Liver Disease Prediction Using Supervised Machine Learning Techniques

Mini project submitted in partial fulfillment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE AND ENGINEERING

Submitted by

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HYDERABAD CAMPUS

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DEPARTMENT OF COMPUTER SCIENCE &ENGINEERING

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DECLARATION

We, hereby declare that the mini project report entitled "**Liver Disease Prediction Using Supervised Machine Learning Techniques**" is an original work done in the Department of Computer Science and Engineering, GITAM School of Technology, GITAM (Deemed to be University) submitted in partial fulfillment of the requirements for the award of the degree of "Bachelor of Technology" in Computer Science and Engineering. The work has not been submitted to any other college or University for the award of any degree or diploma.

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CERTIFICATE

This is to certify that the project report entitled "**Liver Disease Prediction Using Supervised Machine Learning Techniques**" is a bonafide record of work carried out by **Perla Sai Charan Reddy (221710303043), Bathula Alekhya (221710303006), Koganti Sai Krishna Aravind(221710303024), Puppala Kaushik (221710303049)** submitted in partial fulfillment of requirement for the award of degree of Bachelors of Technology in Computer Science and Engineering. at GITAM (Deemed To Be University), Hyderabad during the academic year 2017-21

It is faithful record work carried out by them at the **Computer Science and Engineering**, GITAM University Hyderabad Campus under my guidance and supervision.

Mrs. Koti Neha	**Dr.Phani Kumar**
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We are also thankful to all the staff members of Computer Science and Engineering department who have cooperated in making our project a success. We would like to thank all our parents and friends who extended their help, encouragement and moral support either directly or indirectly in our project work. .

Sincerely,

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ABSTRACT

Liver Disease is the leading cause of global death that impacts the massive quantity of humans around the world. This disease is caused by an assortment of elements that harm the liver. For example, obesity, an undiagnosed hepatitis infection, alcohol misuse. Which is responsible for abnormal nerve function, coughing up or vomiting blood, kidney failure, liver failure, jaundice, liver encephalopathy and there are many more. This disease diagnosis is very costly and complicated. Therefore, the goal of this work is to evaluate the performance of different Machine Learning algorithms in order to reduce the high cost of chronic liver disease diagnosis by prediction.

In this work, we used supervised machine learning algorithms like Logistic Regression, K Nearest Neighbors, Decision Tree, Support Vector Machine,and Random Forest. The performance of different classification techniques is evaluated on different measurement techniques such as accuracy, precision, recall, f1-score, and then deploy in the website.

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1.INTRODUCTION

1.1 OVERVIEW OF TECHNOLOGIES

1.1.1 Introduction for Python

Python is a very powerful programming language used for many different applications. Over time, the huge community around this open source language has created quite a few tools to efficiently work with Python. In recent years, a number of tools have been built specifically for data science. As a result, analysing data with Python has never been easier. Python is a programming language that lets you work quickly and integrate systems more efficiently. There are two major Python versions- Python 2 and Python 3.

Both are quite different. Python is a multi-paradigm programming language. Object Oriented programming and structured programming are fully supported, and many of its features support functional programming and aspect-oriented programming.

Many other paradigms are supported via extensions, including design by contract and logic programming. Python uses dynamic typing, and a combination of reference counting and a cycle-detecting garbage collector for memory management. It also features dynamic name resolution (late binding), which binds method and variable names during program execution.Python's design offers some support for functional programming in the Lisp tradition. It has filter, map, and reduce functions; list comprehensions, dictionaries, sets end generator expressions.

The standard library has two modules (itertools and functools) that implement functional tools borrowed from Haskell and Standard ML. Python is meant to be an easily readable language. Its formatting is visually uncluttered, and it often uses English keywords where other languages use punctuation. Unlike many other languages, it does not use curly brackets to delimit blocks, and semicolons after statements are optional. It has fewer syntactic exceptions and special cases than C or Pascal

1.1.2 Introduction for Machine learning

AI Machine learning is the scientific study of algorithms and statistical models that computer systems use in order to perform a specific task effectively without using explicit instructions, relying on patterns and inference instead. It is seen as a subset of artificial intelligence. Machine learning algorithms build a mathematical model based on sample data, known as "training data", in order to make predictions or decisions without being explicitly programmed to perform the task. Machine learning algorithms are used in a wide variety of applications, such as email filtering, and computer vision, where it is infeasible to develop an algorithm of specific instructions for performing the task. Machine learning is closely related to computational statistics, which focuses on making predictions using computers.

The study of mathematical optimization delivers methods, theory and application domains to the field of machine learning. Machine learning tasks are classified into several broad categories. In supervised learning, the algorithm builds a mathematical model from a set of data that contains both the inputs and the desired outputs. For example, if the task were determining whether an image contained a certain object, the training data for a supervised learning algorithm would include images with and without that object (the input), and each image would have a label (the output) designating whether it contained the object. In special cases, the input may be only partially available, or restricted to special feedback. Classification algorithms and regression algorithms are types of supervised learning.

Classification algorithms are used when the outputs are restricted to a limited set of values. For a classification algorithm that filters emails, the input would be an incoming email, and the output would be the name of the folder in which to file the email. Regression algorithms are named for their continuous outputs, meaning they may have any value within a range. Examples of a continuous value are the temperature, length, or price of an object. In unsupervised learning, the algorithm builds a mathematical model from a set of data which contains only inputs and no desired output labels. Unsupervised learning algorithms are used to find structure in the data, like grouping or clustering of data points. Unsupervised learning can discover patterns in the data, and can group the inputs into categories

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it learn for themselves.

1.1.3 Machine Learning Types

1.1.3.1. Supervised Learning :-

In supervised learning, we are given a data set and already know what our correct output should look like, having the idea that there is a relationship between the input and output.

Two types of Supervised Learning :-

Regression—Estimate continuous values (Real valued output)
Classification—Identify a unique class (Discrete values, Boolean or Categories)

Regression :-

Regression models a target prediction value based on independent variables. It is mostly used for finding out the relationship between variables and forecasting. Regression can be used to estimate/ predict continuous values (Real valued output). For example : Given a picture of a person, we have to predict the age on the basis of the given picture .

Classification :-

Classification means to group the output into a class. If the data set is discrete or categorical then it is a classification problem.For example : Given data about the sizes of houses in the real estate market, making our output about whether the house “sells for more or less than the asking price” i.e. Classifying houses into two discrete categories

1.1.3.2. Unsupervised Learning :-

It allows us to approach problems with little or no idea about what our results look like. We can derive structure from data where we don’t necessarily know the effect of the variables. We can derive this structure by clustering the data based on relationships among the variables in the data.

Clustering :-

Clustering is the task of grouping a set of objects in such a way that objects in the same group (called a cluster) are more similar (in some sense) to each other than to those in other groups (clusters).For example : Take a collection of 1,000,000 different genes, and find a way to automatically group these genes into groups that are somehow similar or related by different variables, such as lifespan, location, roles, and so on.

1.1.3.3. Reinforcement Learning :-

Reinforcement Learning is about taking suitable actions to maximize reward in a particular situation. It is employed by various software and machines to find the best possible behavior or path to take in a specific situation.

Reinforcement learning differs from the supervised learning in a way that in supervised learning the training data has the answer key with it, so the model is trained with the correct answer itself whereas in reinforcement learning, there is no answer and the reinforcement agent decides what to do in order to perform the given task. In the absence of training data set, it is bound to learn from its experience.

1.1.4 Applications of Machine Learning :-

1. Virtual Personal Assistants.
2. Predictions while commuting.Videos Surveillance.Social Media Services.
3. Email Spam and Malware Filtering.Online Customer Support.
4. Search Engine Result Refining.
5. Product Recommendations.
6. Online Fraud Detection.

1.1.5 NumPy

- NumPy is an open-source numerical Python library.
- NumPy contains a multi-dimensional array and matrix data structures.
- It can be utilised to perform a number of mathematical operations on arrays

such as trigonometric, statistical, and algebraic routines. Therefore, the library contains a large number of mathematical, algebraic, and transformation functions.

- NumPy is an extension of Numeric and Numarray.
- Numpy also contains random number generators.
- NumPy is a wrapper around a library implemented in C.

1.1.6 Pandas

In computer programming, pandas is a software library written for the Python programming language for data manipulation and analysis. In particular, it offers data structures and operations for manipulating numerical tables and time series. It is free software released under the three-clause BSD license.

1.1.7 Scikit-learn

Scikit-learn (Sklearn) is the most useful and robust library for machine learning in Python. It provides a selection of efficient tools for machine learning and statistical modeling including classification, regression, clustering and dimensionality reduction via a consistence interface in Python. This library, which is largely written in Python, is built upon NumPy, SciPy and Matplotlib.

1.1.8 Streamlit

Streamlit is an open-source Python library that makes it easy to create and share beautiful, custom web apps for machine learning and data science. In just a few minutes you can build and deploy powerful data apps

1.1.9 Heroku

Heroku is a container-based cloud Platform as a Service (PaaS). Developers use Heroku to deploy, manage, and scale modern apps. Our platform is elegant, flexible, and easy to use, offering developers the simplest path to getting their apps to market.

Heroku is fully managed, giving developers the freedom to focus on their core product without the distraction of maintaining servers, hardware, or infrastructure. The Heroku experience provides services, tools, workflows, and polyglot support all designed to enhance developer productivity.

Heroku enables developers to build, run and operate application entirely on cloud rather than doing locally on your machine. In this project we will deploy using heroku git. There are other methods as well to deploy.

1.2 EXISTING SYSTEM

Existing methods using support vector machine and K-nearest neighbour.

1.2.1 Limitations of existing system

classification is slower and costlier with respect to time and memory

1.3 OBJECTIVES

In India, delayed diagnosis of diseases is a fundamental problem due to a shortage of medical professionals. A typical scenario, prevalent mostly in rural and somewhat in urban areas is:

1. A patient going to a doctor with certain symptoms.
2. The doctor recommending certain tests like blood test, urine test etc depending on the symptoms.
3. The patient taking the aforementioned tests in an analysis lab.
4. The patient taking the reports back to the reports back to the hospital, where they are examined and the disease is identified.

The aim of this project is to somewhat reduce the time delay caused due to the unnecessary back and forth shuttling between the hospital and the pathology lab.A machine learning algorithm will be trained to predict a liver disease in patients.

