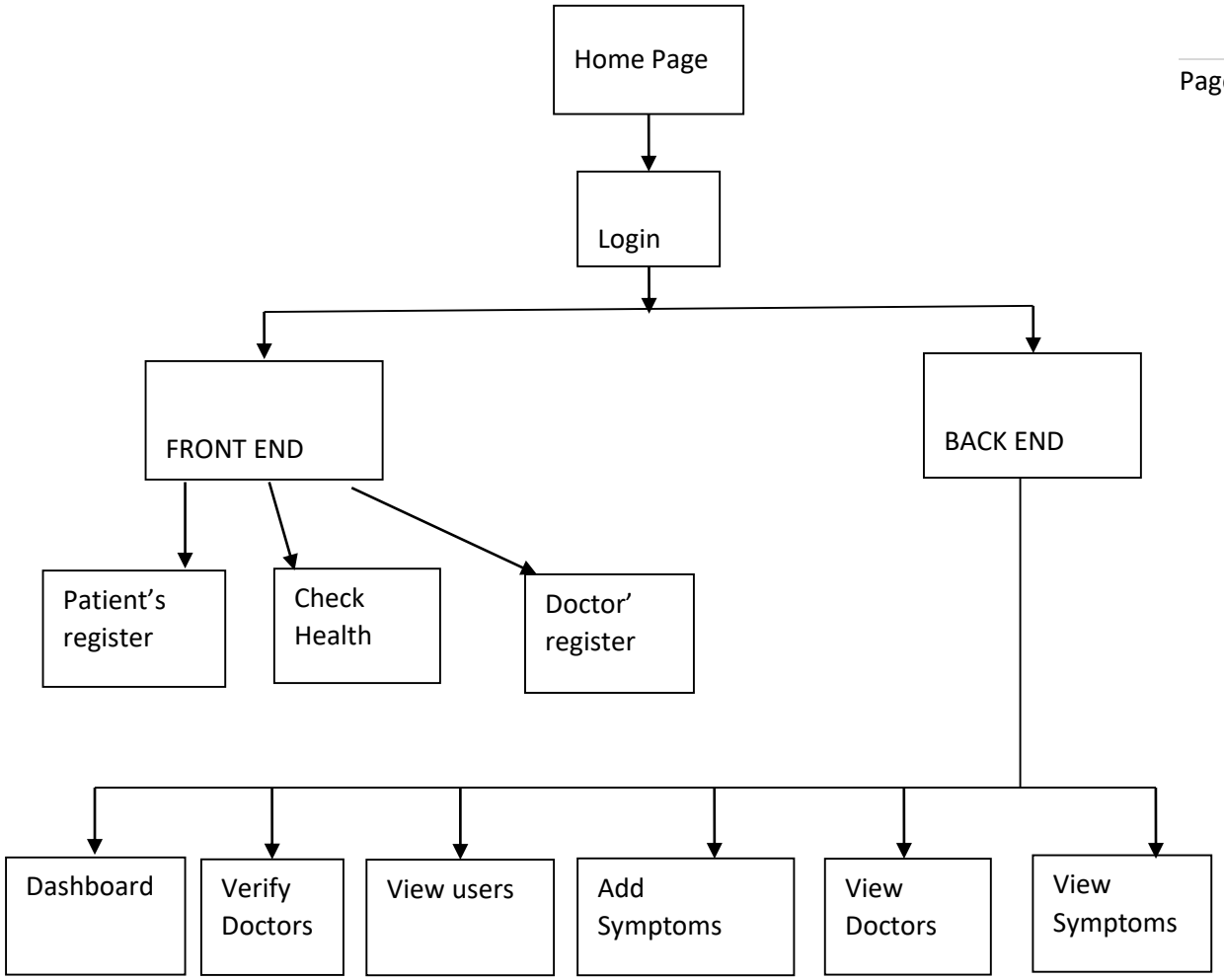

Figure 11: Top-down design of the system

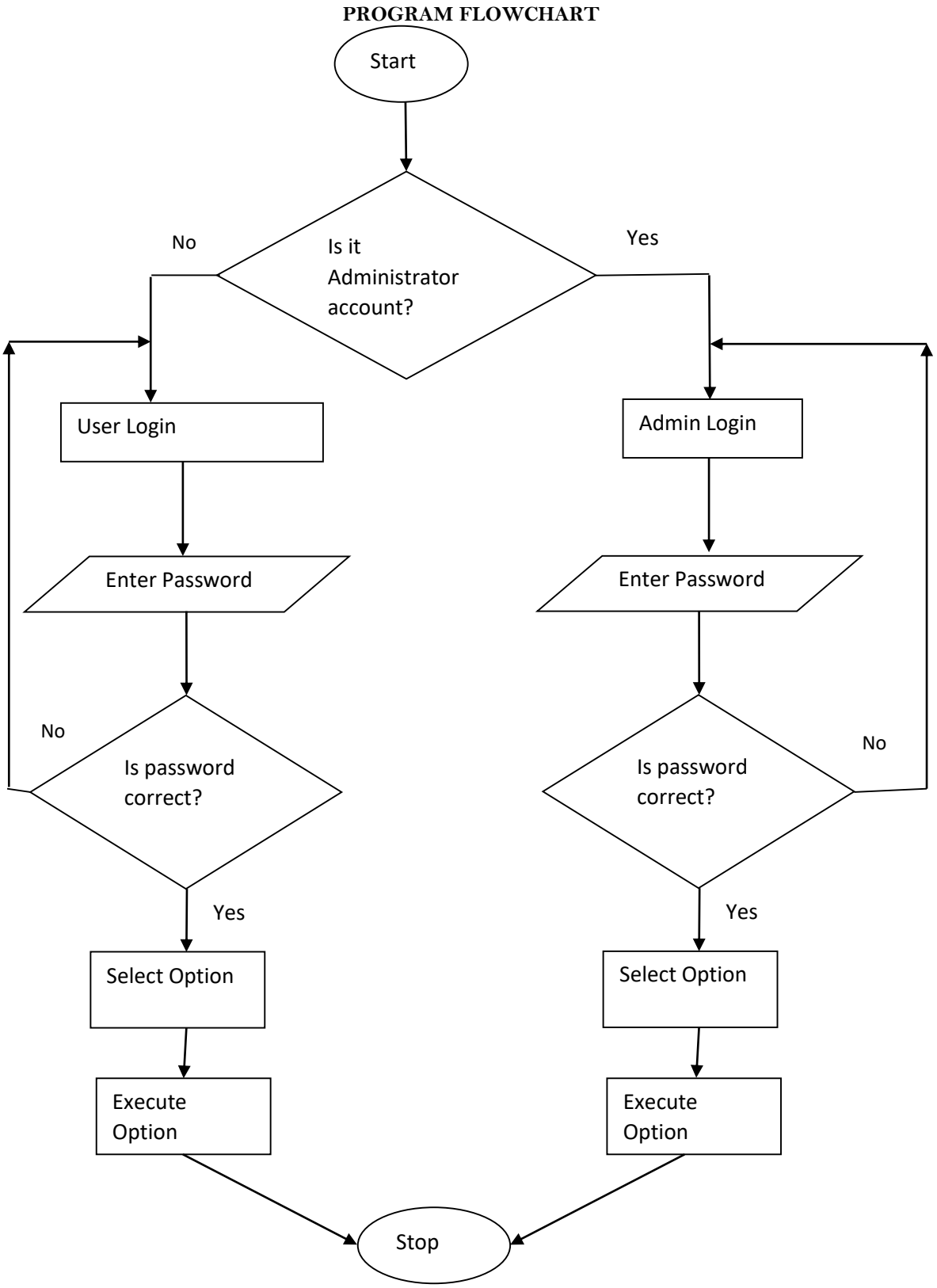

Figure 12: Program flowchart

USER'S FORM FLOWCHART

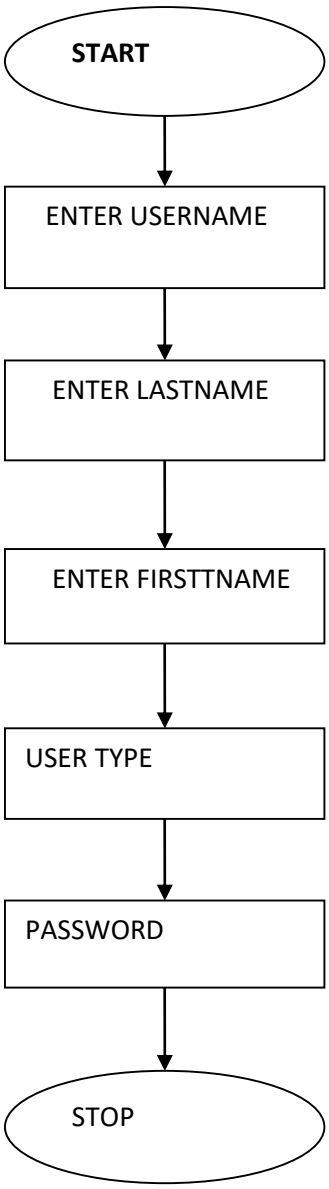

Fig 13: User's form flowchart

SYSTEM DOCUMENTATION AND IMPLEMENTATION

SYSTEM IMPLEMENTATION

The process of bringing a new system into operation is known as system implementation. It may also be seen as the precise manner in which the new system is designed to carry out its tasks by substituting it for the outdated one.

