Visualizing And Predicting Heart Diseases with An Interactive Dash Board

NALAIYA THIRAN PROJECT REPORT 2022

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Project Report

1. INTRODUCTION

1.1 Project Overview

Data analytics is considered as a cost-effective technology in the recent past and it plays an essential role in healthcare which includes new research findings, emergency situations and outbreaks of disease. The use of analytics in healthcare improves care by facilitating preventive care and EDA (Electronic Design Automation) is a vital step while analyzing data. In this project, the risk factors that causes heart disease is considered and predicted using K-means algorithm and the analysis is carried out using a publicly available data for heart disease. The dataset holds 209 records with 8 attributes such as age, chest pain type, blood pressure, blood glucose level, ECG in rest, heart rate and four types of chest pain. To predict the heart disease, K-means clustering algorithm is used along with data analytics and visualization tool. The project discusses the pre-processing methods, classifier performances and evaluation metrics. In the result section, the visualized data shows that the prediction is accurate.

1.2 PURPOSE

Healthcare industries generate enormous amount of data, so called big data that accommodates hidden knowledge or pattern for decision making. The huge volume of data is used to make decision which is more accurate than intuition. Exploratory Data Analysis (EDA) detects mistakes, finds appropriate data, checks assumptions and determines the correlation among the explanatory variables. In the context, EDA is considered as data that excludes inferences and statistical modeling .Analytics is an essential technique for any profession as it forecast the future and hidden pattern. Data analytics is considered as cost effective technology in the recent past and it plays an essential role in healthcare which includes new research findings, emergency situations and outbreaks of disease. The use of analytics in healthcare improves care by facilitating preventive care and EDA is a vital step while analysis data. In this paper, the risk factors that causes heart disease is considered and predicted using K-means algorithm and the analysis is carried out using a publicly available data for heart disease. The dataset holds 209 records with 8 attributes such as age, chest pain type, blood pressure, blood glucose level, ECG in rest, heart rate and four types of chest pain. To predict the heart disease, K-means clustering algorithm is used along with data analytics and visualization tool. The paper discusses the pre-processing methods, classifier performances and evaluation metrics. In the result section, the visualized data.

2. LITERATURE SURVEY

2.1 EXISTING PROBLEM

Bo Jin, Chao Che et al. (2018) proposed a “Predicting the Risk of Heart Fail network .This paper used the electronic health record (EHR) data from real-world datasets related to congestive heart disease to perform the experiment and predict the heart disease before itself. We tend to use done-hot encryption and word vectors to model the diagnosing events and foretold coronary failure events victimization the essential principles of an extended memory network model. By analyzing the results, we tend to reveal the importance of respecting the sequential nature of clinical records [1]. Numerous studies have been done that have focus on diagnosis of Numerous studies have been done that have focus on diagnosis of heart disease. They have applied different data mining techniques for diagnosis & achieved different probabilities for different methods. (Prasad, & Tech Scholar, 2017) proposed Prediction of Heart Disease using Multiple Regression Model and it proves that Multiple Linear Regression is appropriate for predicting heart disease chance. The work is performed using training data set consists of 3000 instances with 13 different attributes which has mentioned earlier. The data set is divided into two parts that is 70% of the data are used for training and 30% used for testing. (Seema, 2017) focuses on techniques that can predict chronic disease by mining the data containing in historical health records using Naïve Bay, Decision tree, Support Vector Machine (SVM) and Artificial.

2.2 REFERENCES

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2.3 PROBLEM STATEMENT DEFINATION

According to the World Health Organization, every year 12 million deaths occur worldwide due to Heart Disease. The load of cardiovascular disease is rapidly increasing all over the world The major challenge in heart disease is its detection. There are instruments available which can predict heart disease but either they are expensive or are not efficient to calculate chance of heart disease in human. Early detection of cardiac diseases can decrease the mortality rate and over all complications. However, it is not possible to monitor patients every day in all cases accurately and consultation of a patient for 24 hours by a doctor is not available since it requires more sapience, time and expertise. Since we have a good amount of data in today's world, we can use various machine learning algorithms to analyze the data for hidden patterns. The hidden patterns can be used for health diagnosis in medicinal data. Heart disease can be managed effectively with a combination of lifestyle changes, medicine and, in some cases, surgery. With the right treatment, the symptoms of heart disease can be reduced and the functioning of the heart improved. The predicted results can be used to prevent and thus reduce cost for surgical treatment and other expensive .The overall objective of my work will be to predict accurately with few tests and attributes the presence of heart disease. Attributes considered form the primary basis for tests and give accurate results more or less. Many more input attributes can be taken but our goal is to predict with few attributes and faster efficiency the risk of having heart disease.

