**eHeart Disease Prediction System**

***A Mini Project-II Report submitted***

***in partial fulfillment of the requirements***

***for the award of the degree of***

**BACHELOR OF TECHNOLOGY**

***In***

**COMPUTER SCIENCE & ENGINEERING**

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**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**

**SHRI VISHNU ENGINEERING COLLEGE FOR WOMEN(A)**

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**BHIMAVARAM – 534 202**

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**CERTIFICATE**

*This is to certify that the Mini Project-II entitled “****Heart disease prediction****”, is being submitted by* Atukuri Sai Venkata Sucharita*,* Devanaboina Tejaswi Sri Lakshmi Bhavani, Adidamu Sowmya, Balla Ramya *bearing* *the* ***Regd. No. 18B01A0503,18B01A0514***, ***18B01A0501,*** **19B05A0501** *in partial fulfillment of the requirements for the award of the degree of “****Bachelor of Technology*** *in* ***Computer Science & Engineering****” is a record of bonafide work carried out by her under my guidance and supervision during the academic year* **2020 – 2021** *and it has been found worthy of acceptance according to the requirements of the university.*

**Internal Guide Head of the department**

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* 1. Introduction to Java/Python/ Any language
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  3. Introduction to Oracle/MySQL

**1.Introduction**

Heart is one such organ which pumps blood throughout the body and if it does not do so, the human body can have fatal circumstances. Heart diseases have become a major concern to deal with as studies show that the number of deaths due to heart diseases have increased significantly over the past few decades in India, in fact it has become the leading cause of death in India.

Early detection and treatment of several heart diseases is very complex, especially in developing countries, because of the lack of diagnostic centers and qualified doctors and other resources that affect the accurate prognosis of heart disease. Thus, preventing Heart diseases has become more than necessary. Identification of any heart related illness at primary stage can reduce the death risk.

Good data-driven systems for predicting heart diseases can improve the entire research and prevention process, making sure that more people can live healthy lives. With this concern, in recent times computer technology and machine learning techniques are being used to make medical aid software as a support system for early diagnosis of heart disease.

This is where Machine Learning comes into play. Machine Learning helps in predicting the Heart diseases, and the predictions made are quite accurate. Various ML techniques are used in medical data to understand the pattern of data and making prediction from them. Healthcare data are generally massive in volumes and complex in structure.

ML algorithms are capable to handle the big data and mine them to find the meaningful information. Machine Learning can play an essential role in predicting presence/absence of Locomotor disorders, Heart diseases and more. Such information, if predicted well in advance, can encourage cardiologists in taking quicker actions so more patients can get medicines within a shorter timeframe, thus saving large number of lives.

We have four main types of Machine learning Methods based on the kind of learning we expect from the algorithms: Here we going to use supervised machine learning algorithm.

**Supervised learning** is the types of machine learning in which machines are trained using well "labelled" training data, and on basis of that data, machines predict the output. The labelled data means some input data is already tagged with the correct output. In supervised learning, the training data provided to the machines work as the supervisor that teaches the machines to predict the output correctly. It applies the same concept as a student learns in the supervision of the teacher.

Supervised learning is a process of providing input data as well as correct output data to the machine learning model. The aim of a supervised learning algorithm is to **find a mapping function to map the input variable(x) with the output variable(y).**In the real-world, supervised learning can be used for **Risk Assessment, Image classification, Fraud Detection, heart disease prediction, spam filtering**, etc.

In supervised learning, models are trained using labelled dataset, where the model learns about each type of data. Once the training process is completed, the model is tested on the basis of test data, and then it predicts the output.

Supervised learning can be further divided into two types of problems: **1Regression:** Regression algorithms are used if there is a relationship between the input variable and the output variable. It is used for the prediction of continuous variables, such as Weather forecasting, Market Trends, etc. **2. Classification:** Classification algorithms are used when the output variable is categorical, which means there are two classes such as Yes-No, Male-Female, True-false, etc.

So, in our project Machine learning (ML) plays a significant role in heart disease prediction. It predicts whether the patient has a heart disease or not based on an efficient learning technique. Here, we are utilizing supervised learning techniques for predicting the early stage of heart disease. Now we are going to use some supervised machine learning algorithms such as a Logistic regression and k-nearest neighbor (KNN), algorithms to classify whether the people tested belong to the class of heart disease or healthy people.

In modern days, Machine learning algorithms are being the solution for different medical fields, for this case also we can use machine learning algorithms to predict the heart diseases. Here we are going to compare the accuracy of different machine learning technique over “heart.csv” dataset and conclude which algorithm gives the best result.

And we also will use Streamlit. Streamlit is an open source python library. It is used to create and share data web apps.

**2. System Analysis**

* 1. Existing system
  2. Proposed system
  3. Feasibility study
  4. **Existing system:**

Very few systems use the available clinical data for prediction purpose.

Diagnosis solely depends upon the doctors intuition and patients records.

Practical use of various collected data is time consuming.

**Drawbacks:**

It is time consuming and need a cardiac specialist.

It is not more accurate.

* 1. **Proposed system:**

Cardiovascular disease (CVD) is increasing rapidly in the modern world. Millions of people die due to cardiovascular disease. The diagnosis of heart disease is a challenging task. The project aims to determine whether a person is diagnosed with a heart disease or not. We are implementing different machine learning classification algorithms to predict heart disease.

After evaluating the results from the existing methodologies, we have used python and pandas operations to perform heart disease classification for the data obtained from the UCI repository. It provides an easy-to-use visual representation of the dataset, working environment and building the predictive analytics. ML process starts from a preprocessing data phase followed by feature selection based on data cleaning, classification of modelling performance evaluation.