CHOICE OF PROGRAMMING LANGUAGE

The new system was developed using a high level programming language; PHP, HTML, MYSQL, CSS and JavaScript are used as the presentation

PHP: PHP (Hypertext Pre-processor) is a widely-used open source general- purpose scripting language that is especially suited for web development and can be embedded into HTML.

HTML: (Hypertext Mark-up Language) is the set of mark-up symbols or codes inserted in a file intended for display on a World Wide Web browser page.

MySQL : MySQL is an open source relational database management system. Information in a MySQL database is stored in the form of related tables.

CSS: Stands for Cascading Style Sheets. CSS describes how HTML elements are to be displayed on screen, paper, or in other media.

JavaScript: An object-oriented computer programming language commonly used to create interactive effects within web browsers.

PROPOSED SYSTEM REQUIREMENTS

To be used efficiently, all computer software needs certain hardware components or other software resources to be present on a computer. These prerequisites are known as computer system requirements and are often used as a guideline as opposed to an absolute rule. Most software defines two sets of system requirements: minimum and recommended. With increasing demand for higher processing power and resources in newer versions of software, system requirements tend to increase over time.

HARDWARE REQUIRMENT

Hardware is described as any physical component of a computer system that contains a circuit board, ICs, or other electronics devices. They are devices that can be touched for example RAM, Hard disk, Monitor, Mouse etc. Hardware requirement the new system is IBM compatible PC with the following specifications:

I. A minimum of Pentium 3 processor of not less than 758MHZ
II. Hard disk capacity of at least 2GB
III. A minimum of 256MB of RAM

SOFTWARE REQUIREMENTS

Software is a programs that contribute to the control and performance of the computer system fo**r** this work to be functional, software required to effectively run this program are:

- Window 7 and any higher version
- Web browser
- MYSQL database

SOFTWARE TESTING AND USER MANUAL

A. How to install the software

How to install the software – Ensure you have access to internet, then open software, type the username and password to access the software.

B. **Maintenance details**

This is a codified, in-depth document that contains the new system's design. It describes the approaches and procedures used to fix the flaws in the current system as outlined in the statement of issues.

The package may be reused in the future thanks to the documentation. The fundamental goal of documentation is to provide a thorough, comprehensive, and understandable record of the new system's made-of-program.

CHANGEOVER PLAN

The seamless transition from one method of doing things to another and the reduction of disturbance to company operations during the switch are key considerations in system changeover. Direct changeover, parallel running, and phased implementation are the three basic techniques employed.

- **Phased implementation:** an approach that involves modifying one aspect of the total system at a time. In the event that issues do develop, they are minor and not important. After one section of the system has been successfully altered, the other areas may do the same, using any lessons gained to assure the success of the switch as a whole.
- **Parallel running:** Project managers are able to assess the effectiveness and dependability of the new system by comparing how the old and new systems operate side by side while utilising real-time data. Once they are happy, the old system is shut down and the new one is fully operational and used across the whole business.
- **Direct changeover:** The transition from one system to the other one happens at a single, fixed moment. This method of system changeover is the cheapest, fastest, and simplest; nevertheless, it is also the riskiest since if the system is flawed or ineffective, the whole business will suffer.

SUMMARY CONCLUSION AND RECOMMENDATION

The Heart Disease Prediction System allows users to immediately provide information about the fundamental health risks to which they are exposed without disclosing any personal information. Both the rule-based Expert System and the deep learning technique were used to develop the primary system's two systems, which the user may choose to employ for prediction. When accuracy is taken into account, rule-based expert systems outperform deep learning systems because they make predictions based on previously established rules. However, a deep learning system is more effective than an expert system because it can learn on its own, while an expert system cannot, and because it can learn more accurately if it is taught on more data. Future versions of this system will exclusively be based on Deep Learning algorithms with enhanced features that allow for learning on enormous datasets. This is a current, effective learning technique that has applications across various industries. The third area for improvement is comparison research, which may be done between the expert system and deep learning system or with other AI techniques.

CONCLUSION

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.

RECOMMENDATION

In the light of our finding in the course of this research work, it may be pertinent to make the following recommendation:

I. The hardware and software to be used for the new system should satisfy the hardware and software requirements mentioned in chapter four, and should be in good efficient conditions to avoid unnecessary breakdown.
II. The computerization effort should gradually be extended to cover all forms of diseases.
III. The computerization effort should also gradually be extended to cover all operations and other forms of diagnoses in hospital/healthcare as indicated in the study.
IV. This project (application) is highly recommended for any medical organization, and the end-users/staff should be trained on how to use it, and is open to improvements. The pilot changeover method should be used in implementing this system.

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