3. IDENTION PROPOSED SOLUTION

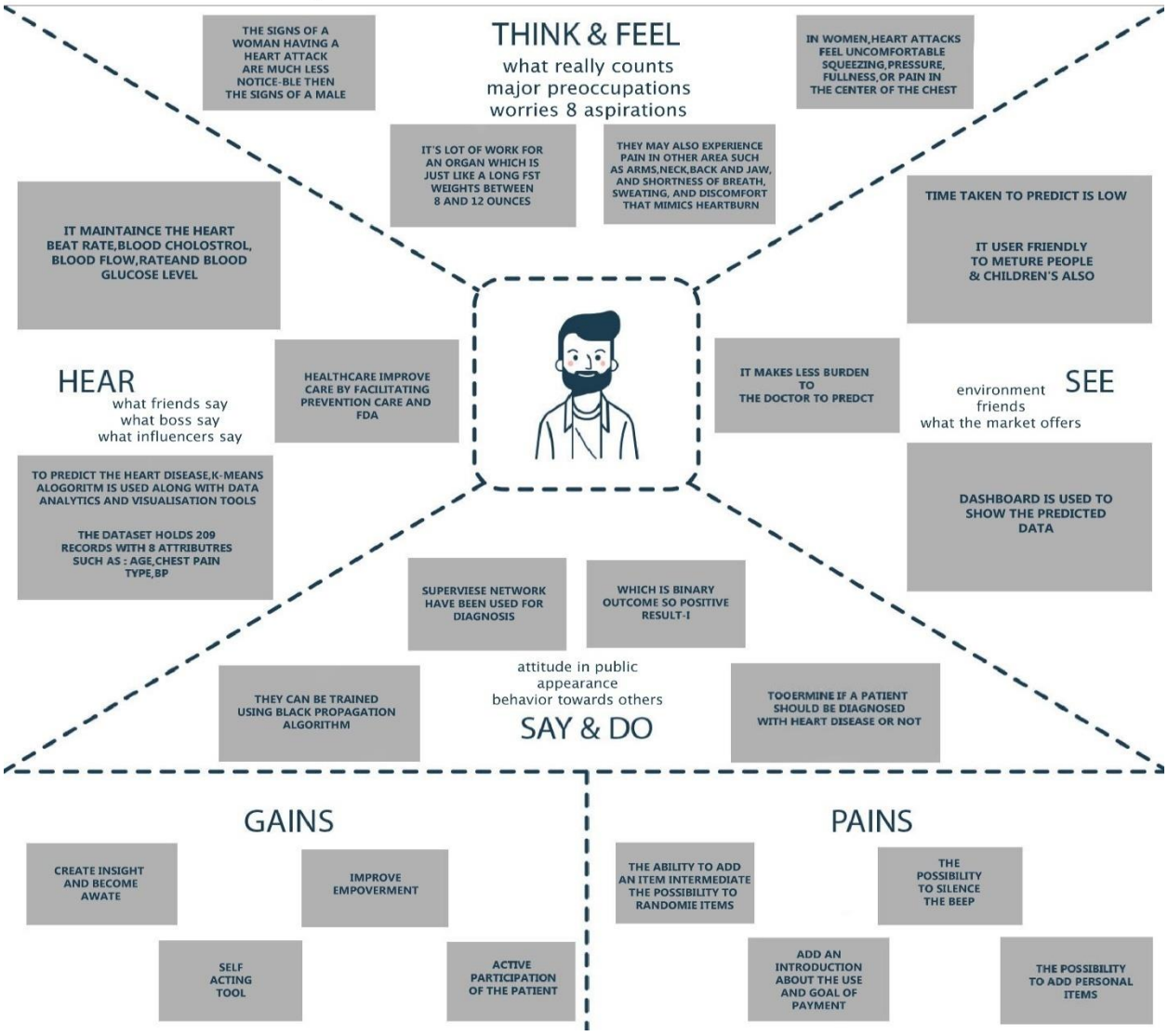
3.1 EMPATHY MAP

An empathy map is a collaborative tool teams can use to gain a deeper insight into their customers. Much like a user persona, an empathy map can represent a group of users, such as a customer segment. The empathy map was originally created by Dave Gray and has gained much popularity within the agile community. An Empathy Map consists of four quadrants. The four quadrants reflect four key traits, which the user demonstrated/possessed during the observation/research stage**.** The four quadrants refer to what the user: Said, Did, Thought, and Felt. It's fairly easy to determine what the user said and did Each of the four quadrants comprises a category that helps us delve into the mind of the user. The four empathy map quadrants look at what the user says, thinks, feels, and does. This section contains direct quotes from the user that have been gathered from the research phase or previous data. It might feature statements like “I need something fast,” or “I’m not sure where to go from here.” Thinks While this quadrant may have similar content to the “Says” section, it is more focused on what a user is thinking and doesn’t choose to say out loud. Use your qualitative research to ask what matters to the user and what is on their mind. Looking at why they might be hesitant to share their thoughts out loud can reveal even further insight into the user and how they relate to the product or experience at hand.