1.4 OUTCOMES

The Patients data is collected from UCI machine learning repository. With this data will be going to train the Machine learning Models and evaluate accuracy. Then Deploy in the website. When the new patient data is entered in the website we can predict the likelihood weather the patient has liver disease or not

1.5 APPLICATIONS

This strategy used for liver disease prediction

1.6 STRUCTURE OF PROJECT (SYSTEM ANALYSIS)

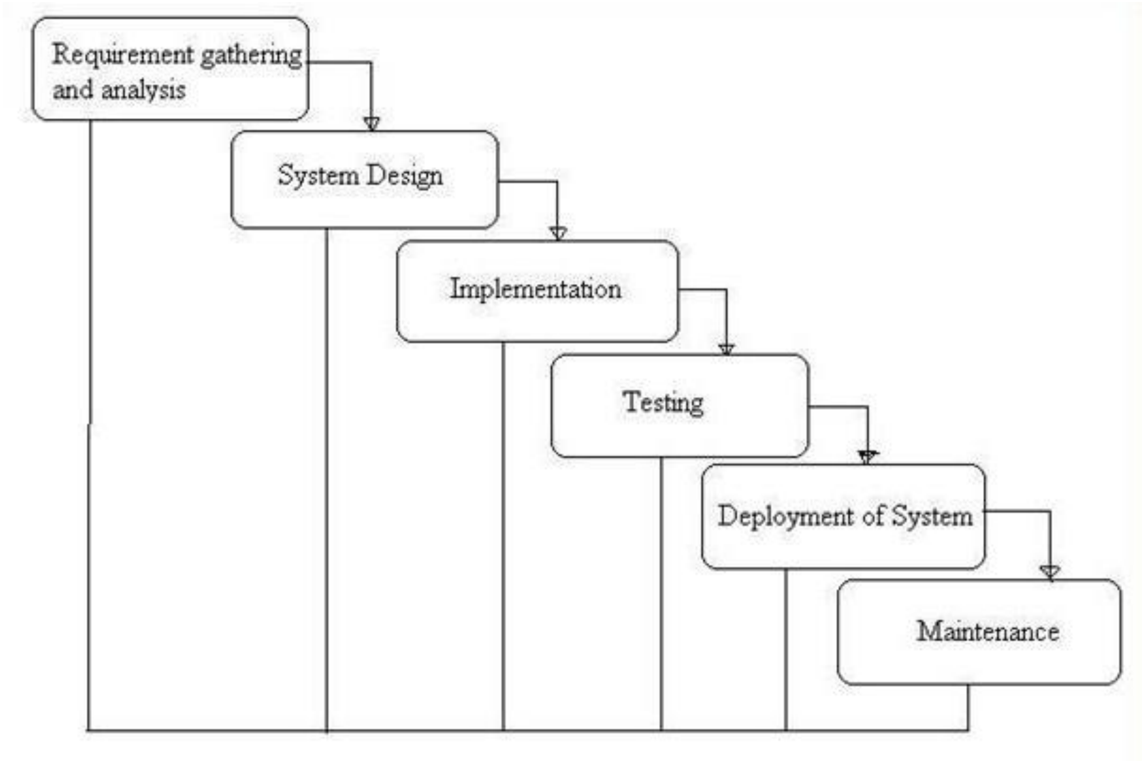


Fig: 1.1 Project SDLC

- Project Requisites Accumulating and Analysis
- Application System Design
- Practical Implementation
- Manual Testing of My Application
- Application Deployment of System
- Maintenance of the Project

1.6.1 Requisites Accumulating And Analysis

It’s the first and foremost stage of the any project as our is a an academic leave for requisites amassing we followed of IEEE Journals and Amassed so many IEEE Relegated papers and final culled a Paper designated “Individual web revisitation by setting and substance importance input and for analysis stage we took referees from the paper and did literature survey of some papers and amassed all the Requisites of the project in this stage

1.6.2 System Design

In System Design has divided into three types like GUI Designing, UML Designing with avails in development of project in facile way with different actor and its utilizer case by utilizer case diagram, flow of the project utilizing sequence, Class diagram gives information about different class in the project with methods that have to be utilized in the project if comes to our project our UML Will utilizable in this way The third and post import for the project in system design is Data base design where we endeavor to design data base predicated on the number of modules in our project

1.6.3 Implementation

The Implementation is Phase where we endeavor to give the practical output of the work done in designing stage and most of Coding in Business logic lay coms into action in this stage its main and crucial part of the project

1.6.4 Testing Unit Testing

It is done by the developer itself in every stage of the project and fine-tuning the bug and module predicated additionally done by the developer only here we are going to solve all the runtime errors

1.6.5 Manual Testing

As our Project is academic Leave, we can do any automatic testing so we follow manual testing by endeavor and error methods

1.6.6 Deployment Of System And Maintenance

Once the project is total yare, we will come to deployment of client system in genuinely world as its academic leave we did deployment i our college lab only with all need Software’s with having Windows OS .

The Maintenance of our Project is one-time process only

1.7 FUNCTIONAL REQUIREMENTS

1.Data Collection

2.Data Pre-processing

3.Training And Testing

4.Modeling

5.Predicting

1.8 NON FUNCTIONAL REQUIREMENTS

NON-FUNCTIONAL REQUIREMENT (NFR) specifies the quality attribute of a software system. They judge the software system based on Responsiveness, Usability, Security, Portability and other non-functional standards that are critical to the success of the software system. Example of nonfunctional requirement, “how fast does the website load?” Failing to meet non-functional requirements can result in systems that fail to satisfy user needs. Non- functional Requirements allows you to impose constraints or restrictions on the design of the system across the various agile backlogs. Example, the site should load in 3 seconds when the number of simultaneous users are > 10000. Description of non-functional requirements is just as critical as a functional requirement.

- Usability requirement
- Serviceability requirement
- Manageability requirement
- Recoverability requirement
- Security requirement
- Data Integrity requirement
- Capacity requirement
- Availability requirement
- Scalability requirement
- Interoperability requirement
- Reliability requirement
- Maintainability requirement
- Regulatory requirement
- Environmental requirement

1.8.1 Examples Of Non-Functional Requirements

Here, are some examples of non-functional requirement:

1.8.1.1 Users must upload dataset

1.8.1.2 The software should be portable. So moving from one OS to other OS does not create any problem.

1.8.1.3 Privacy of information, the export of restricted technologies, intellectual property rights, etc. should be audited.

1.8.2 Advantages Of Non-Functional Requirement

Benefits/pros of Non-functional testing are:

- The nonfunctional requirements ensure the software system follow legal and compliance rules.
- They ensure the reliability, availability, and performance of the software system
- They ensure good user experience and ease of operating the software.
- They help in formulating security policy of the software system.

1.8.3 Disadvantages Of Non-Functional Requirement

Cons/drawbacks of Non-function requirement are:

- None functional requirement may affect the various high-level software subsystem
- They require special consideration during the software architecture/high-level design phase which increases costs.
- Their implementation does not usually map to the specific software sub-system,
- It is tough to modify non-functional once you pass the architecture phase.

2. LITERATURE SURVEY

This seems to be a classic example of supervised learning. We have been provided with a fixed number of features for each data point, and our aim will be to train a variety of Supervised Learning algorithms on this data, so that , when a new data point arises, our best performing classifier can be used to categorize the data point as a positive example or negative. Exact details of the number and types of algorithms used for training is included in the 'Algorithms and Techniques' sub-section of the 'Analysis' part.

2.1 PROBLEM STATEMENT

The problem statement is formally defined as:

Given a dataset containing various attributes of 584 Indian patients, use the features available in the dataset and define a supervised classification algorithm which can identify whether a person is suffering from liver disease or not. This data set contains 416 liver patient records and 167 non- liver patient records.The data set was collected from north east of Andhra Pradesh, India. This data set contains 441 male patient records and 142 female patient records. Any patient whose age exceeded 89 is listed as being of age "90".

2.2 STRATEGY

This seems to be a classic example of supervised learning. We have been provided with a fixed number of features for each data point, and our aim will be to train a variety of Supervised Learning algorithms on this data, so that , when a new data point arises, our best performing classifier can be used to categorize the data point as a positive example or negative. Exact details of the number and types of algorithms used for training is included in the 'Algorithms and Techniques' sub-section of the 'Analysis' part.

2.3 METRICS

In problems of disease classification like this one, simply comparing the accuracy, that is, the ratio of correct predictions to total predictions is not enough. This is because depending on the context like severity of disease, sometimes it is more important that an algorithm does not wrongly predict a disease as a non-disease, while predicting a healthy person as diseased will attract a comparatively less severe penalty.

Thus, here we will use **F-1 score** as a performance metric, which is basically the weighted harmonic mean of precision and recall. Precision and Recall are defined as:

Precision=TP/ (TP+FP), Recall=TP/ (TP+FN), where

TP=True Positive

FP=False Positive

FN=False Negative

3. PROBLEM ANALYSIS

3.1 EXISTING APPROACH:

Existing methods using support vector machine and K-nearest neighbour.

3.1.1 Drawbacks

Classification is slower and costlier with respect to time and memory

3.2 PROPOSED SYSTEM

By using machine learning the liver disease can detected and prevented. Sklearn, numpy, pandas these are the some of the packages for understanding purpose of machine learning. Liver disease have been continuously increasing because of excessive consumption of alcohol, inhale of harmful gases, intake of contaminated food, pickles and drugs

3.2.1 Advantages

- Fast, less time

3.3 SOFTWARE AND HARDWARE REQUIREMENTS

3.3.1 Software Requirements

The functional requirements or the overall description documents include the product perspective and features, operating system and operating environment, graphics requirements, design constraints and user documentation.

The appropriation of requirements and implementation constraints gives the general overview of the project in regards to what the areas of strength and deficit are and how to tackle them.

- **Python IDE 3.7 version (or)**
- **Anaconda 3.7 (or)**
- **Jupiter (or)**
- **Google colab**

3.3.2 Hardware Requirements

Minimum hardware requirements are very dependent on the particular software being developed by a given Enthought Python / Canopy / VS Code user. Applications that need to store large arrays/objects in memory will require more RAM, whereas applications that need to perform numerous calculations or tasks more quickly will require a faster processor.

- **Operating system : windows, Linux**
- **Processor : minimum Intel i3**
- **Ram : minimum 4 GB**
- **Hard disk : minimum 250GB**

3.4 DATASET

	A	B	C	D	E	F	G	H	I	J	K
1	Age	Gender	Total_Bilirubin	Direct_Bilirubin	Alkaline_Phosphotase	Alamine_Aminotransferase	Aspartate_Aminotransferase	Total_Protiens	Albumin	Albumin_and_Globulin_Ratio	Dataset
2	65	Female	0.7	0.1	187	16	18	6.8	3.3	0.9	1
3	62	Male	10.9	5.5	699	64	100	7.5	3.2	0.74	1
4	62	Male	7.3	4.1	490	60	68	7	3.3	0.89	1
5	58	Male	1	0.4	182	14	20	6.8	3.4	1	1
6	72	Male	3.9	2	195	27	59	7.3	2.4	0.4	1
7	46	Male	1.8	0.7	208	19	14	7.6	4.4	1.3	1
8	26	Female	0.9	0.2	154	16	12	7	3.5	1	1
9	29	Female	0.9	0.3	202	14	11	6.7	3.6	1.1	1
10	17	Male	0.9	0.3	202	22	19	7.4	4.1	1.2	2
11	55	Male	0.7	0.2	290	53	58	6.8	3.4	1	1
12	57	Male	0.6	0.1	210	51	59	5.9	2.7	0.8	1
13	72	Male	2.7	1.3	260	31	56	7.4	3	0.6	1
14	64	Male	0.9	0.3	310	61	58	7	3.4	0.9	2
15	74	Female	1.1	0.4	214	22	30	8.1	4.1	1	1
16	61	Male	0.7	0.2	145	53	41	5.8	2.7	0.87	1
17	25	Male	0.6	0.1	183	91	53	5.5	2.3	0.7	2
18	38	Male	1.8	0.8	342	168	441	7.6	4.4	1.3	1
19	33	Male	1.6	0.5	165	15	23	7.3	3.5	0.92	2
20	40	Female	0.9	0.3	293	232	245	6.8	3.1	0.8	1

Fig 3.1 Dataset

Context

Patients with Liver disease have been continuously increasing because of excessive consumption of alcohol, inhale of harmful gases, intake of contaminated food, pickles and drugs. This dataset was used to evaluate prediction algorithms in an effort to reduce burden on doctors.

Content

This data set contains 416 liver patient records and 167 non liver patient records collected from North East of Andhra Pradesh, India. The "Dataset" column is a class label used to divide groups into liver patient (liver disease) or not (no disease). This data set contains 441 male patient records and 142 female patient records. Any patient whose age exceeded 89 is listed as being of age "90".