**2.3 FEASIBILITY STUDY:**

Generally, the feasibility study is used for determining the resource cost, benefits and whether the proposed system is feasible with respect to the organization. The proposed system feasibility could be as follows. There are six types of feasibility which are equally important are:

* Technical feasibility
* Economic feasibility
* Behavioural feasibility

**Technical Feasibility**

Technical feasibility deals with the existing technology, software and hardware requirements for the proposed system. The proposed system “Hand Gesture Detection” is planned to run on phyton. Thus, the project is considered technically feasible for the development. The work for the project can be done with current equipment, existing software technology and available personnel. Hence the proposed system is technically feasible.

**Economic Feasibility**

This method is most frequently used for evaluating the effectiveness of a python. It is also called as benefit analysis. In this project “Hand Gesture Detection” is developed on current equipment, existing software technology. Since the required hardware and software for developing the system is already available in the organization, it does not cost must developing the proposed system.

**Behavioural Feasibility**

This project has been implemented by phyton and it satisfies all conditions and norms of the organization and the users. This proposed system “Hand Gesture Detection” Application has much behavioural feasibility because users are provided with a better facility.

**3. System Requirements Specification:**

3.1 Software Requirements

3.2 Hardware Requirements

3.3 Functional Requirements

**3.1 Software Requirements:**

Google colab

Language: Python

Tools: Pycharm

**3.2 Hardware Requirements:**

Processor: I3

RAM: 4GB

Space on Hard Disk: 1TB

**3.3 Functional Requirements:**

Functional requirements are the requirements which deals with the operational

requirements of the system and the requirements that are requested by the user.

**NON-FUNCTIONAL REQUIREMENTS**

A non-functional requirement specifies the process that can be used to check the

operations of a system. They are contrasted with the functional requirements that define

specific behaviour or functions. The plan for implementing non-functional requirements is

detailed in the system architecture, because they are usually architecturally significant

requirements.

Some of them are,

* Robustness to cope with errors during execution and cope with erroneous input.
* Performance which tells us whether the input is valid or not and obtained output.
* The cost should be less when compared to the existing system.
* The system acts as platform independent.
* The system is secured.

1. **System Design**

4.1 Introduction

4.2 UML Diagrams

**4.1 Introduction:**

System design is the process of designing the elements of a system such as the architecture, modules and components, the different interfaces of those components and the data that goes through that system.

System Analysis is the process that decomposes a system into its component pieces for the purpose of defining how well those components interact to accomplish the set requirements. The purpose of the System Design process is to provide sufficient detailed data and information about the system and its system elements to enable the implementation consistent with architectural entities as defined in models and views of the system architecture.

The purpose of the design phase is to plan a solution of the problem specified by the requirement document. This phase is the first step in moving from problem domain to the solution domain. The design of a system is perhaps the most critical factor affecting the quality of the software, and has a major impact on the later phases, particularly testing and maintenance. The output of this phase is the design document. This document is similar to a blueprint or plan for the solution, and is used later during implementation, testing and maintenance.

The design activity is often divided into two separate phase-system design and detailed design. System design, which is sometimes also called top-level design, aims to identify the modules that should be in the system, the specifications of these modules, and how they interact with each other to produce the desired results. At the end of system design all the major data structures, file formats, output formats, as well as the major modules in the system and their specifications are decided.

A design methodology is a systematic approach to creating a design by application of set of techniques and guidelines. Most methodologies focus on system design. The two basic principles used in any design methodology are problem partitioning and abstraction. A large system cannot be handled as a whole, and so for design it’s partitioned into smaller systems. Abstraction is a concept related to problem partitioning. When partitioning is used during design, the design activity focuses on one part of the system at a time. Since the part being designed interacts with other parts of the system, a clear understanding of the interaction is essential for property designing the part.

**4.2 UML Diagrams:**

UML Diagrams is a rich visualizing model for representing the system architecture and design. These diagrams help us to know the flow of the system.

Some of them are;

* Use case diagram
* Sequence diagram
* State chart diagram

**USECASE DIAGRAM:**

A Use Case Diagram in the Unified Modelling Language (UML) is a type of behavioural diagram defined by and created from a Use-case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals (represented as use cases), and any dependencies between those use cases.

The main purpose of a use case diagram is to show what system functions are performed for which actor. Roles of the actors in the system can be depicted. Interaction among actors is not shown on the use case diagram. If this interaction is essential to a coherent description of the desired behavior, perhaps the system or use case boundaries should be re-examined. Alternatively, interaction among actors can be part of the assumptions used in the use case.

**Use cases:**

A use case describes a sequence of actions that provide something of measurable value to an actor and is drawn as a horizontal ellipse.

**Actors:**

An actor is a person, organization, or external system that plays a role in one or more interactions with the system.

**System boundary boxes:**

A rectangle is drawn around the use cases, called the system boundary box, to indicate the scope of system. Anything within the box represents functionality that is in scope and anything outside the box is not.

Four relationships among use cases are used often in practice.

**Include:**

In one form of interaction, a given use case may include another. "Include is a Directed Relationship between two use cases, implying that the behaviour of the included use case is inserted into the behaviour of the including use case.

The first use case often depends on the outcome of the included use case. This is useful for extracting truly common behaviours from multiple use cases into a single description. The notation is a dashed arrow from the including to the included use case, with the label "«include» “. There are no parameters or return values. To specify the location in a flow of events in which the base use case includes the behaviour of another, you simply write include followed by the name of use case you want to include, as in the following flow for track order.

**Extend:**

In another form of interaction, a given use case (the extension) may extend another. This relationship indicates that the behaviour of the extension use case may be inserted in the extended use case under some conditions. The notation is a dashed arrow from the extension to the extended use case, with the label "«extend»". Modelers use the «extend» relationship to indicate use cases that are "optional" to the base use case.

**Generalization:**

In the third form of relationship among use cases, a generalization/specialization relationship exists. A given use case may have common behaviours, requirements, constraints, and assumptions with a more general use case. In this case, describe them once, and deal with it in the same way, describing any differences in the specialized cases. The notation is a solid line ending in a hollow triangle drawn from the specialized to the more general use case (following the standard generalization notation

**Associations:**

Associations between actors and use cases are indicated in use case diagrams by solid lines. An association exists whenever an actor is involved with an interaction described by a use case. Associations are modelled as lines connecting use cases and actors to one another, with an optional arrowhead on one end of the line. The arrowhead is often used to indicating the direction of the initial invocation of the relationship or to indicate the primary actor within the use case.