Empathy Map

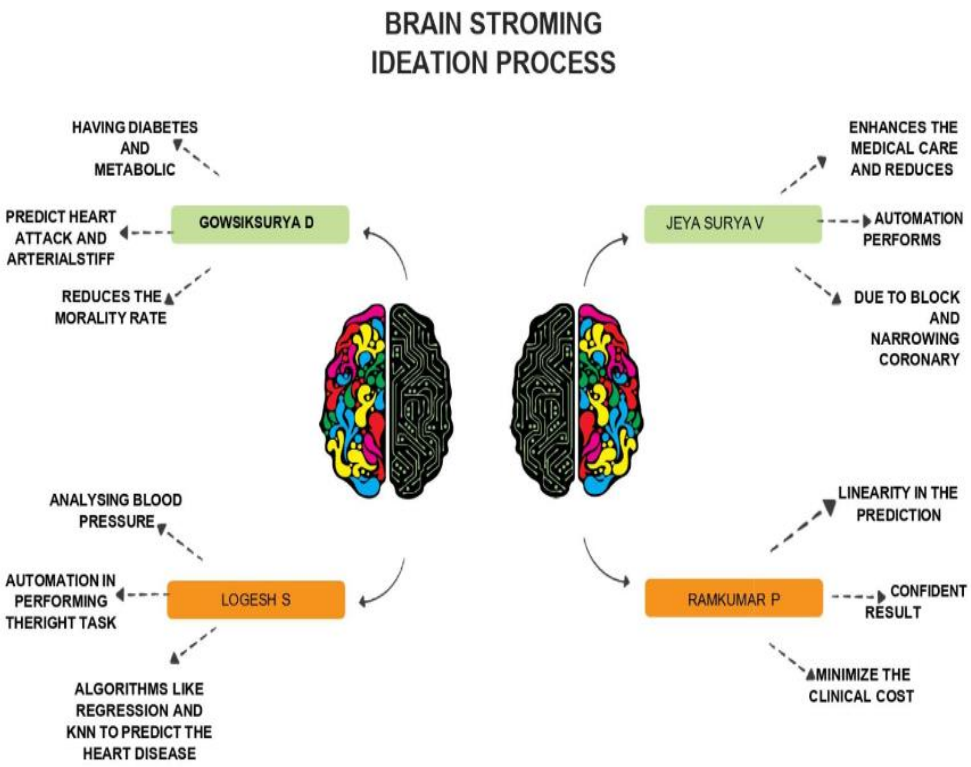
PROJECT NAME :

Visualizing and Predicting Heart Diseases with an Interactive Dash Board



3.2 IDEATION & BRAINSTORMING

Brainstorming is a group creativity technique by which efforts are made to find a conclusion for a specific problem by gathering a list of ideas spontaneously contributed by its members. Brainstorming is a group problem-solving method that involves the spontaneous contribution of creative ideas and solutions. This technique requires intensive, freewheeling discussion in which every member of the group is encouraged to think aloud and suggest as many ideas as possible based on their diverse knowledge.



3.4 PROPOSED SOLUTION

 Solve complex problems in a way that fits the state of your customers.

 Succeed faster and increase your solution adoption by tapping into existing mediums and

customer behavior.

 Sharpen your communication and marketing strategy with the right triggers and messaging.

 Increase touch points with your company by finding the right problem-behavior fit and build trust,

solving frequent annoyances or urgent / costly problems.

 Based on Lean Startup, Design Thinking, Lazy User Model (LUM) principles and fundamentals of User

Experience design.

 Understand existing situation to design for improvement.