Columns:

- Age of the patient
- Gender of the patient
- Total Bilirubin
- Direct Bilirubin
- Alkaline Phosphotase
- Alamine Aminotransferase
- Aspartate Aminotransferase
- Total Protiens
- Albumin
- Albumin and Globulin Ratio
- Data set: field used to split the data into two sets (patient with liver disease, or no disease)

3.5 EXPLORATORY DATA ANALYSIS

COUNT PLOT OF LIVER PATIENTS DIAGNOISED

Number of patients diagnosed with liver disease: 416

Number of patients not diagnosed with liver disease: 167

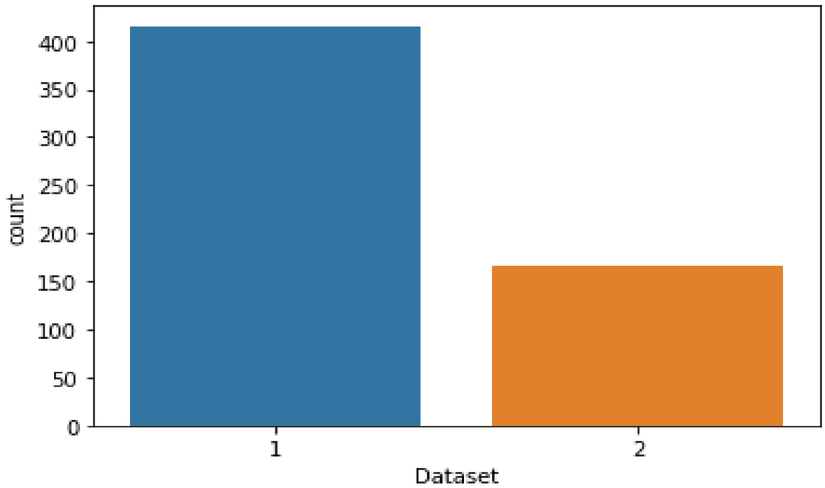


Fig 3.2 EDA1

COUNT PLOT OF MALE & FEMALE PATIENTS

Number of patients that are male: 441

Number of patients that are female: 142

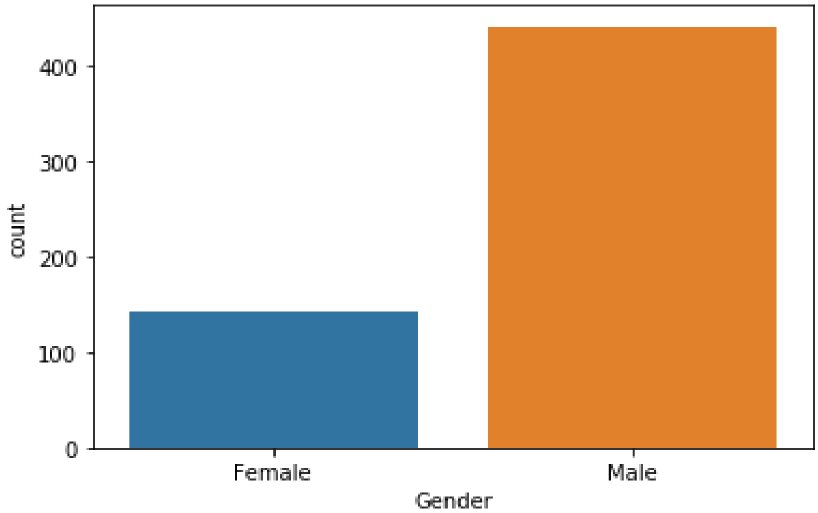


Fig 3.3 EDA2

3.6 ALGORITHMS

Decision trees, logistic regression, Naive Bayes, random forests, linear and SVMs , Neural Networks

4. DESIGN

4.1UML DIAGRAMS

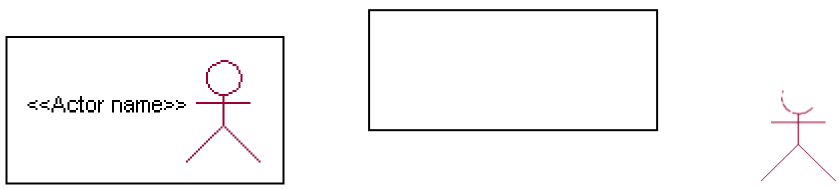
The System Design Document describes the system requirements, operating environment, system and subsystem architecture, files and database design, input formats, output layouts, human-machine interfaces, detailed design, processing logic, and external interfaces.

4.1.1Global Use Case Diagrams:

Identification of actors:

Actor: Actor represents the role a user plays with respect to the system. An actor interacts with, but has no control over the use cases.

Graphical representation:



Actor

An actor is someone or something that:Interacts with or uses the system.

Provides input to and receives information from the system.

Is external to the system and has no control over the use cases.

Actors are discovered by examining:

- Who directly uses the system?
- Who is responsible for maintaining the system?
- External hardware used by the system.
- Other systems that need to interact with the system. Questions to identify actors:

Who is using the system? Or, who is affected by the system? Or, which groups need help from the system to perform a task?

Who affects the system? Or, which user groups are needed by the system to perform its functions? These functions can be both main functions and secondary functions such as administration.

Which external hardware or systems (if any) use the system to perform tasks?

What problems does this application solve (that is, for whom)?

And, finally, how do users use the system (use case)? What are they doing with the system?

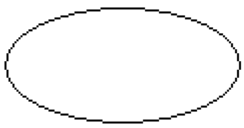
The actors identified in this system are:

a. **System Administrator**
b. **Customer**
c. **Customer Care**

Identification of usecases:

Usecase: A use case can be described as a specific way of using the system from a user's (actor's) perspective.

4.1.2 Graphical representation:



A more detailed description might characterize a use case as:

- Pattern of behavior the system exhibits
- A sequence of related transactions performed by an actor and the system
- Delivering something of value to the actor Use cases provide a means to:

- capture system requirements
- communicate with the end users and domain experts
- test the system

Use cases are best discovered by examining the actors and defining what the actor will be able to do with the system.

Guide lines for identifying use cases:

- For each actor, find the tasks and functions that the actor should be able to perform or that the system needs the actor to perform. The use case should represent a course of events that leads to clear goal
- Name the use cases.
- Describe the use cases briefly by applying terms with which the user is familiar. This makes the description less ambiguous

Questions to identify use cases:

- What are the tasks of each actor?
- Will any actor create, store, change, remove or read information in the system?
- What use case will store, change, remove or read this information?
- Will any actor need to inform the system about sudden external changes?
- Does any actor need to inform about certain occurrences in the system?
- What usecases will support and maintains the system?

4.1.3 Flow of Events

A flow of events is a sequence of transactions (or events) performed by the system. They typically contain very detailed information, written in terms of what the system should do, not how the system accomplishes the task. Flow of events are created as separate files or documents in your favorite text editor and then attached or linked to a use case using the Files tab of a model element.

A flow of events should include:

- When and how the use case starts and ends
- Use case/actor interactions

- Data needed by the use case
- Normal sequence of events for the use case
- Alternate or exceptional flows Construction of Usecase diagrams:

Use-case diagrams graphically depict system behavior (use cases). These diagrams present a high level view of how the system is used as viewed from an outsider's (actor's) perspective. A use-case diagram may depict all or some of the use cases of a system.

A use-case diagram can contain:

- actors ("things" outside the system)
- use cases (system boundaries identifying what the system should do)
- Interactions or relationships between actors and use cases in the system including the associations, dependencies, and generalizations.

Relationships in use cases:

4.1.3.1 Communication:

The communication relationship of an actor in a usecase is shown by connecting the actor symbol to the usecase symbol with a solid path. The actor is said to communicate with the usecase.

4.1.3.2Uses:

A Uses relationship between the usecases is shown by generalization arrow from the usecase.

4.1.3.3 Extends:

The extend relationship is used when we have one usecase that is similar to another usecase but does a bit more. In essence it is like subclass.

4.1.4 SEQUENCE DIAGRAMS

A sequence diagram is a graphical view of a scenario that shows object interaction in a time- based sequence what happens first, what happens next. Sequence diagrams establish the roles of objects and help provide essential information to determine class responsibilities and interfaces. There are two main differences between sequence and collaboration diagrams: sequence diagrams show time-based object interaction while collaboration diagrams show how objects associate with each other. A sequence diagram has two dimensions: typically, vertical placement represents time and horizontal placement represents different objects.

Object:

An object has state, behavior, and identity. The structure and behavior of similar objects are defined in their common class. Each object in a diagram indicates some instance of a class. An object that is not named is referred to as a class instance.

The object icon is similar to a class icon except that the name is underlined: An object's concurrency is defined by the concurrency of its class.

Message:

A message is the communication carried between two objects that trigger an event. A message carries information from the source focus of control to the destination focus of control. The synchronization of a message can be modified through the message specification. Synchronization means a message where the sending object pauses to wait for results.

Link:

A link should exist between two objects, including class utilities, only if there is a relationship between their corresponding classes. The existence of a relationship between two classes symbolizes a path of communication between instances of the classes: one object may send messages to another. The link is depicted as a straight line between objects or objects and class instances in a collaboration diagram. If an object links to itself, use the loop version of the icon.

4.1.5 CLASS DIAGRAM:

Identification of analysis classes:

A class is a set of objects that share a common structure and common behavior (the same attributes, operations, relationships and semantics). A class is an abstraction of real-world items. There are 4 approaches for identifying classes:

a. Noun phrase approach:

b. Common class pattern approach.
c. Use case Driven Sequence or Collaboration approach.
d. Classes , Responsibilities and collaborators Approach

Noun Phrase Approach:

The guidelines for identifying the classes:

- Look for nouns and noun phrases in the usecases.
- Some classes are implicit or taken from general knowledge.
- All classes must make sense in the application domain; Avoid computer implementation classes – defer them to the design stage.
- Carefully choose and define the class names After identifying the classes we have to eliminate the following types of classes:
- Adjective classes.

Common class pattern approach:

The following are the patterns for finding the candidate classes:

- Concept class.
- Events class.
- Organization class
- Peoples class
- Places class
- Tangible things and devices class.

Use case driven approach:

We have to draw the sequence diagram or collaboration diagram. If there is need for some classes to represent some functionality then add new classes which perform those functionalities.

CRC approach:

The process consists of the following steps:

- Identify classes' responsibilities (and identify the classes)

- Assign the responsibilities
- Identify the collaborators. Identification of responsibilities of each class:

The questions that should be answered to identify the attributes and methods of a class respectively are:

a. What information about an object should we keep track of?

b. What services must a class provide? Identification of relationships among the classes:

Three types of relationships among the objects are:

Association: How objects are associated?

Super-sub structure: How are objects organized into super classes and sub classes? Aggregation: What is the composition of the complex classes?

Association:

The questions that will help us to identify the associations are:

a. Is the class capable of fulfilling the required task by itself?

b. If not, what does it need?

c. From what other classes can it acquire what it needs? Guidelines for identifying the tentative associations:

- A dependency between two or more classes may be an association. Association often corresponds to a verb or prepositional phrase.

- A reference from one class to another is an association. Some associations are implicit or taken from general knowledge.

Some common association patterns are:

Location association like part of, next to, contained in….. Communication association like talk to, order to ……

We have to eliminate the unnecessary association like implementation associations, ternary or n-ary associations and derived associations.

Super-sub class relationships:

Super-sub class hierarchy is a relationship between classes where one class is the parent class of another class (derived class).This is based on inheritance.

Guidelines for identifying the super-sub relationship, a generalization are

Top-down*:*

Look for noun phrases composed of various adjectives in a class name. Avoid excessive refinement. Specialize only when the sub classes have significant behavior.

Bottom-up*:*

Look for classes with similar attributes or methods. Group them by moving the common attributes and methods to an abstract class. You may have to alter the definitions a bit.

Re-usability*:*

Move the attributes and methods as high as possible in the hierarchy.