**Identified Use Cases**

The “user model view” encompasses a problem and solution from the preservative of those individuals whose problem the solution addresses. The view presents the goals and objectives of the problem owners and their requirements of the solution. This view is composed of “use case diagrams”. These diagrams describe the functionality provided by a system to external integrators. These diagrams contain actors, use cases, and their relationships.

**Use Case Diagram for Heart Disease Prediction System:**

![Diagram

Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4SW6RXhpZgAATU0AKgAAAAgABgALAAIAAAAmAAAIYgESAAMAAAABAAEAAAExAAIAAAAmAAAIiAEyAAIAAAAUAAAIrodpAAQAAAABAAAIwuocAAcAAAgMAAAAVgAAEUYc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAFdpbmRvd3MgUGhvdG8gRWRpdG9yIDEwLjAuMTAwMTEuMTYzODQAV2luZG93cyBQaG90byBFZGl0b3IgMTAuMC4xMDAxMS4xNjM4NAAyMDIxOjA1OjEwIDExOjI2OjI1AAAGkAMAAgAAABQAABEckAQAAgAAABQAABEwkpEAAgAAAAMzNgAAkpIAAgAAAAMzNgAAoAEAAwAAAAEAAQAA6hwABwAACAwAAAkQAAAAABzqAAAACAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA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MDBAUIBQUEBAUKBwcGCAwKDAwLCgsLDQ4SEA0OEQ4LCxAWEBETFBUVFQwPFxgWFBgSFBUU/9sAQwEDBAQFBAUJBQUJFA0LDRQUFBQUFBQUFBQUFBQUFBQUFBQUFBQUFBQUFBQUFBQUFBQUFBQUFBQUFBQUFBQUFBQU/8AAEQgBsgMFAwEiAAIRAQMRAf/EAB8AAAEFAQEBAQEBAAAAAAAAAAABAgMEBQYHCAkKC//EALUQAAIBAwMCBAMFBQQEAAABfQECAwAEEQUSITFBBhNRYQcicRQygZGhCCNCscEVUtHwJDNicoIJChYXGBkaJSYnKCkqNDU2Nzg5OkNERUZHSElKU1RVVldYWVpjZGVmZ2hpanN0dXZ3eHl6g4SFhoeIiYqSk5SVlpeYmZqio6Slpqeoqaqys7S1tre4ubrCw8TFxsfIycrS09TV1tfY2drh4uPk5ebn6Onq8fLz9PX29/j5+v/EAB8BAAMBAQEBAQEBAQEAAAAAAAABAgMEBQYHCAkKC//EALURAAIBAgQEAwQHBQQEAAECdwABAgMRBAUhMQYSQVEHYXETIjKBCBRCkaGxwQkjM1LwFWJy0QoWJDThJfEXGBkaJicoKSo1Njc4OTpDREVGR0hJSlNUVVZXWFlaY2RlZmdoaWpzdHV2d3h5eoKDhIWGh4iJipKTlJWWl5iZmqKjpKWmp6ipqrKztLW2t7i5usLDxMXGx8jJytLT1NXW19jZ2uLj5OXm5+jp6vLz9PX29/j5+v/aAAwDAQACEQMRAD8A/TDwE0n/AAhHh/CKR/Z8H8WP+Wa1tzNL5T5jXof4/wD61ZHgH/kRvD3/AGD4P/Ra1uTf6l/oaAI0aXYv7ten9/8A+tTbhpfKOY16j+P3HtU0f+rT6U25/wBSfqP5igA3S/8APNf++/8A61RzNLmPMaj5v73sfarFRz/8s/8Af/oaAE3y/wDPNf8Avv8A+tTGaXzo/wB2vf8Ai+ntVio3/wBfF9G/pQAm6X/nmv8A33/9ambpftB+Rc7B/F7n2qx/hUY/4+W/3B/M0AG6X/nmv/ff/wBao42l82X92vUfx+w9qsVHH/rZv94fyFABvl/55r/33/8AWqOFpQHxGp+dv4/f6VZqK3+6/wDvt/OgA3y/881/77/+tUdu0nkpiNen9/8A+tVmobX/AI94/pQA2ZpfJfMa42n+P2+lOVpdo/dqf+B//Wp1x/x7yf7p/lTk+6PpQBBcNL5RzGvUfx+49qk3S/8APNf++v8A61Fz/qT9R/MVJQBnaoZPs6ZjUfOMfN7H2rzTxAWb43fDzcu0+VqPfP8AyxHtXqGrf8e6f74/ka8x8Rf8lu+Hf/XLUv8A0SK7aHwy9H+Rx1vjj6o9aoopa4jsCiiigAooooAKSlooASilooASloooAKQ0tI1AHjfxp/aBtPg18Qfh1pOsXWkaToHiS4uob3VtXuhbx2vlQl1w7Mqjc2B81Zvgz9qzwtr0fi/UrzVtPm8P6XraaPpt7ohfUW1B2RWCxpAJGlfLHiMHABJxgmuj+JHwpv8Axp8XPhn4strq1hsvCs95NdQTbvMmE0BjUJgEcE85I4ry7x/+yXq/ibWNV1q21G2N8vilfEGn20eqXumBo/I8h43ubXbLC+1mIaPPoeGNAHq+p/tIfDvSdF0fVZ/ELSWerJJJbfZ7G5nlCocSNJFHGXhCH5WMiqEIw2DxVjV/j94H0bUNRsG1eS91DT7D+1J7XT7G4unW2MbSLIfKjb5SqNg9zx1IFeDax+yB40vfC9h4fs/EcOl6HcWeoLqOl2PiLWYY47y5l3i4MvnNNekL8rLO6oxJbYudo9A+FfwB1/wm/iSTWL3TC2reG7LQlFi8kgR4IXiZyWReDuBx7GgDVk/aIi1r9mO5+LXh/TpADpX9o29lqMUsQ3YBCncqFl5+8oweoJHNZ/h/43eKtE1rwvp/jq30WO38VadNd6ZqekpMkcE0UPnPBNG7Mx+TLBlIztIxk0mk/A3xLD+yND8KLy60pNetdDTRob2CWV7aQIiosjExhlyBkgA49TVbTfgh4x8VX3hu58aT6FZReFdKuLLSrHRp5rlZbmaDyDczSSRRldqEgIqn75JJ4FAHUaZ+0l4Ji0Hw5dal4jiu5dWsIr5brS9MvHtvKcgLM5CN5EZJ4MxX3re/4Xl4JXxn/wAIqNcRtY81LchLeZrZJnTzEha5CGFZWQhhGXDEEYHNfP0f7IvjDTfCvgvTdOvNJsdd0XQLXR38UaTrep6XeW5jYFyFh/d3kRxkRzBQD9a14v2RdUj+J17qs99Bqui3muweIWuLrXtWikhnRUyBp8UyWsjeYgZZXOVBwUfAoA9i0n9oPwBrmranp1p4hRptPjmlnlmtporcrCcTGOd0EcuwghvLZsEHOKj0n9ofwBrOj6xqkOuta2mk26Xd3/aVhc2cqwuSElWOaNGkRipCsgYMRgZPFeK6T+y38QE8UQa9rPiDTfEN8kWo2dwdZ1bUr62uobjO1hayN5UGBhTFCFBH8fYw2/7H/inUfBXirw7ea7/Yej3ljYwaZ4etfEup6lZW09tMZRMktxia2VwFQxxHACgg5FAH0f4T+JGh+PNBu9U0C7e7itiySxXFvLbTROq52yRSqrocEH5gOCDXgvgT9pjxvqXhX4feLtfsPDraH4v1X+zI9O01Lhb23JeVFkDM7LIB5WWAUcH2r0n4I/CG7+Hei+IDqEVvBq+sy+ZMYdZ1HVuibFL3F9I0jn6KgAwMHrWP+zv+y/4b+C3gfTIp/DXhlvHEEU8dz4i0/TY1uZ/MkduZzGJW+VlBye1AHSw/tIfDu68Oza5b689zpkd19hWa3026kM1xuKeTEixFpXBVsrGCRg5AFM1r9ozwLp3hvTNVt9b+1nV4Z5NNggsriWWQxA7/ADIkjLxBGG1zIF2HhsGvKbv9knWZvg74R8PnUrWbXvDevT6zD5Gp3unQziWSQlPtNttnhYJLwyDqMYIJpvh/9ljxR4J1Dw3rXh+TQI9Wjs9WstUsry/v7iEC+mExljnuDPNLIrKu5n2iQ7jhM7QAd38Of2jtM8QeG7DWvEWsaPocT+H2128tisoMEIkKmXzSdnl4GMctml8TftbeBND8Ntq9rNqepMuoW2nyWP8AZF7BdRvORsdoXgEgUqchtuGxgEmvOJf2Nte1Hww+k3ev6fDIfCI0JbiCORlF0tz56SFCBuiyFBXIOMjmu48cfDT4nfEzwStprUnhOw1Kx1Sxv9PtbCa5eArAys/mztGG+Y5wFi+UDqc8AHYL8dPDOmw63d6pr0DW9nqSadHb2mn3TXXnMoZYPJCNJLLg5xGp46jg0t1+0d8OrHS9Hvp/EQSPVppbWzhFncG4kmiBMkJhEfmJIoByjKG9q81vv2bfE6+K5fGNne6Q+v2nis+JLGwuJZRayq9r9nkhlk8sshAZirqjHgcYJpvhX9l/xBpnjrw34tv9V05tQTxFqHiHVra3aVoka5g8pYrcsuSFAXJYLnngdKAPZY/iho+rfDW98a+H3bX9MhspryJLZHWSfy1YmMKyhlclduCMg9RxXkPwX/aZvPiB4bTxfqPiDwJfeE00salqUfh+7llvtGyAwSeMFy2BkH5UOVJxivQfhL8Ndc+Gfwxv9CTUbA6xJd3t1bXRiea3jaaV3j3JlCwG4ZAI+tebf8KBvNU+JVr8QvG+i+CvDLadYXMeqXfhgSST6wskWxvtLvBGdiqCQpMhzgZ4zQB65qnxw8D6L5hu/EEMfl6UutNsikf/AENnCJJ8qnO5yFVPvMegNcn4m/aw8E6Db6DJA2p376rq6aP9nXSbyOe3lZS2ZYWh8xOMEBlGQcjIBx438DPgdqXjL4I+OZdRs9K1qXxDINK0lfEEEsMdxotrIy2scjRsJY94LsHHKlwwU4welt/2Z/Hsdhosza9b3FxpHiaDW7PR9V12+1SC2hSMo0KXlwjT87t20rgYwODQB7Jb/HzwJd+KLvw/Hrp/tK1MqSFrO4WBniQPLEk5TypJEU5aNGLDDZA2nGAv7XHwmks5LpPFgeCO0F/uXTrs77bODMg8rLxqc7mXITHzba8u8O/sc6nofi65dprO60WLVNQ1iyurnX9XkkSW5STCiw80WkbK8zgzAPuUcpliR0Gk/sw63p/h3R9Pm1HTJJ7LwXdeGWkG/BnlJxIPk+5yM9/Y0AfRWnX9tqtjb3tnPHdWlzGs0M0TBkkRgCrKe4IIqzXO/Dnw7deD/Afh3QryZLm603T4LSWaMkq7JGqkgkA4yO4ro6AEopaKACiiigApKWigBKKWigBKMD0paKACiiigDmviWM/DnxV/2Crr/wBEvXl37N19IPg/4YjEasNkn8X/AE2evUviX/yTnxV/2Cbr/wBEvXk/7Nv/ACSPwv8A7kn/AKOeu2h/Dn8v1OOt8cPme4zNIbaTMa/cP8Xt9Km3S/8APNf++/8A61Nn/wCPOX/cP8qmriOwr3DS+WP3a/eX+P8A2h7VJul/55r/AN9f/WouP9WP95f/AEIVJQBXlaTzIcoo+f8Av/7J9qfvl/55r/33/wDWpZv9ZB/v/wDspqTsaAKzNJ9oT5Fztbjd7j2qXdL/AM81/wC+/wD61I3/AB9R/wC4381qWgCurS/aH/dr91f4vdvapN0v/PNf++//AK1C/wDHxJ/ur/M1JQBXiaTzJsRqfn/v+w9qk3S/881/77/+tRD/AKyf/f8A/ZRUtAFa3aXYcRr95v4v9o+1Sb5f+ea/99//AFqLb/Vn/fb/ANCNS0AVbVpfs8WI1+4v8ft9KW5aX7PLmNcbD/H7fSpLX/j1h/3F/lRdf8es3+438qADfL/zzX/vr/61RXDS+WMxqPnX+L/aHtVmo7n/AFY/31/9CFABul/55r/33/8AWqOVpPMhyij5/wC//sn2qzUU3+sg/wB//wBlagBN8vaJf++//rUVLRQBzvgLzf8AhCPD+GQD+z4Oqn/nmvvW3M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**Sequence Diagram:**