There are various application areas that are not established yet and for which new ideas and models are presently under development and evaluation. These are domains in which the possibility of rapidly building new applications is essential and strategic from a practical point of view. Examples of application domains that can be classified in this category include Web-based Education, electronic commerce, biology, and financial market. An interesting strategy for developing new applications for these domains is the development of object-oriented application frameworks [10, 13]. Frameworks can reduce the

costs of developing applications since it allows designers and implementers to reuse their previous experience with problem solving at the design and code levels. Prior research has shown that high levels of software reuse can be achieved through the use of object oriented frameworks. An object-oriented framework captures the common aspects of a family of applications, which can be seen as a domain theory [19]. The approach to framework design is based on the idea that any design can be divided into two parts: the kernel sub-system design and the hot-spot sub-system design. The kernel sub-system design is common to all the applications that the framework may generate, and the hot-spot sub-system design describes the different characteristics of each application that can be supported by the framework. The hot-spot sub-system uses the method and the information provided by the kernel sub-system and may extend it. The kernel structure is defined by analyzing the viewpoints design representations to produce a resulting design representation that reflects a structure that is common to all chosen viewpoints. This part of the design approach is based on a domain-dependent semantic analysis of the design diagrams to elicit the common features of the framework design structure, and is formally described in this dissertation. The elements that are not in the kernel are the ones that vary for each application, and depend on the use of the framework. These elements define the framework hot-spots [17, 20] that must be adapted to each related application. We defined new relationship in object-oriented design, called the hot-spot relationship, to specify all the hot-spots in the system. The semantics of this new relationship is given by the design patterns essentials [18].

3.4 PROBLEM SOLUTION FIT

 Solve complex problems in a way that fits the state of your customers.

 Succeed faster and increase your solution adoption by tapping into existing mediums and

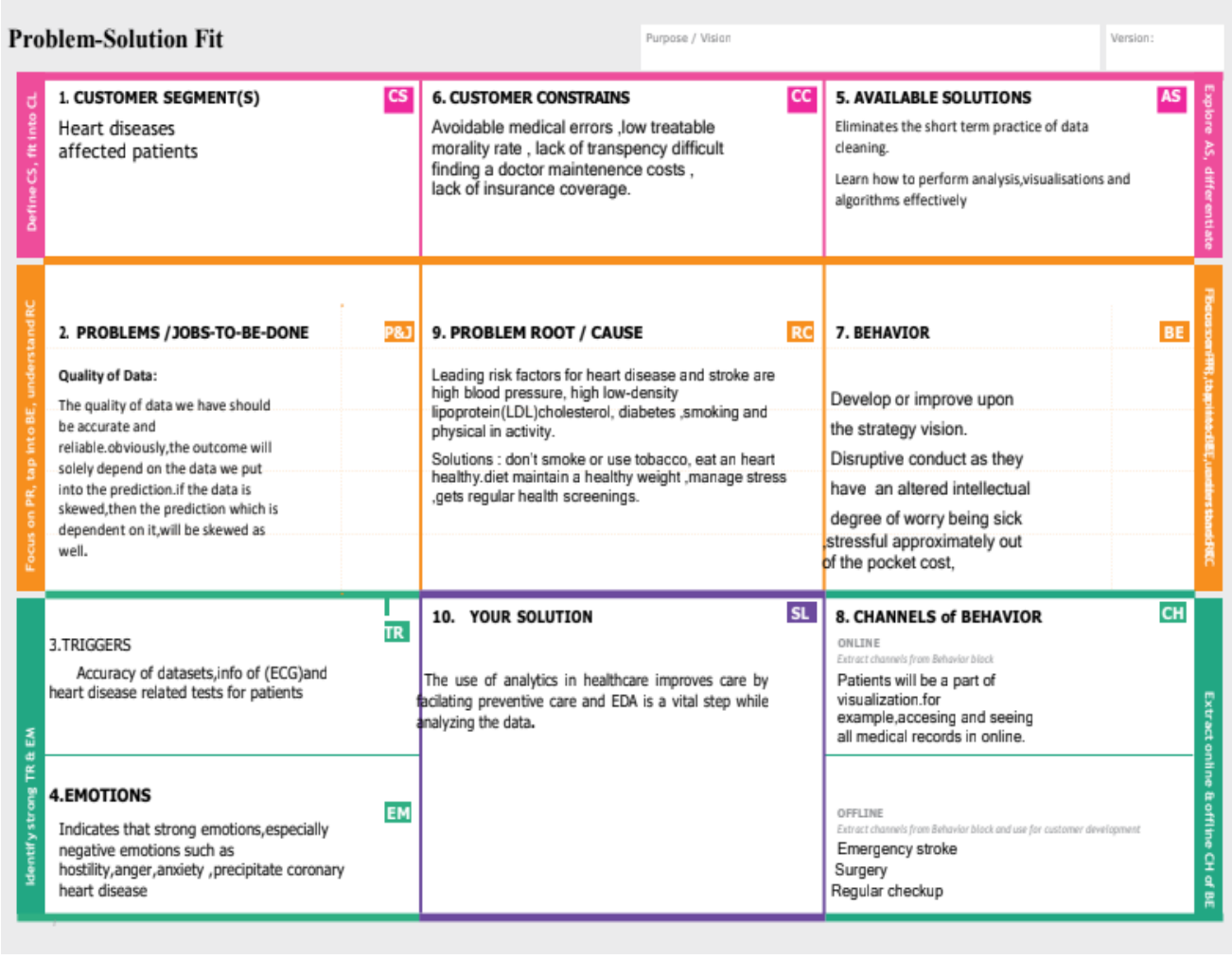
customer behavior.