Multiple inheritances*:*

Avoid excessive use of multiple inheritances. One way of getting benefits of multiple inheritances is to inherit from the most appropriate class and add an object of another class as an attribute.

Aggregation or a-part-of relationship:

It represents the situation where a class consists of several component classes. A class that is composed of other classes doesn't behave like its parts. It behaves very difficultly. The major properties of this relationship are transitivity and anti symmetry.

The questions whose answers will determine the distinction between the part and whole relationships are:

- Does the part class belong to the problem domain?
- Is the part class within the system's responsibilities?

- Does the part class capture more than a single value?(If not then simply include it as an attribute of the whole class)
- Does it provide a useful abstraction in dealing with the problem domain? There are three types of aggregation relationships. They are:

Assembly:

It is constructed from its parts and an assembly-part situation physically exists.

Container:

A physical whole encompasses but is not constructed from physical parts.

Collection member:

A conceptual whole encompasses parts that may be physical or conceptual. The container and collection are represented by hollow diamonds but composition is represented by solid diamond.

4.2 Class Diagram:

In software engineering, a class diagram in the Unified Modeling Language (UML) is a type of static structure diagram that describes the structure of a system by showing the system's classes, their attributes, operations (or methods), and the relationships among the classes. It explains which class contains information.

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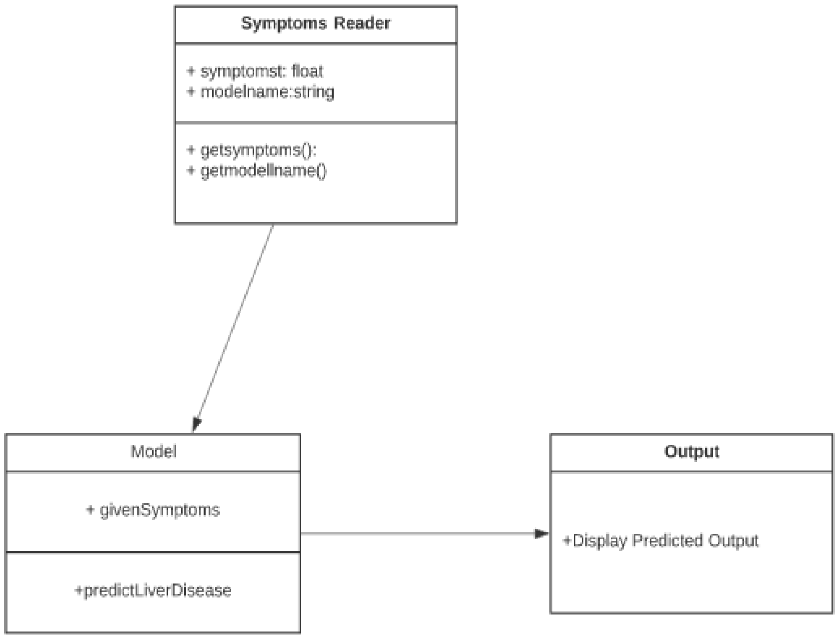


Fig 4.1: Class Diagram

4.3 Use Case Diagram:

A use case diagram at its simplest is a representation of a user's interaction with the system and depicting the specifications of a use case. A use case diagram can portray the different types of users of a system and the various ways that they interact with the system. This type of diagram is typically used in conjunction with the textual use case and will often be accompanied by other types of diagrams as well.

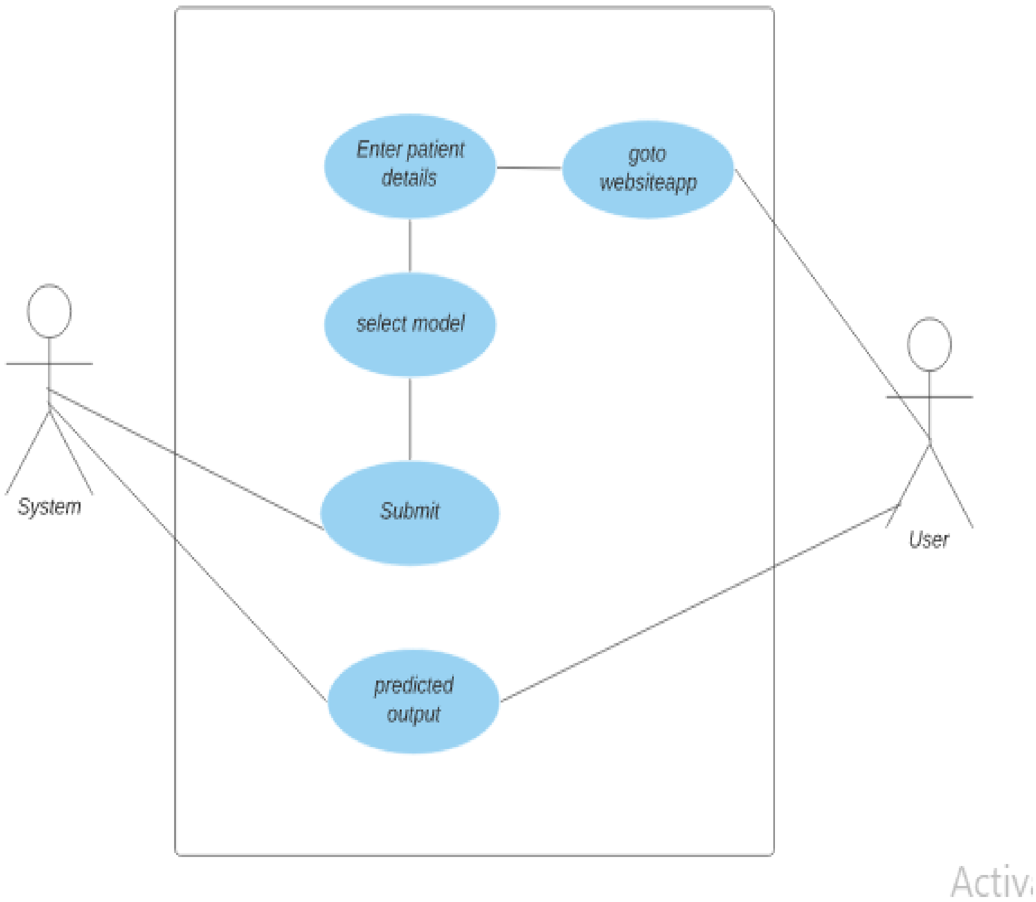


Fig 4.2: Usecase diagram

4.4 Sequence Diagram:

A sequence diagram is a kind of interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. 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 of the system under development. Sequence diagrams are sometimes called event diagrams, event scenarios, and timing diagrams.

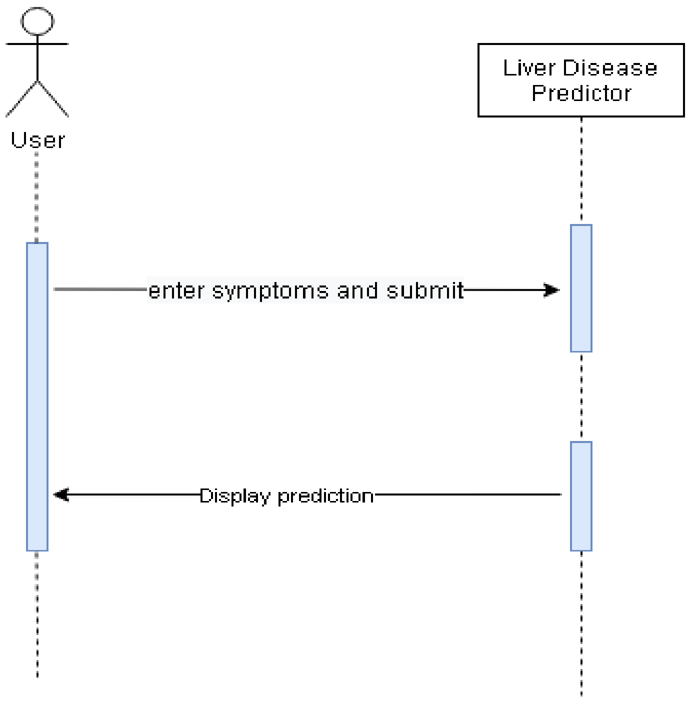


Fig 4.3:Sequence diagram

4.5 State Chart Diagram

State chart 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 State chart diagram is to model lifetime of an object from creation to termination.

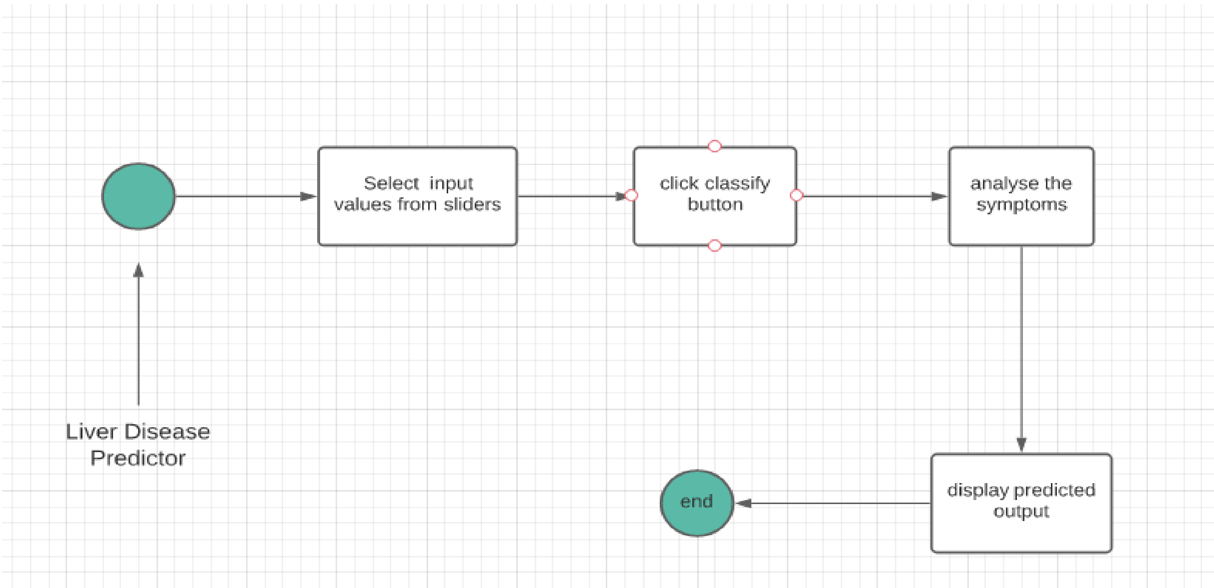


Fig 4.4:State chart diagram

4.6 Activity Diagram:

Activity diagram is another important diagram in UML to describe dynamic aspects of the system. It is basically a flow chart to represent the flow form one activity to another activity. The activity can be described as an operation of the system.