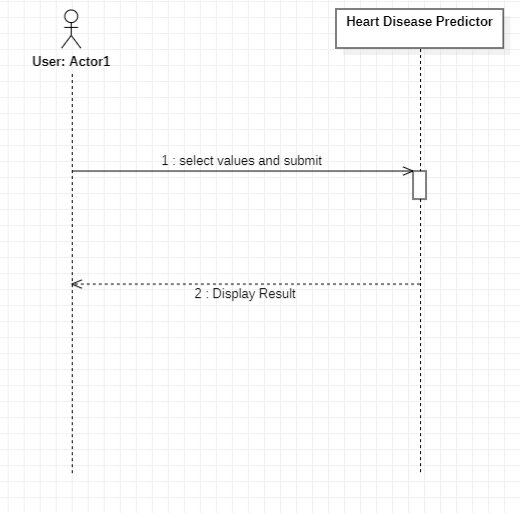
A **sequence diagram** shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario. Sequence diagrams are typically associated with use case realizations in the [Logical View](https://en.wikipedia.org/wiki/4%2B1_architectural_view_model) of the system under development. Sequence diagrams are sometimes called **event diagrams** or **event scenarios**.

A sequence diagram shows, as parallel vertical lines (*lifelines*), different processes or objects that live simultaneously, and, as horizontal arrows, the messages exchanged between them, in the order in which they occur. This allows the specification of simple runtime scenarios in a graphical manner.

### Purpose of Sequence Diagram:

* Model high-level interaction between active objects in a system.
* Model the interaction between object instances within a collaboration that realizes a use case.
* Model the interaction between objects within a collaboration that realizes an operation.
* Either model generic interactions (showing all possible paths through the interaction) or specific instances of a interaction (showing just one path through the interaction).

**Sequence Diagram for Heart Disease Prediction System**



**STATE CHART DIAGRAM:**

Statechart diagram is one of the five UML diagrams used to model the dynamic nature of a system. They define different states of an object during its lifetime and these states are changed by events. Statechart diagrams are useful to model the reactive systems. Reactive systems can be defined as a system that responds to external or internal events.

Statechart diagram describes the flow of control from one state to another state. States are defined as a condition in which an object exists and it changes when some event is triggered. The most important purpose of Statechart diagram is to model lifetime of an object from creation to termination.

Statechart diagrams are also used for forward and reverse engineering of a system. However, the main purpose is to model the reactive system.

Following are the main purposes of using Statechart diagrams −

* To model the dynamic aspect of a system.
* To model the lifetime of a reactive system.
* To describe different states of an object during its lifetime.
* Define a state machine to model the states of an object.

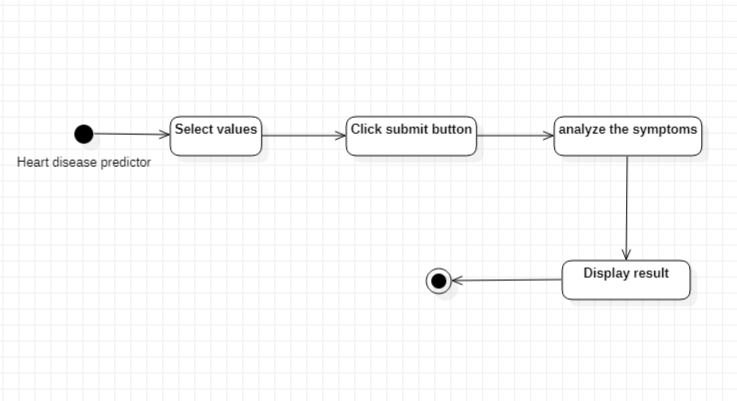
Statechart diagram is used to describe the states of different objects in its life cycle. Emphasis is placed on the state changes upon some internal or external events. These states of objects are important to analyze and implement them accurately.

Statechart diagrams are very important for describing the states. States can be identified as the condition of objects when a particular event occurs.

Before drawing a Statechart diagram we should clarify the following points −

* Identify the important objects to be analyzed.
* Identify the states.
* Identify the events.

**State chart Diagram for Heart Disease Prediction System**



1. **System Implementation**

5.1 Introduction

5.2 Project Modules

5.3 Algorithms(optional)

5.4 Screens

**5.1 Introduction:**

Heart disease affects millions of people, and it remains the chief cause of death in the world. Medical diagnosis should be proficient, reliable, and aided with computer techniques to reduce the effective cost for diagnostic tests. Machine learning is a software technology that helps computers to build and classify various attributes. Here we are using classification techniques to predict heart disease. This section gives a portrayal of the machine learning and its methods with brief descriptions, data pre-processing, evaluation measurements and description of the dataset used here.