 Sharpen your communication and marketing strategy with the right triggers and messaging.

 Increase touch points with your company by finding the right problem-behavior fit and build trust.

Steve Blank suggests a process to place aside to product development, which aims to discover and validate the right market for an idea [2]. The first part of the discovery consists of finding problem/solution fit. The aim is to test the riskiest hypotheses of the problem taken in consideration by implementing a first solution. The second step is to build the right product features that solve real customers' needs, also known as the product/market fit. If the product/market-fit is not achieved, then a problem/solution-fit must be reiterated, an operation known as pivoting. Ash Maurya provides a simpler perspective of which to understand problem/solution-fit versus product/market-fit [10]. He suggests one has reached problem/solution-fit when the answer is yes to the following: "Do I have a problem worth solving?". This implies answering three underlying questions: "Is it something customers want?" or is it a must-have solution, "Will they pay for it?" or is it viable,

and lastly, “can it be solved?” or is it feasible. Besides getting confirmation on these three question, Maurya suggests that the goal of the Problem/solution fit stage is to derive a minimum feature set in which to launch a minimum viable product, an MVP, which is to be the subject of learning and iterated upon toward solving the customer’s confirmed problem The terms of problem/solution fit are slightly fuzzy and originally not well defined. In this article, the simpler definition made by Maurya will be used as a reference



4. REQUIREMENT ANALYSIS

SOLUTION REQUIREMENT

System requirements are the configuration that a system must have in order for a hardware or software application to run smoothly and efficiently. Failure to meet these requirements can result in installation problems or performance problems

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 system requirements and are often used as a guideline as opposed to an absolute rule.

A software requirements specification (SRS) includes in-depth descriptions of the software that will be developed. A system requirements specification collects information on the requirements for a system. “Software” and “system” are sometimes used interchangeably as SRS.

Solution requirement are in two types

They are,

1. Functional requirement.
2. Non-Functional requirement.

4.1 FUNCTIONAL REQUIREMENT

Functional requirements may involve calculations, technical details, data manipulation and processing, and other specific functionality that define what a system is supposed to accomplish**.** Behavioral requirements describe all the cases where the system uses the functional requirements, these are captured in use cases. The Functional Requirements Specification is designed to be read by a general audience. Readers should understand the system, but no particular technical knowledge should be required to understand the document Functional requirements should include functions performed by specific screens, outlines of work-flows performed by the system, and other business or compliance requirements the system must meet. Depending on the system being described, different categories of requirements are appropriate. System Owners, Key End-Users, Developers, Engineers, and Quality Assurance should all participate in the requirement gathering process, as appropriate to the system. Requirements outlined in the Functional Requirements Specification are usually tested in the Operational Qualification. The Functional Requirements Specification describes what the system must do; how the system does it is described in the Design Specification. If a User Requirement Specification was written, all requirements outlined in the User Requirement Specification should be addressed in the Functional Requirements Specification. The Functional Requirements Specification should be signed by the System Owner and Quality Assurance. If key end-users, developers, or engineers were involved with

developing the requirements, it may be.

S.no.	Functional Requirement (Epic)	Sub Requirement (Story / Sub-Task)
1.	 User Registration	Registrations can be done using Email
2.	 User Confirmation	Registration Confirmation can be sent through E-mail.
3.	 Visualizing Data	Visualize the presence of heart disease through Dashboard created using IBM Cognos Analytics.
4.	 Generation Report	View and generate report.

4.2 NON-FUNCTIONAL REQUIREMENT

Well-written functional requirements typically have the following characteristics: Necessary. Although functional requirements may have different priority, every one of them needs to relate to a particular business goal or user requirement. Concise.