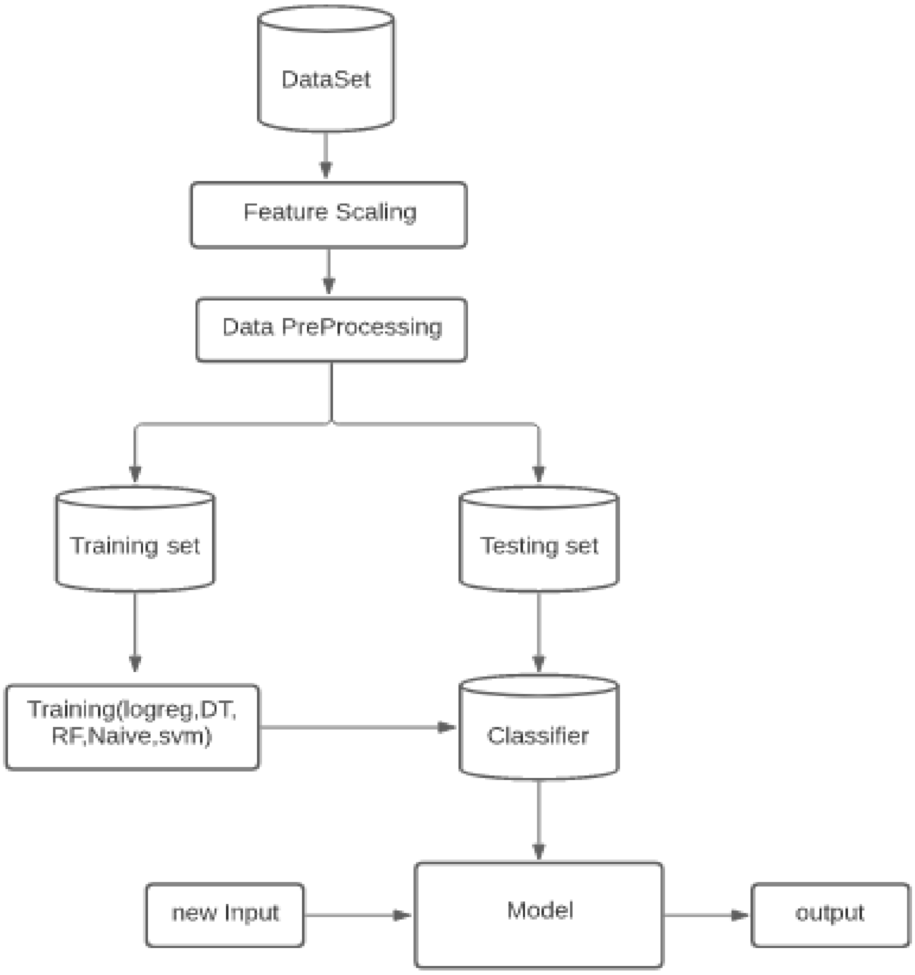


Fig 4.5:Activity diagram

4.7 Data Flow Diagram:

A DFD is a model for constructing and analyzing information processes. DFD illustrates the low of information in a process depending upon the inputs and outputs. A DFD can also be referred to as a Process Model. A DFD demonstrates business or technical process with the support of the outside data saved, plus the data flowing from the process to another and the end results.

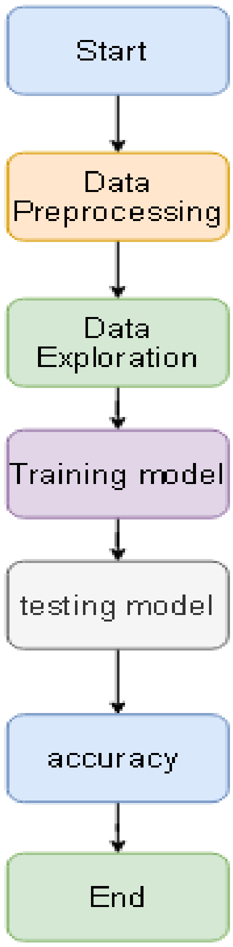


Fig 4.6:Data flow Diagram

4.8 ARCHITECTURE OF PROJECT

The machine learning architecture defines the various layers involved in the machine learning cycle and involves the major steps being carried out in the transformation of raw data into training data sets capable for enabling the decision making of a system.

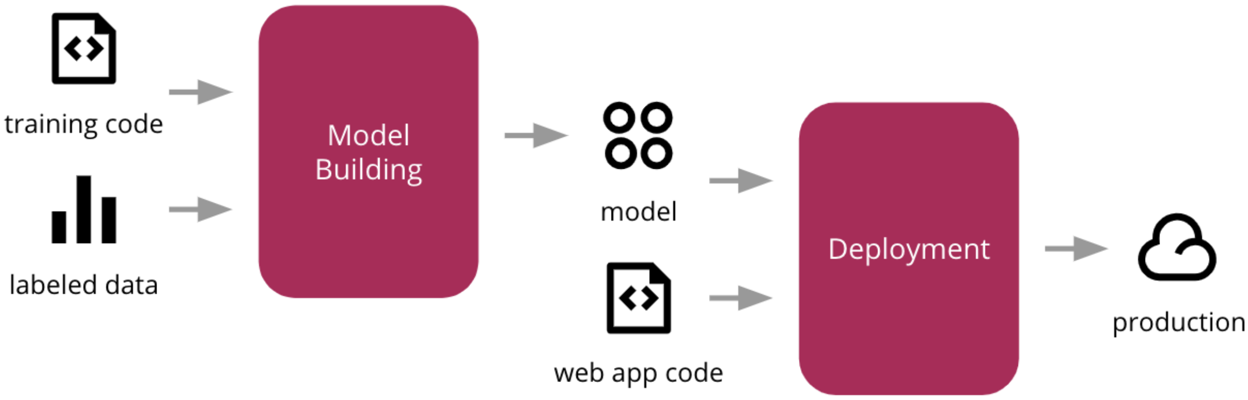


Fig 4.7:Architecture diagram

5. IMPLEMENTATION

5.1 ALGORITHOMS

5.1.1 Logistic regression

Logistic regression is a supervised learning classification algorithm used to predict the probability of a target variable. The nature of target or dependent variable is dichotomous, which means there would be only two possible classes.

In simple words, the dependent variable is binary in nature having data coded as either 1 (stands for success/yes) or 0 (stands for failure/no).

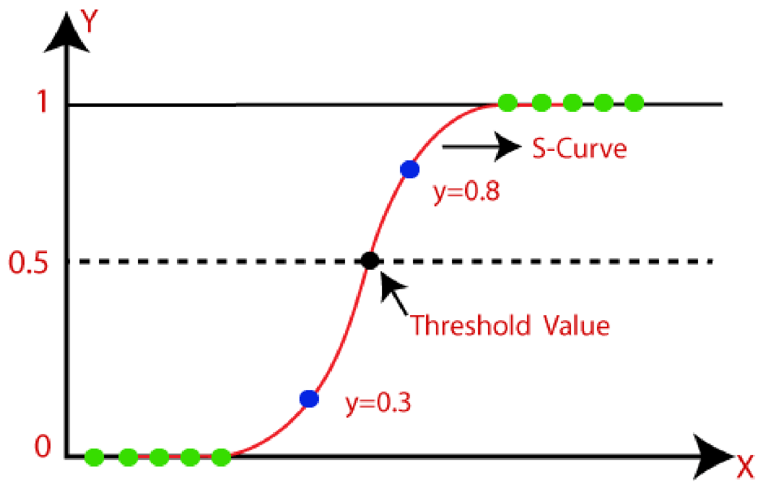
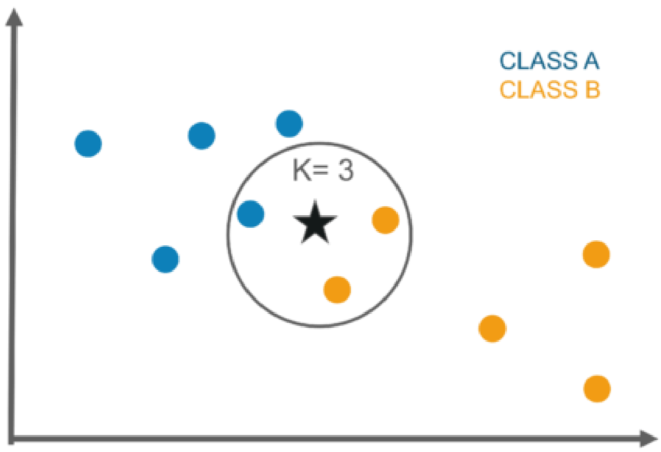


Fig 5.1 Logistic Regression Graph

5.1.2 KNN Algorithom

K Nearest Neighbour is a simple algorithm that stores all the available cases and classifies the new data or case based on a similarity measure. It is mostly used to classifies a data point based on how its neighbours are classified.



$$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Fig 5.2 KNN Graph

5.1.3 Decision Tree

Decision Tree is a Supervised learning technique that can be used for both classification and Regression problems, but mostly it is preferred for solving Classification problems. It is a tree-structured classifier, where internal nodes represent the features of a dataset, branches represent the decision rules and each leaf node represents the outcome.

In a Decision tree, there are two nodes, which are the Decision Node and Leaf Node. Decision nodes are used to make any decision and have multiple branches, whereas Leaf nodes are the output of those decisions and do not contain any further branches.

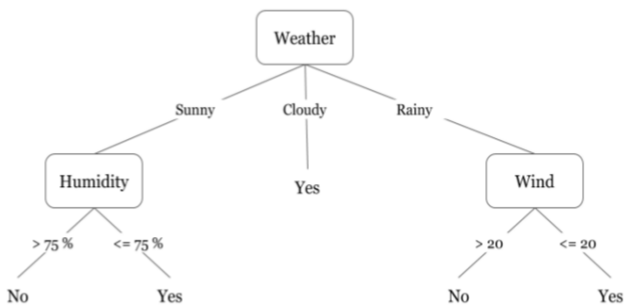


Fig 5.3 Decision Tree

5.1.4 Random Forest

Random forest is a supervised learning algorithm. The "forest" it builds, is an ensemble of decision trees, usually trained with the “bagging” method. The general idea of the bagging method is that a combination of learning models increases the overall result.

Put simply: random forest builds multiple decision trees and merges them together to get a more accurate and stable prediction.

5.1.5 Support Vector Machine

A Support Vector Machine (SVM) performs classification by finding the hyperplane that maximizes the margin between the two classes. The vectors (cases) that define the hyperplane are the support vectors.

A support vector machine is a supervised learning algorithm that sorts data into two categories. It is trained with a series of data already classified into two categories, building the model as it is initially trained. The task of an SVM algorithm is to determine which category a new data point belongs in. This makes SVM a kind of non-binary linear classifier.An SVM algorithm should not only place objects into categories, but have the margins between them on a graph as wide as possible.