Machine learning is an emerging subdivision of artificial intelligence. Its primary focus is to design systems, allow them to learn and make predictions based on the experience. It trains machine learning algorithms using a training dataset to create a model. The model uses the new input data to predict heart disease. Using machine learning, it detects hidden patterns in the input dataset to build models. It makes accurate predictions for new datasets. The dataset is cleaned and missing values are filled. The model uses the new input data to predict heart disease and then tested for accuracy.

**5.2 Project Modules:**

Data Analysis

Data pre-processing

Applying ML algorithms

Deploy ML model using streamlit.

**Data Analysis:**

The dataset is collected from Kaggle. It consists of 14 attributes.

Our dataset consists of 3 types of data.

Continuous

Ordinal data

Binary data

Attributes in dataset:

Age thalach

Gender exang

Chest pain oldpeak

Trestbps slope

Chol ca

Fbs thal

Restecg target

**Data pre-processing:**

Data preprocessing is required tasks for cleaning the data.

And to make the data suitable for a machine learning model.

It also increases the accuracy and efficiency of a machine learning model.

**Applying ML algorithms:**

We have applied the following ml algorithms:

1. Logistic Regression
2. K-nearest neighbors (KNN) algorithm

**Deploy ML model using Streamlit:**

Streamlit is an open-source python library.

It is used to create and share data web apps.

**5.3 Algorithms:**

**Logistic Regression Algorithm:**

Logistic regression is basically a supervised classification algorithm. It is essentially used to predict a binary outcome based on a set of independent variables.

A **binary outcome** is one where there are only two possible scenarios - either the event happens (1) or it does not happen (0). **Independent variables** are those variables or factors which may influence the outcome.

So, Logistic regression is the correct type of analysis to use when we are working with binary data.

*Different types of Logistic regression*:

1. Binary logistic regression

2. Multinomial logistic regression

3. Ordinal logistic regression

**K-nearest neighbors (KNN):**

K-Nearest Neighbors is one of the essential classification algorithms in Machine Learning.

The following two properties would define KNN well:

1. Lazy learning algorithm

2. Non-parametric learning algorithm

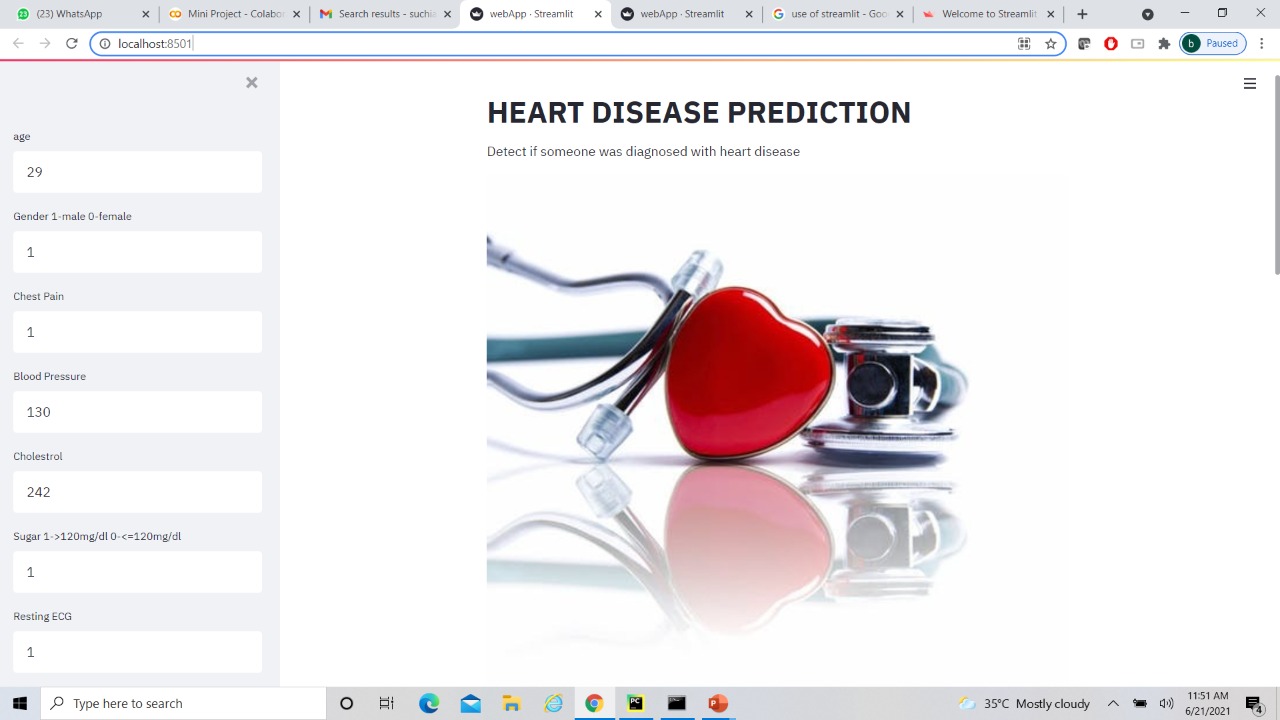
Using the k-nearest neighbor algorithm we fit the historical data and predict the future.