Non-functional requirements or NFRs are a set of specifications that describe the system's operation capabilities and constraints and attempt to improve its functionality. These are basically the requirements that outline how well it will operate including things like speed, security, reliability, data integrity, etc Both functional and non-functional requirements describe specific characteristics that a product must have to meet the needs of the stakeholders and the business itself. But, as you can tell from the name, they focus on different things. Performance defines how fast a software system or a particular piece of it responds to certain users' actions under a certain workload. In most cases, this metric explains how long a user must wait before the target operation happens (the page renders, a transaction is processed, etc.) given the overall number of users at the moment. But it's not always like that. Performance requirements may describe background processes invisible to users, e.g. backup. But let's focus on user-centric performance.

S.no.	Non-Functional Requirement	Description
1.	 **Usability**	Simple User Interface with easy understanding.
2.	 **Security**	Maintain a secondary/backup dataset User reports are kept safely and remove false data set.
3.	 **Reliability**	Must work without error or minimum error and able to work with various data set
4.	 **Performance**	Depending on the error metrics we have to choose an algorithm with high response time.
5.	 **Availability**	It is based on the IBM cognos analytics so it should be available to all time.
6.	 **Scalability**	Should handle a high number of request at same time and large datasets.

5. PROJECT DESIGN

A Data Flow Diagram (DFD) is a traditional visual representation of the information flows within a system. A neat and clear DFD can depict the right amount of the system requirement graphically.

It shows how data enters and leaves the system, what changes the information, and where data is stored.

It illustrates what kinds of data will be input and output from the system, where the data will come from and go to, and where the data will be stored. A DFD is often an elaboration of a context diagram to show some of the detail of the system that was first illustrated through the context diagram.

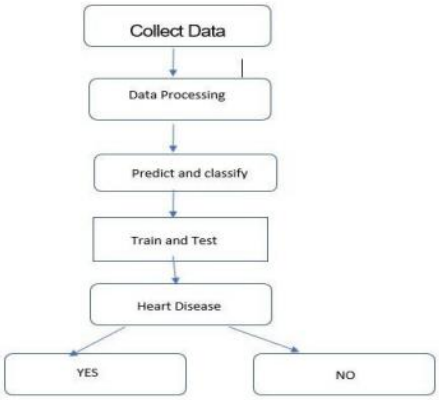
The detailed design report is prepared by the lead consultant for the client at the end of the detailed design stage, when the design is detailed but has yet to be packaged. The detailed design report might include: A design and access statement. Site layout plans. Functional layouts

Mention the outline of the report, give context and mention the scope and methodologies used in the report. Body - This is the lengthy section of the report as it contains background details, analysis, data, and graphics. Conclusion - This section brings the entire project report together.

The design process is a tool that helps you break down large projects into smaller, easier-to handle stages. It's prominent in engineering, architecture, and manufacturing because it helps companies deliver finished solutions that helps.

5. PROJECT DESIGN DIGRAM

Data Flow Diagram for Heart Disease Prediction Dashboard:



5.2 SOLUTION & TECHNICAL ARCHITECTURE

A solution architecture (SA) is an architectural description of a specific solution. SAs combine guidance from different enterprise architecture viewpoints (business, information and technical), as well as from the enterprise solution architecture (ESA). Solution architecture is a practice to provide ground for software development projects by tailoring IT solutions to specific business needs and defining their functional requirements and stages of implementation. It is comprised of many sub processes that draw guidance from various enterprise architecture viewpoints. Prepare and document testing requirements. Identify areas where IT can support business needs and goals. Work with business units to develop IT strategies and to improve current IT implementations. Build and migrate software and services across the organization. Solution architecture is the practice of designing, describing, and managing solution engineering to match it with specific business problems. For example, protecting customer data under GD and other privacy regulations is a business-level problem. Solution architecture defines how those requirements would translate into the way a given software is in charge of leading the practice and introducing the overall technical vision for a particular solution. While the practice can be managed in-house, there are companies that provide solution architecture consulting as a specific set of services.