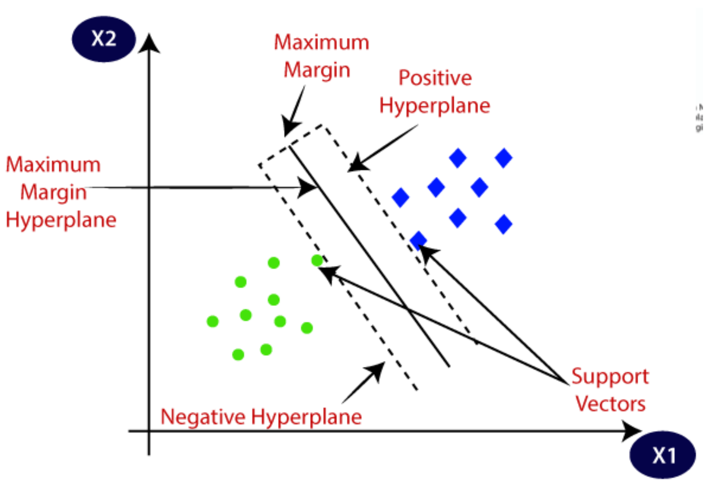


Fig 5.4 SVM

5.1.6 Neural Network

The structure of the human brain inspires a Neural Network. It is essentially a Machine Learning model (more precisely, Deep Learning) that is used in unsupervised learning. A Neural Network is a web of interconnected entities known as nodes wherein each node is responsible for a simple computation. In this way, a Neural Network functions similarly to the neurons in the human brain

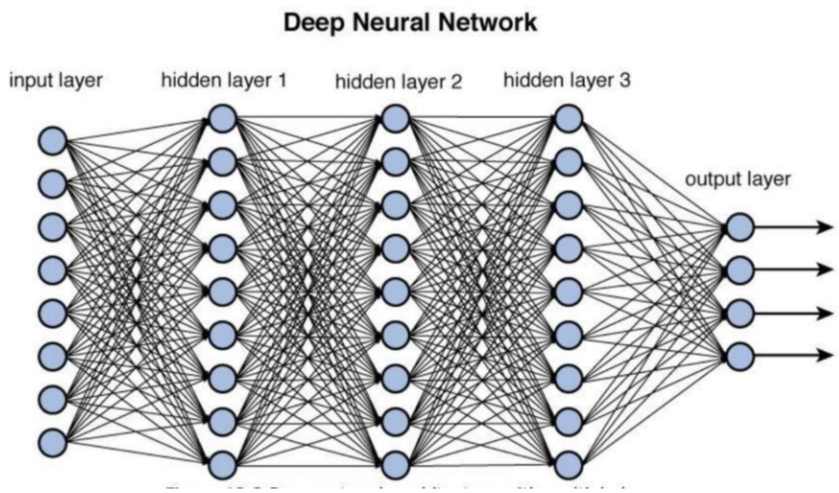


Fig 5.5 Neural Networks

5.2 CODING

5.2.1 Logistic Regression

```
from sklearn.linear_model import Logistic Regression
clf=LogisticRegression(random_state=0,solver='lbfgs',multi_class='multinomial'
max_iter=100)
clf.fit(X_train,y_train)
y_pred=clf.predict(X_test)
from sklearn.metricsimport
accuracy_score,precision_score,recall_score,confusion_matrix
print('Accuracy:',round(accuracy_score(y_test,y_pred)*100,2))
print('Precision:',round(precision_score(y_test,y_pred)*100,2))
print('Recall     :',round(recall_score(y_test,y_pred)*100,2))
print('Confusion Matrix: \n',confusion_matrix(y_pred,y_test))
```

5.2.2 KNN Algorithm

```
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import cross_val_score
# creating odd list of K for KNN
neighbors = list(range(1,20,2))
# empty list that will hold cv scores
cv_scores = []
for k in neighbors:
    knn = KNeighborsClassifier(n_neighbors=k)
    scores = cross_val_score(knn, X_train, y_train, cv=5, scoring='accuracy')
    cv_scores.append(scores.mean())
# changing to misclassification error
MSE = [1 - x for x in cv_scores]
```

```
# determining best k
optimal_k = neighbors[MSE.index(min(MSE))]
print('\nThe optimal number of neighbors is %d.' % optimal_k)
```

5.2.3 Decision Tree

```
from sklearn.tree import DecisionTreeClassifier
dtclf=DecisionTreeClassifier()
dtclf.fit(X_train,y_train)
print('Accuracy:',round(accuracy_score(y_test,y_pred)*100,2))
print('Precision:',round(precision_score(y_test,y_pred)*100,2))
print('Recall      :',round(recall_score(y_test,y_pred)*100,2))
print('Confusion Matrix: \n',confusion_matrix(y_pred,y_test))
```

5.2.4 Random Forest

```
from sklearn.ensemble import RandomForestClassifier
from math import sqrt
from sklearn.metrics import mean_squared_error
rfclf=RandomForestClassifier(n_estimators=100,max_depth=2,random_state=0)
rfclf.fit(X_train,y_train)
y_pred = rfclf.predict(X_test)
```

5.2.5 Support Vector Machine

```
from sklearn import svm
svmclf=svm.SVC(kernel='rbf',gamma='auto',decision_function_shape='ovo',prob
bility=True)
svmclf.fit(X_train,y_train)
```

```
y_pred = svmclf.predict(X_test)
print('Accuracy:',round(accuracy_score(y_test,y_pred)*100,2))
print('Precision:',round(precision_score(y_test,y_pred)*100,2))
print('Recall      :',round(recall_score(y_test,y_pred)*100,2))
print('Confusion Matrix: \n',confusion_matrix(y_pred,y_test))
```

5.2.6 Neural Networks

```
from sklearn.neural_network import MLPClassifier
from sklearn.metrics import accuracy_score
from sklearn.model_selection import train_test_split
from sklearn.metrics import classification_report,confusion_matrix
neural = MLPClassifier(max_iter=350)
neural.fit(X_train, y_train)
y_pred = neural.predict(X_test)
neural_score_test = round(neural.score(X_test, y_test) * 100, 2)
print('Neural Test Score: \n', neural_score_test)
print('Accuracy:',round(accuracy_score(y_test,y_pred)*100,2))
print('Precision:',round(precision_score(y_test,y_pred)*100,2))
print('Recall      :',round(recall_score(y_test,y_pred)*100,2))
print('Confusion Matrix: \n',confusion_matrix(y_pred,y_test))

import pickle
pickle.dump(clf,open('log.pkl','wb'))
pickle.dump(classifier,open('knn.pkl','wb'))
pickle.dump(dtclf,open('decisiontree.pkl','wb'))
pickle.dump(rfclf,open('randomforest.pkl','wb'))
pickle.dump(nbclf,open('navebais.pkl','wb'))
```

```
pickle.dump(svmclf,open('svm.pkl','wb'))
pickle.dump(gbclass,open('gbost.pkl','wb'))
pickle.dump(neural,open('neural.pkl','wb'))
```

5.2.7 Web App

```
import streamlit as st
import pickle
log=pickle.load(open('log.pkl','rb'))
knn=pickle.load(open('knn.pkl','rb'))
decisiontree=pickle.load(open('decisiontree.pkl','rb'))
randomforest=pickle.load(open('randomforest.pkl','rb'))
naivebayes=pickle.load(open('navebais.pkl','rb'))
svm=pickle.load(open('svm.pkl','rb'))
neural=pickle.load(open('neural.pkl','rb'))

def classify(num,t):
    if (num==1 and t==1): return "The Patient is likely has liver disease";
    else : return "The Patient    is likely not having liver disease";

def main():
    st.title("Liver disease Predection")
    html_temp = """
    <div style="background-color:teal ;padding:10px">
    <h2 style="color:white;text-align:center;">Liver disease Predection</h2>
    </div>
```

```
"""
st.markdown(html_temp, unsafe_allow_html=True)

activities=['LogisticRegression','KNN','Decisiontree','Randomforest','naivebayes','SV
M','Neural networks']
option=st.sidebar.selectbox('Which model would you like to use?',activities)
st.subheader(option)


age=st.slider("Enter    age",1,100)
gender = st.radio("Gender",("Male","Female"))
Total_Bilirubin=st.slider('Total_Bilirubin', 0, 75)
Direct_Bilirubin=st.slider('Direct_Bilirubin', 0, 20)
Alkaline_Phosphotase=st.slider('Alkaline_Phosphotase ', 0, 2100)
Alamine_Aminotransferase=st.slider('Alamine_Aminotransferase ', 0, 2000)
Aspartate_Aminotransferase=st.slider('Aspartate_Aminotransferase      ',      0,
5000)
Total_Protiens=st.slider('Total_Protiens ', 0, 10)
Albumin=st.slider('Albumin ', 0, 6)
Albumin_and_Globulin_Ratio=st.slider('Albumin_and_Globulin_Ratio   ',   0,
5)


if gender=="Female":
    gender1=1
    gender2=0
else:
    gender1=0
    gender2=1
```

```
    inputs=[[age,Total_Bilirubin,Direct_Bilirubin,Alkaline_Phosphotase,Alamine_Aminotransferase,

Aspartate_Aminotransferase,Total_Protiens,Albumin,Albumin_and_Globulin_Ratio,gender1,gender2]]
        t=(age!=0 and Total_Bilirubin!=0 and Direct_Bilirubin!=0 and Alkaline_Phosphotase!=0and
Aspartate_Aminotransferase!=0andTotal_Protiens!=0andAlbumin!=0andAlbumin_and_Globulin_Ratio!=0)
        if st.button('Classify'):
            if option=='Logistic Regression':
                st.success(classify(log.predict(inputs),t))
            elif option=='KNN':
                st.success(classify(knn.predict(inputs),t))
            elif option=='Decision tree':
                st.success(classify(decisiontree.predict(inputs),t))
            elif option=='Random forest':
                st.success(classify(randomforest.predict(inputs),t))
            elif option=='naive bayes':
                st.success(classify(naivebayes.predict(inputs),t))
            elif option=='svm':
                st.success(classify(svm.predict(inputs),t))
            elif option=='Neural networks':
                st.success(classify(neural.predict(inputs),t))


    if __name__=='__main__':
        main()
```

6.TESTING

6.1 SOFTWARE TESTING

Testing

Testing is a process of executing a program with the aim of finding error. To make our software perform well it should be error free. If testing is done successfully it will remove all the errors from the software.

6.1.1 Types of Testing

1. White Box Testing
2. Black Box Testing
3. Unit testing
4. Integration Testing
5. Alpha Testing
6. Beta Testing
7. Performance Testing and so on

White Box Testing

Testing technique based on knowledge of the internal logic of an application's code and includes tests like coverage of code statements, branches, paths, conditions. It is performed by software developers

Black Box Testing

A method of software testing that verifies the functionality of an application without having specific knowledge of the application's code/internal structure. Tests are based on requirements and functionality.

Unit Testing

Software verification and validation method in which a programmer tests if individual units of source code are fit for use. It is usually conducted by the development team.

Integration Testing

The phase in software testing in which individual software modules are combined and tested as a group. It is usually conducted by testing teams.

Alpha Testing

Type of testing a software product or system conducted at the developer's site. Usually it is performed by the end users.

Beta Testing

Final testing before releasing application for commercial purpose. It is typically done by end- users or others.

Performance Testing

Functional testing conducted to evaluate the compliance of a system or component with specified performance requirements. It is usually conducted by the performance engineer.

Black Box Testing

Blackbox testing is testing the functionality of an application without knowing the details of its implementation including internal program structure, data structures etc. Test cases for black box testing are created based on the requirement specifications. Therefore, it is also called as specification-based testing. Fig.4.1 represents the black box testing:

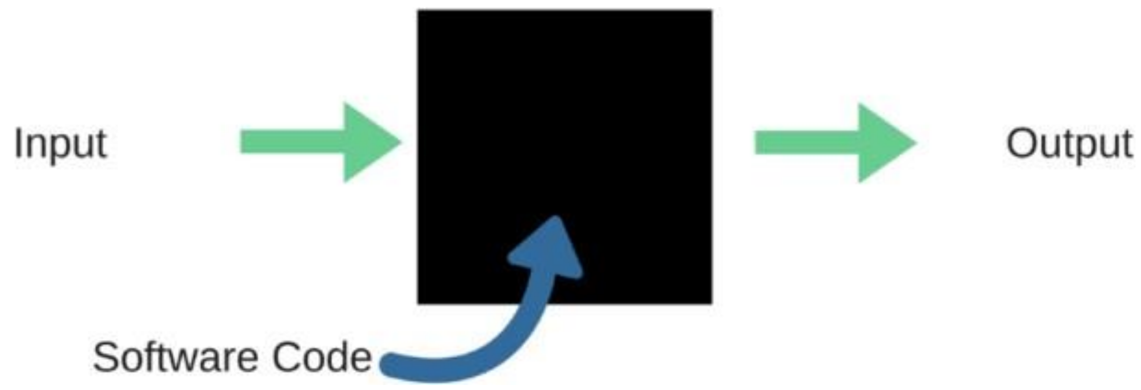


Fig.6.1:Black Box Testing

When applied to machine learning models, black box testing would mean testing machine learning models without knowing the internal details such as features of the machine learning

model, the algorithm used to create the model etc. The challenge, however, is to verify the test outcome against the expected values that are known beforehand.