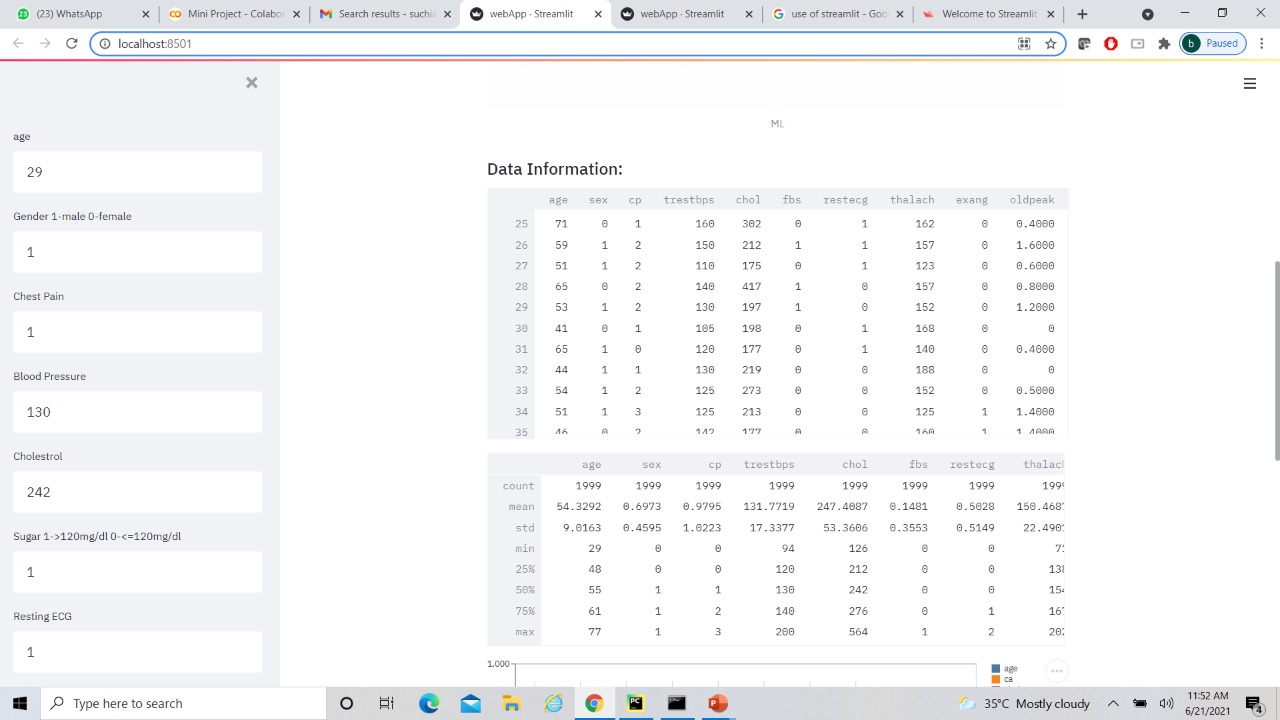
K-nearest neighbor or K-NN algorithm basically creates an imaginary boundary to classify the data.

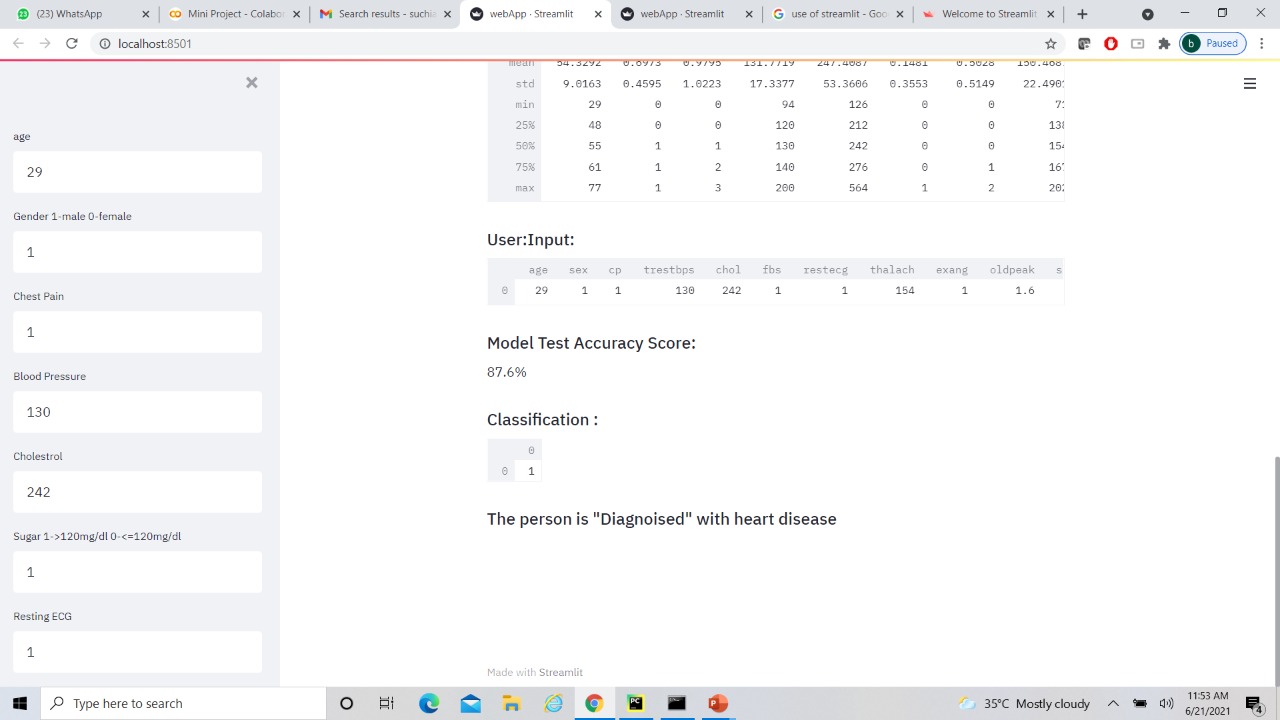
When new data points come in, the algorithm will try to predict that to the nearest of the boundary line.