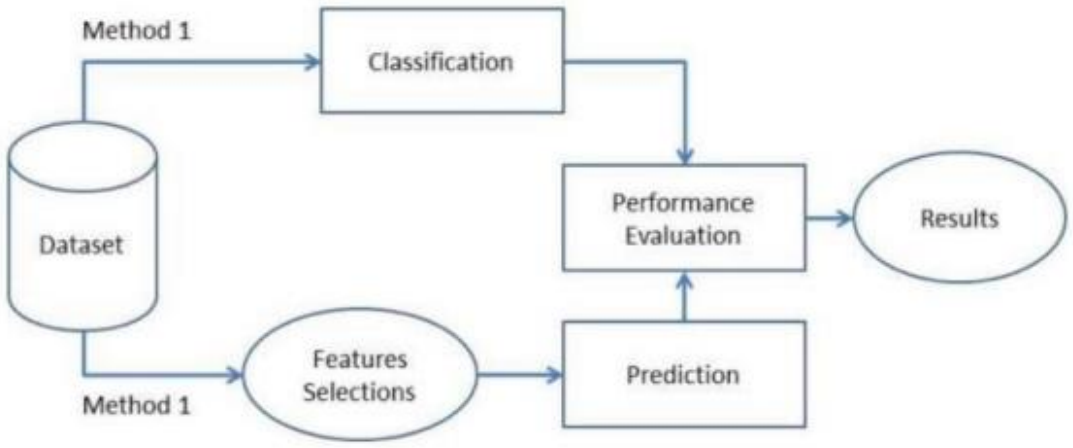

Method 1
Classification
Dataset
Performance Evaluation
Results
Features Selections
Prediction
Method 1

Table-1: Component & Technologies:

S.No	Component	Description	Technologies
1	User Interface	How user interacts with application e.g. Web UI, Mobile App, Chatbot etc.	HTML, CSS, JavaScript, React JS
2	Application Logic	Logic for a process in the application	Python
3	Database	Data Type, Configurations etc.	MySQL
4	Cloud Database	Database Service on Cloud	IBM DB2
5	File Storage	File storage requirements	IBM Block Storage or Other Storage Service or Local Filesystem
6	Machine Learning Model	To train and test the model for prediction	k-means, Decision Tree, Naïve Bayes
7	Infrastructure (server/cloud)	Application Deployment on Local System / Cloud Local Server Configuration: Cloud Server Configuration	Local, Cloud Foundry

Lets start with the main concerns within agile solution architecture: Problem domain definition. Pattern encapsulation. Enterprise architecture integration. Prepare and document testing requirements. Identify areas where IT can support business needs and goals. Work with business units to develop IT strategies and to improve current IT implementations. Build and migrate software and services across the organization.

Table-2: Application Characteristics:

S. No	Characteristics	Descriptions	Technology
1	Open-Source Framework	List the open-source frameworks used	IBM Cognos Analytics
2	Security Implementation	List all the security / access controls implemented, use of firewalls etc.	Security provided by cloud
3	Scalable Architecture	Justify the scalability of architecture (3 – tier, Micro-services)	IBM Cognos Analytics
4	Availability	Justify the availability of application (e.g. use of load balancers, distributed servers etc.)	IBM Cloud Service
5	Performance	Design consideration for the performance of the application	Reliable Data Classification Models

Your application needs to provide some sort of value to your user Engagement. In fact, you want your users to find value in your application over and over again. User Experience& Design. Stability & Updates.

5.3 USER STORIES

A second way of adding detail to a story is to add notes about what the story must do in order for the product owner to accept it as complete. For now, we can refer to these as the acceptance criteria for the story. User stories describe the why and the what behind the day-to-day work of development team members, often expressed as persona + need + purpose. Understanding their role as the source of truth for what your team is delivering, but also why, is key to a smooth process. A user story is a small, self-contained unit of development work designed to accomplish a specific goal within a product. A user story is usually written from the user's perspective and follows the format: “As [a user persona], I want [to perform this action] so that [I can accomplish this goal].” A user story should be written with the minimum amount of detail necessary to fully encapsulate the value that the feature is meant to deliver. Any specifications that have arisen out of conversations with the business thus far can be recorded as part of the acceptance criteria The most important part is the conversation! This is key because it is so frequently overlooked. A user story is not documentation of the requirements but rather a representation of the requirement. "User stories are written with too much detail" might at first sound like an oxymoron—you can’t be too rich, too thin, or have too much detail on a product backlog item. Except it is entirely possible to have too much detail in product backlog items. When excessive detail is included, the time and money spent adding the unnecessary detail is wasted. Telling my grocery shopper to find apples that were three inches in diameter would have been a waste of my time and the shopper’s, unless there was some rare circumstance that truly required apples of precisely that diameter.

Use the below template to list all the user stories for the product.