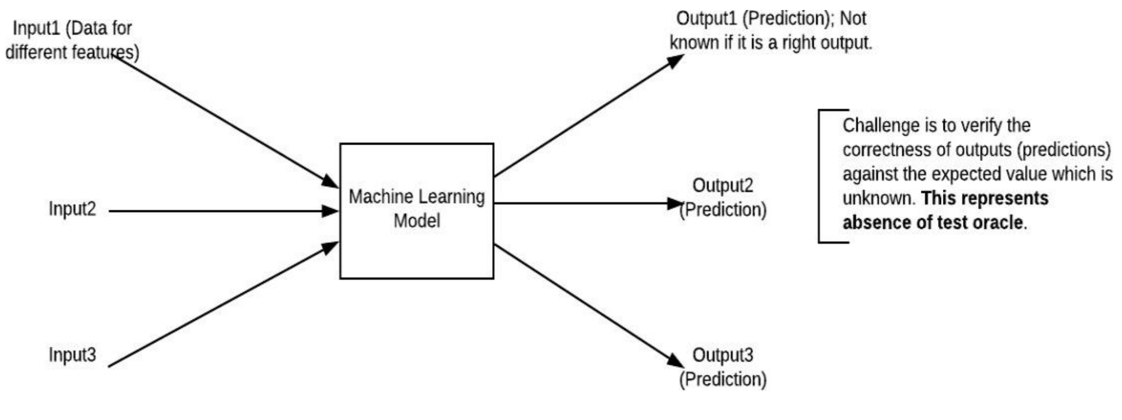


Fig.6.2:Black Box Testing for Machine Learning algorithms

The above Fig.4.2 represents the black box testing procedure for machine learning algorithms.

Fig.6.3:Black box Testing

Input	Actual Output	Predicted Output
[26,1,25,13,1002,800,2000,5,3,1]	0	0
[60,0,60,25,500,600,1005,6,2,1]	1	1

The model gives out the correct output when different inputs are given which are mentioned in Table 6.3. Therefore the program is said to be executed as expected or correct program

Test Case Id	Test Case Name	Test Case Description	Test Steps			Test Case Status	Test Priority
			Step	Expected	Actual		
01	Start the Application	Host the application and test if it starts making sure the Required software is available	If it doesn't Start	We cannot run The application	The application Hosts success	High	High
02	Home Page	Check the deployment Environment for properly Loading the application	If it doesn't load .	We cannot access the Application.	The application is running successfully	High	High
03	User Mode	Verify the working of The application in freestyle mode	If it doesn't Respond	We cannot use the Freestyle mode	The application displays the Freestyle Page	High	High
04	Data Input	Verify if the application takes input and updates	If it fails to take the input or store in The Database	We cannot proceed further	The application updates the input to application	High	High

Fig 6.4 Testing

In the work, we utilized some factual estimations that measure the test execution of various classification algorithms. The performance of the classification methods was assessed by various evaluation procedures, for example, accuracy, precision, recall and f1 measure. Consequently, the exhibition evaluation variables are determined by the confusion matrix. Here,

True Positives (TP) - These are the correctly predicted positive values which means that the value of actual class is yes and the value of predicted class is also yes. E.g. if actual class value indicates that this passenger survived and predicted class tells you the same thing.

True Negatives (TN) - These are the correctly predicted negative values which means that the value of actual class is no and value of predicted class is also no. E.g. if actual class says this passenger did not survive and predicted class tells you the same thing.

False positives and false negatives, these values occur when your actual class contradicts with the predicted class.

False Positives (FP) – When actual class is no and predicted class is yes. E.g. if actual class says this passenger did not survive but predicted class tells you that this passenger will survive.

False Negatives (FN) – When actual class is yes but predicted class in no. E.g. if actual class value indicates that this passenger survived and predicted class tells you that passenger will die.

Once you understand these four parameters then we can calculate Accuracy, Precision, Recall and F1 score.

Accuracy - Accuracy is the most intuitive performance measure and it is simply a ratio of correctly predicted observation to the total observations. One may think that, if we have high accuracy then our model is best. Yes, accuracy is a great measure but only when you have symmetric datasets where values of false positive and false negatives are almost same. Therefore, you have to look at other parameters to evaluate the performance of your model. For our model, we have got 0.803 which means our model is approx. 80% accurate.

Accuracy = TP+TN/TP+FP+FN+TN

Precision - Precision is the ratio of correctly predicted positive observations to the total predicted positive observations. The question that this metric answer is of all passengers that labeled as survived, how many actually survived? High precision relates to the low false positive rate. We have got 0.788 precision which is pretty good.

Precision = TP/TP+FP

Recall (Sensitivity) - Recall is the ratio of correctly predicted positive observations to the all observations in actual class - yes. The question recall answers is: Of all the passengers that truly survived, how many did we label? We have got recall of 0.631 which is good for this model as it's above 0.5.

Recall = TP/TP+FN

F1 score - F1 Score is the weighted average of Precision and Recall. Therefore, this score takes both false positives and false negatives into account. Intuitively it is not as easy to understand as accuracy, but F1 is usually more useful than accuracy, especially if you have an uneven class distribution. Accuracy works best if false positives and false negatives have similar cost. If the cost of false positives and false negatives are very different, it's better to look at both Precision and Recall. In our case, F1 score is 0.701.

F1 Score = 2*(Recall * Precision) / (Recall + Precision)

Confusion Matrix

A confusion matrix is a tabular summary of the number of correct and incorrect predictions made by a classifier. It is used to measure the performance of a classification model.

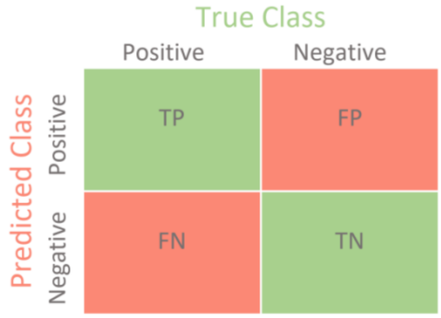


Fig 6.5 Confusion Matrix

True Positive (TP): The result of prediction correctly identifies that a patient has liver disease.

False Positive (FP): The result of prediction incorrectly identifies that a patient has liver disease. True

Negative (TN): The result of prediction correctly rejects that a patient has liver disease.

False Negative (FN): The result of prediction incorrectly rejects that a patient has liver disease.

Logistic Regression

Accuracy : 76.07
Precision: 75.65
Recall : 100.0
f1 score : 86.14
Confusion Matrix:
[[87 28]
[0 2]]

KNN

Accuracy : 75.21
Precision: 77.36
Recall : 94.25
f1 score : 84.97
Confusion Matrix:
[[82 24]
[5 6]]

Decision Tree

Accuracy : 71.79
Precision: 84.62
Recall : 75.86
f1 score : 80.0
Confusion Matrix:
[[66 12]
[21 18]]

Random Forest

Accuracy : 74.36
Precision: 74.36
Recall : 100.0
f1 score : 85.29
Confusion Matrix:
[[87 30]
[0 0]]

:

	Model	Accuracy	Precision	Recall	F1 score
0	Logistic Regression	76.07	75.65	100.00	86.14
1	KNN	75.21	77.36	94.25	84.97
2	Decision Tree	71.79	84.62	75.86	80.00
3	Random Forest	74.36	74.36	100.00	85.29
4	Naive Bayes	74.36	74.36	100.00	85.29
5	SVM	74.36	74.36	100.00	85.29
6	Neural Networks	73.50	76.42	93.10	83.94

Fig 6.6 Metrics Table

7. RESULTS AND DISCUSSIONS

7.1 Import required package and extracting the data set

```
In [1]: #importing built in modules
        import pandas as pd
        import numpy as np
        import matplotlib.pyplot as plt
        import seaborn as sns

In [2]: #Loading Data
        df=pd.read_csv(r"C:\Users\charan\Desktop\indian_liver_patient.csv")

In [3]: df.shape

Out[3]: (583, 11)

In [4]: df.columns

Out[4]: Index(['Age', 'Gender', 'Total_Bilirubin', 'Direct_Bilirubin',
               'Alkaline_Phosphotase', 'Alamine_Aminotransferase',
               'Aspartate_Aminotransferase', 'Total_Protiens', 'Albumin',
               'Albumin_and_Globulin_Ratio', 'Dataset'],
              dtype='object')

In [5]: df.head()

Out[5]:
```

	Age	Gender	Total_Bilirubin	Direct_Bilirubin	Alkaline_Phosphotase	Alamine_Aminotransferase	Aspartate_Aminotransferase	Total_Protiens	Albumi
0	65	Female	0.7	0.1	187	16	18	6.8	3
1	62	Male	10.9	5.5	699	64	100	7.5	3
2	62	Male	7.3	4.1	490	60	68	7.0	3
3	58	Male	1.0	0.4	182	14	20	6.8	3
4	72	Male	3.9	2.0	195	27	59	7.3	2

Activate Windows
Go to Settings to

Fig.7.1 import modules

7.2 Data Processing

```
In [16]: y.head()

Out[16]: 0    1
         1    1
         2    1
         3    1
         4    1
         Name: Dataset, dtype: int64

In [17]: df_2=pd.get_dummies(df, columns=["Gender"],drop_first=False)
         df_2

Out[17]:
```

	Age	Total_Bilirubin	Direct_Bilirubin	Alkaline_Phosphotase	Alamine_Aminotransferase	Aspartate_Aminotransferase	Total_Protiens	Albumin	Al
0	65	0.7	0.1	187	16	18	6.8	3.3	
1	62	10.9	5.5	699	64	100	7.5	3.2	
2	62	7.3	4.1	490	60	68	7.0	3.3	

Fig.7.2 Data Processing

7.3 Data Visualization

```
In [9]: sns.countplot(data=df, x = 'Dataset', label='Count')

        LD, NLD = df['Dataset'].value_counts()
        print('Number of patients diagnosed with liver disease: ',LD)
        print('Number of patients not diagnosed with liver disease: ',NLD)

Number of patients diagnosed with liver disease:  416
Number of patients not diagnosed with liver disease:  167
```

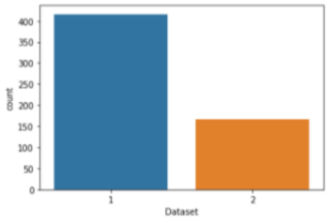


Fig.7.3 Data visualization

```
In [10]: sns.countplot(data=df, x = 'Gender', label='Count')

         F, M = df['Gender'].value_counts()
         print('Number of patients that are female: ',M)
         print('Number of patients that are male: ',F)

Number of patients that are female:  142
Number of patients that are male:  441
```

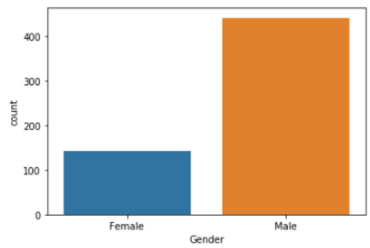


Fig.7.4 Data visualization

7.4 Feature Scaling

```
n [19]: # Scale down the values  using normalization between (0-1)
        # Xnorm = (X-Xmin)/(Xmax-Xmin)

        from sklearn import preprocessing
        x=df_2.values
        min_max_scaler=preprocessing.MinMaxScaler()
        x_scaled=min_max_scaler.fit_transform(x)
        df=pd.DataFrame(x_scaled)

n [20]: df
```