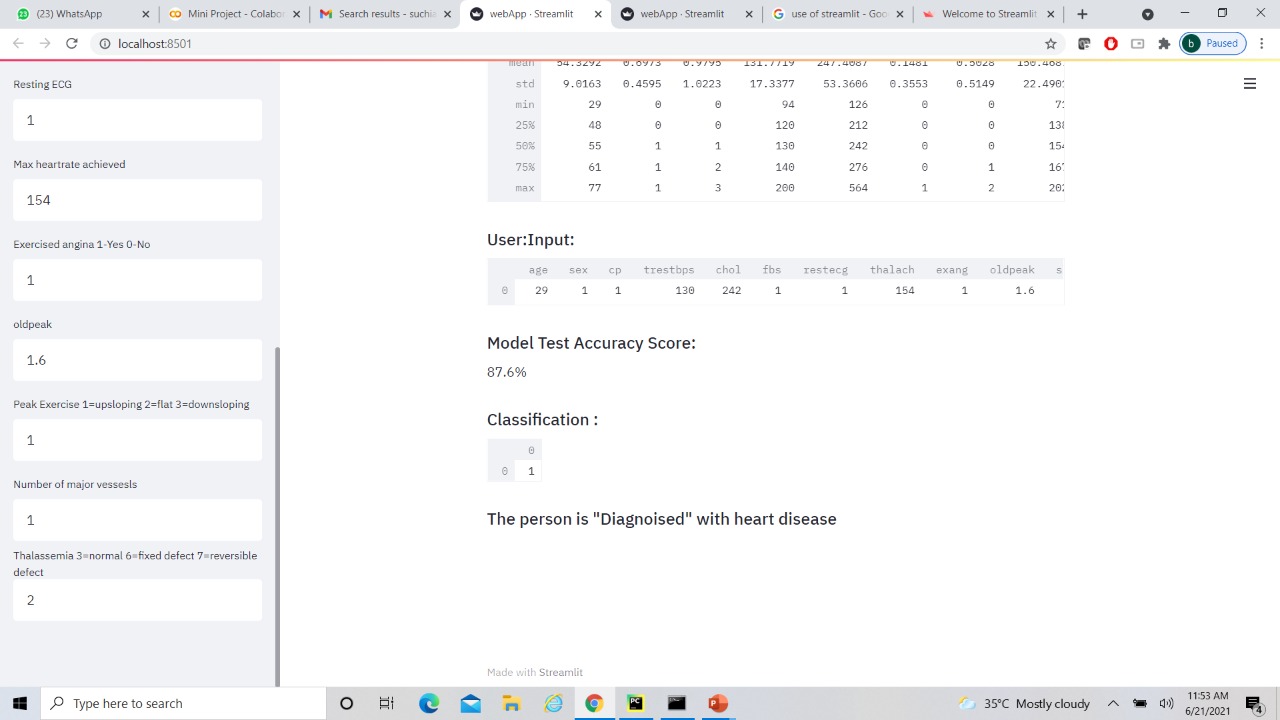
Therefore, larger k value means smother curves of separation resulting in less complex models. Whereas, smaller k value tends to overfit the data and resulting in complex models.

**5.4 Screens:**









1. **System Testing**
   1. Introduction
   2. Testing Methods
   3. **Introduction:**

Software Testing is an important element of the software quality assurance and represents the ultimate review of specification, design and coding. The increasing feasibility of software as a system and the cost associated with the software failures are motivated forces for III planned through testing.

**TESTING OBJECTIVES:**

These are several rules that can save as testing objectives:

* Testing is a process of executing program with the intent of finding an error.
* A good testcase is one that has a high probability of finding an undiscovered error.

**Test Levels:**

The purpose of testing is to discover errors. Testing is the process of trying to discover every conceivable fault or darkness in a work product. It provides a way to check the functionality of components, subassemblies, assemblies and/or a finished product. Software system meets its requirements and user expectations and does not fail in an unacceptable manner. There are various types of test. Each test type addresses a specific testing requirement.

**6.2 TESTING METHODS:**

**6.2.1 Unit Testing**

Unit testing involves the design of test cases that validate that the internal program logic is functioning properly, and that program inputs produce valid outputs. All decision branches and internal code flow should be validated. It is the testing of individual software units of the application.

**6.2.2 Integration Testing**

Integration tests are designed to test integrated software components to determine if they run as one program. Testing is event driven and is more concerned with the basic outcome of screens or fields.

**6.2.3 Functional Testing**

Functional tests provide systematic demonstrations that functions tested are available as specified by the business and technical requirements, system documentation, and user manuals. Organization and preparation of functional tests is focused on requirements, key functions, or special test cases.

**6.2.4 System Testing**

System testing ensures that the entire integrated software system meets requirements. It tests a configuration to ensure known and predictable results. An example of system testing is the configuration-oriented system integration test.

**6.2.5 White Box Test**

White Box Testing is a testing in which in which the software tester has knowledge of the inner workings, structure and language of the software, or at least its purpose. It is purpose. It is used to test areas that cannot be reached from a black box level.

**6.2.6 Black Box Test**

Black Box Testing is testing the software without any knowledge of the inner workings, structure or language of the module being tested. Black box tests, as most other kinds of tests, must be written from a definitive source document, such as specification or requirements document, such as specification or requirements document.

**6.2.7 Unit Testing**

Unit testing is usually conducted as part of a combined code and unit test phase of the software lifecycle, although it is not uncommon for coding and unit testing to be conducted as two distinct phases.

**6.2.8 Integration Testing**

Software integration testing is the incremental integration testing of two or more integrated software components on a single platform to produce failures caused by interface defects.

**6.2.9 Acceptance Testing**

User Acceptance Testing is a critical phase of any project and requires significant participation by the end user.

**7.CONCLUSION**

The early prognosis of cardiovascular diseases can aid in making decisions on lifestyle changes in high-risk patients and in turn reduce the complications, which can be a great milestone in the field of medicine. This project resolved the existing system drawbacks and successfully predict the heart disease, with 91% accuracy. The models used are Logistic Regression and K-nearest neighbors (KNN) algorithm. In these both we got more accuracy with K-nearest neighbors (KNN) algorithm compared to logistic regression. Further for its enhancement, we can train on models and predict the types of cardiovascular diseases providing recommendations to the users, and also use more enhanced models.