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Customer (Mobile user)	Registration	USN-1	As a user, I can register for the application by entering my email, password, and confirming my password.	I can access my account / dashboard	High	Sprint-1
		USN-2	As a user, I will receive confirmation email once I have registered for the application	I can receive confirmation email & click confirm	High	Sprint-1
		USN-3	As a user, I can register for the application through Gmail	I can receive conformation email	Medium	Sprint-1
Customer (Web user)	Login	USN-4	As a user, I can log into the application by entering email & password	I can access my account using my details	High	Sprint-1
	Dashboard	USN-5	User can view his/her complete medical analysis and accuracy of disease prediction	I can view my medical analysis and accuracy	High	Sprint-2
	Dashboard	USN-6	User can view the accuracy of occurrence of heart disease through report generation	I can view the accuracy of heart disease in the dashboard	high	Sprint-2

User Type	Functional Requirement (Epic)	User Story Number	User Story / Task	Acceptance criteria	Priority	Release
Administrator	User profile	USN-9	As an admin, he/she can update the health details of users.	I can view my updated health details	High	Sprint-4
		USN-10	As an admin, he/she can add or delete users.	I can access my account / Dashboard when logged in	High	Sprint-4
		USN-11	As an admin, he/she can manage the user details.	I can view the organized data of myself.	High	Sprint-4

A user story is an informal, general explanation of a software feature written from the perspective of the end user or customer. The purpose of a user story is to articulate how a piece of work will deliver a particular value back to the customer A user story is a small, self-contained unit of development work designed to accomplish a specific goal within a product. A user story is usually written from the user's perspective and follows the format: “As [a user persona], I want [to perform this action] so that [I can accomplish this goal].”

10. ADVANTAGE

- The system uses 15 medical parameters such as age, sex, blood pressure, cholesterol, and obesity for prediction.
- The EHDPS predicts the likelihood of patients getting heart disease. It enables significant knowledge, relationships between medical factors related to heart disease and patterns, to be established.
- The proposed work predicts the chances of Heart Disease and classifies patient's risk level by implementing different data mining techniques such as Naive Bayes, Decision Tree, Logistic Regression and Random Forest
- A test called an echocardiogram is often the best test to diagnose your heart failure. Your doctor can also use this test to find out why you have heart failure, and then monitor your condition going forward every three to six months.

- User can search for doctor’s help at any point of time.
- User can talk about their Heart Disease and get instant diagnosis.
- Doctors get more clients online.
- Very useful in case of emergency.

DISADVANTAGES

- Prediction of cardiovascular disease results is not accurate. International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056. ...
- Data mining techniques does not help to provide effective decision making.
- An electrocardiogram (ECG) – this records the electrical activity of your heart to check for problems. an echocardiogram – a type of ultrasound scan where sound waves are used to examine your heart.
- A test called an echocardiogram is often the best test to diagnose your heart failure. Your doctor can also use this test to find out why you have heart failure, and then monitor your condition going forward every three to six months.
- Those with heart failure can develop swelling, dizziness, and other symptoms that can affect their ability to complete daily tasks.
- A person with diagnosed heart disease must also live with the stress of knowing they have a long-term illness that could result in a cardiac event, such as heart attack or stroke.

11.CONCLUSION

This Heart Disease detection system assists a patient based on his/her clinical information of them been diagnosed with a previous heart disease. The algorithms used in building the given model are Logistic regression, Random Forest Classifier and KNN. The accuracy of our model is 87.5.Heartdisease is one of the biggest causes of morbidity and mortality among the population of the world. Prediction of cardiovascular disease is regarded as one of the most important subjects in the section of clinical data analysis. The amount of data in the healthcare industry is huge Thus, the smart healthcare model with Io T-assisted fog computing has attained promising performance. In the future, the suggested model could be extended by using more advanced feature selection algorithms, optimization techniques, and classification algorithms to improve the efficiency of the predictive system for the diagnosis of heart disease. This model can also be deployed in real-time applications. Nowadays, humans face various diseases due to the current environmental condition and their living habits. The identification and prediction of such diseases at their earlier stages are much important, so as to prevent the extremity of it.**7** Examples of predictive analytics in healthcare

FUTURE SCOPE

The objective of this project is to check whether the patient is likely to be diagnosed with any cardiovascular heart diseases based on their medical attributes such as gender, age, chest pain, fasting sugar level, etc.Conditions that fall within the scope of heart disease include cardiac arrhythmias, high blood pressure, heart failure, coronary artery disease, valve disorders, and congenital heart defects, among others. Heart disease is the leading causing of death in the United States, responsible for 1 in 4 deaths every year, reports the CDC. Almost 6 million Americans currently have heart failure, a figure that is expected to increase 46 percent, to 8 million, by 2030.Having either high LDL cholesterol (“bad” cholesterol) or low HDL cholesterol (“good” cholesterol)—or both—is one of the best predictors of your risk of heart disease. A blood lipid profile measures both your cholesterol numbers and your triglycerides, another type of fat in the blood that is a risk factor. Scientists have developed a blood test that can predict whether someone is at high risk of a heart attack, stroke, heart failure or dying from one of these conditions within the next four years. The test, which relies of measurements of proteins in the blood, has roughly twice the accuracy of existing risk scores.