Fig.7.5 Feature Scaling

7.5 MODELS

7.5.1 Logistic Regression

```
In [25]: #from sklearn.datasets import load_iris
         from sklearn.linear_model import LogisticRegression
         clf=LogisticRegression(random_state=0,solver='lbfgs',multi_class='multinomial',max_iter=10000)
         clf.fit(X_train,y_train)

Out[25]: LogisticRegression(C=1.0, class_weight=None, dual=False, fit_intercept=True,
                            intercept_scaling=1, l1_ratio=None, max_iter=10000,
                            multi_class='multinomial', n_jobs=None, penalty='l2',
                            random_state=0, solver='lbfgs', tol=0.0001, verbose=0,
                            warm_start=False)

In [26]: y_pred=clf.predict(X_test)
```

Fig.7.6 Logistic regression

7.5.2 Decision Tree

```
In [39]: from sklearn.tree import DecisionTreeClassifier    # decision tree classifier using gini impurity (CART):
         dtclf=DecisionTreeClassifier()
         #dtclf=DecisionTreeClassifier(criterion='entropy')
         dtclf.fit(X_train,y_train)

Out[39]: DecisionTreeClassifier(class_weight=None, criterion='gini', max_depth=None,
                                max_features=None, max_leaf_nodes=None,
                                min_impurity_decrease=0.0, min_impurity_split=None,
                                min_samples_leaf=1, min_samples_split=2,
                                min_weight_fraction_leaf=0.0, presort=False,
                                random_state=None, splitter='best')

In [40]: y_pred = dtclf.predict(X_test)
```


Fig.7.7 Decision Tree

7.5.3 Random Forest

```
In [42]: from sklearn.ensemble import RandomForestClassifier
         from math import sqrt
         from sklearn.metrics import mean_squared_error
         rfclf=RandomForestClassifier(n_estimators=100,max_depth=2,random_state=0)
         rfclf.fit(X_train,y_train)
         y_pred = rfclf.predict(X_test)

In [43]: rm_acc=round(accuracy_score(y_test, y_pred)*100,2)
         rm_precision=round(precision_score(y_test,y_pred)*100,2)
         rm_recall=round(recall_score(y_test,y_pred)*100,2)
         rm_f1=round(f1_score(y_test,y_pred)*100,2)
         print('Accuracy :',rm_acc)
         print('Precision:',rm_precision)
         print('Recall    :',rm_recall)
         print('f1 score :',rm_f1)
         print('Confusion Matrix: \n',confusion_matrix(y_pred,y_test))
```

Fig.7.8 Random Forest

7.5.4 SVM

In [47]:

```
from sklearn import svm
svmclf=svm.SVC(kernel='rbf',gamma='auto',decision_function_shape='ovo',probability=True)
svmclf.fit(X_train,y_train)
y_pred = svmclf.predict(X_test)
```

In [48]:

```
svm_acc=round(accuracy_score(y_test, y_pred)*100,2)
svm_precision=round(precision_score(y_test,y_pred)*100,2)
svm_recall=round(recall_score(y_test,y_pred)*100,2)
svm_f1=round(f1_score(y_test,y_pred)*100,2)
print('Accuracy :',svm_acc)
print('Precision:',svm_precision)
print('Recall    :',svm_recall)
print('f1 score :',svm_f1)
print('Confusion Matrix: \n',confusion_matrix(y_pred,y_test))
```

Fig.7.9 Svm

7.5.5 Neural Networks

In [50]:

```
from sklearn.neural_network import MLPClassifier
from sklearn.metrics import classification_report

neural = MLPClassifier(max_iter=350)
neural.fit(X_train, y_train)
#Predict Output
y_pred = neural.predict(X_test)
```

Fig.7.10 Neural Networks

7.5.6 KNN

In [30]:

```
from sklearn.neighbors import KNeighborsClassifier
from sklearn.model_selection import cross_val_score
# creating odd list of K for KNN
neighbors = list(range(1,20,2))
# empty list that will hold cv scores
cv_scores = []
for k in neighbors:
    knn = KNeighborsClassifier(n_neighbors=k)
    scores = cross_val_score(knn, X_train, y_train, cv=5, scoring='accuracy')
    cv_scores.append(scores.mean())

# changing to misclassification error
MSE = [1 - x for x in cv_scores]

# determining best k
optimal_k = neighbors[MSE.index(min(MSE))]
print('\nThe optimal number of neighbors is %d.' % optimal_k)
```

Fig.7.11 Knn

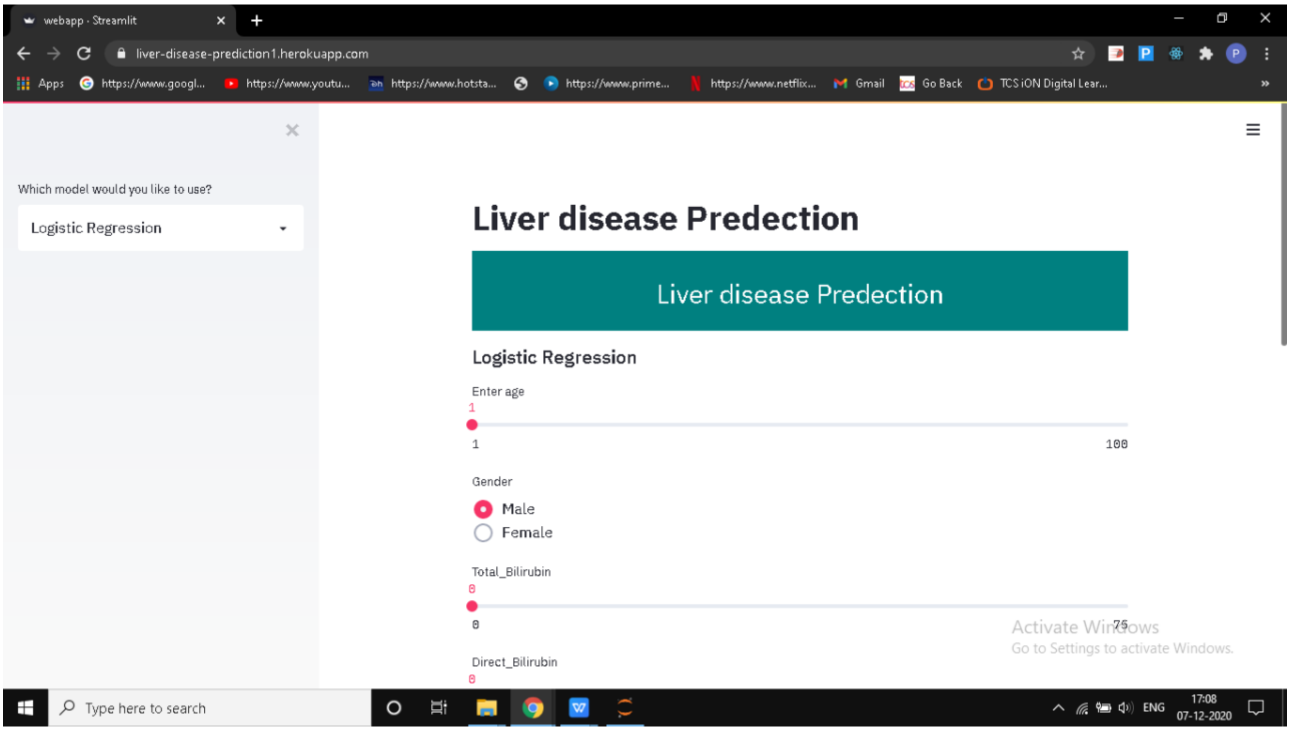


Fig.7.12. Output

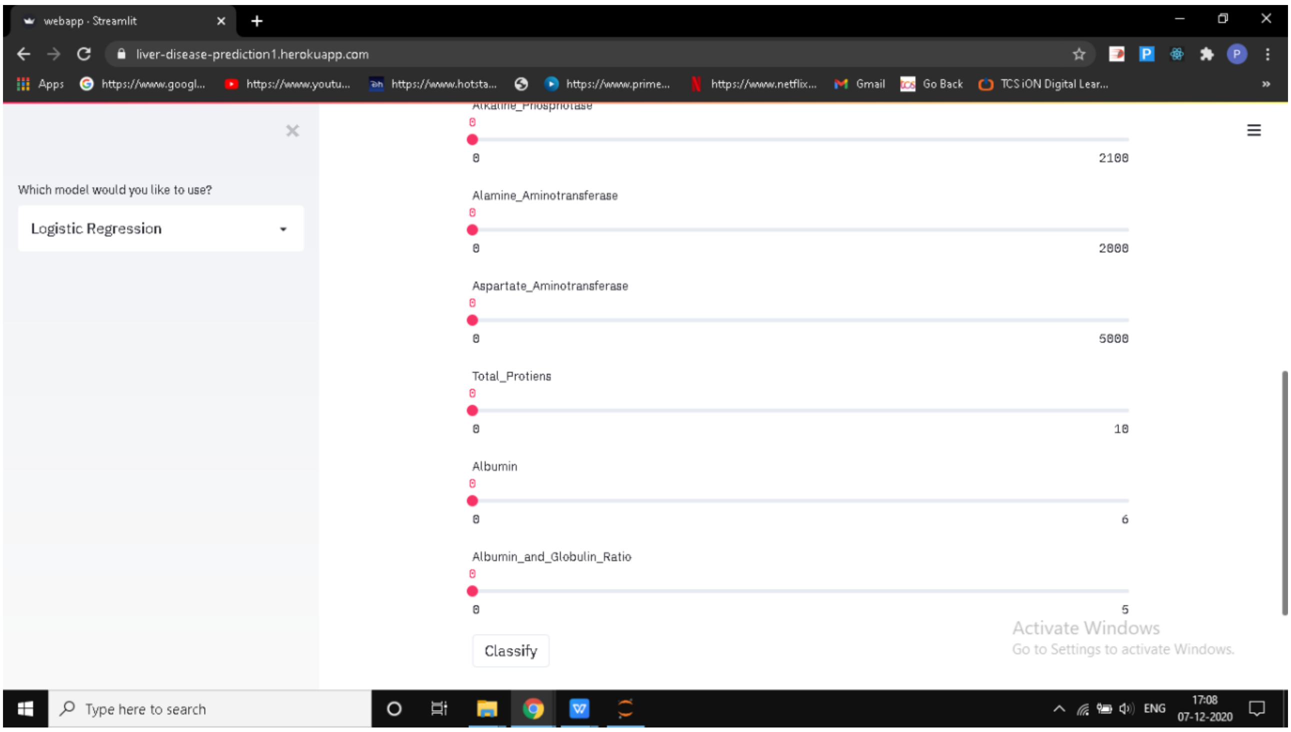


Fig.7.13. Output

8. CONCLUSIONS AND FUTURE SCOPE

The dataset for this problem is the ILPD (Indian Liver Patient Dataset) taken from the UCI Machine Learning Repository. Region specified in this dataset is of Andhra Pradesh of year 2017.

Initially, the data set was explored and made ready to be fed into the classifiers. This was achieved by removing some rows containing null values, transforming some columns which were showing skewness and using appropriate methods (one-hot encoding) to convert the labels so that they can be useful for classification purposes. Performance metrics on which the models would be evaluated were decided. The data set was then split into a training and testing set.

Then the training data is fed to the different models Logistic Regression, KNN, Decision Tree, Random Forest, Support Vector Machine, Neural Networks. And then these models are tested with the testing data using different measuring metrics like accuracy, precision, recall, f1- score. Then the models are converted into pickle file and deployed in web using Heroku Platform as a Service.

This project aims to predict the liver disease on the basis of the symptoms. The project is designed in such a way that the system takes symptoms from the user as input and produces output i.e. predict disease. In conclusion, for disease risk modelling, the accuracy of risk prediction depends on the diversity feature of the hospital data.

As our dataset is small it’s training dataset is similar to test dataset so we cannot rely on this model for predicting accuracy for large dataset. We need more precised data set containing larger values and attributes to classify values and get best accuracy

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