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Institute of Science and Technology

Project Proposal on

Medicine Recommendation System

Submitted to

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Department of IT

Submitted by:

Sharada Luitel (26517/077)

Krish Kumar Shrestha (26493/077)

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Introduction

Implementation of technology within the sphere of medical practice is shifting cultures of attending to patients to be able to deliver efficient, personalized and feasible treatment solutions. Offshore outsourcing technology used in the present world such as the wearables, digital health equipment allows several monitoring and measuring of patient's data that produce acute diagnosis and treatment plans for every unique patient. This technology advancement and ensures the patients receive right prescriptions depending on the data collected and reduce the chances of human error while enhancing patient safety apart from enhancing the quality of the services. Technology enables healthcare delivery to be efficient and enhanced by enabling it to reduce complexities of medical processes such as prescriptions, appointment setting and follow-ups among others.

A medicine recommendation system is one of the biggest innovations in individualized medication systems. These systems also incorporated the best algorithms and data analytics in searching the patient's symptoms that would enable the system to recommend the best prescriptions. Through the application of this technology, users would be in a position to be more cautious. In addition, it helps to protect the patient's safety. In addition, by automating the analytical process, the cognitive load that falls unto the healthcare workers is reduced so that they can effectively focus on other important aspects of patients' care.

In the context of Nepal there are some special challenges for the Nepalese healthcare system especially those that are quite remote and/or rural, lack doctors. Moreover, there is a great divide and differentiation on the healthcare system some areas have advanced hospitals, while others have mere clinics. These factors create a problem in the provision of standard and quality treatment across the country. The deliver of standardized care is already challenging because of the disease type and the patient's cultural background, economic status, and overall health.

Problem Statement

There are several head-scratching issues that prevails in Nepalese healthcare system that makes perilous in delivering uniform and qualitative treatment and care across the nation. Some of these factors include; limited of access to medical care services, especially in the peripheral regions and the rural setting, poor density of qualified practitioners, fundamental and emergency drugs, and inadequate medical facilities. They point to the fact that while some urban centers will have well-endowed hospitals, most rural areas will only have clinics that are badly equipped and cannot handle the demand that exists in those areas. Also, having a large and diverse human structure with the population of Nepal is heterogeneous in terms of cultural, economic and health conditions of people prevent applying general health care models which aim to satisfy the need of the general population. These challenges point to the fact that there is need to come up with advanced approaches that include the medicine recommendation system that assist in coming up with the appropriate prescription pattern to give the patients hence improving the Nepalese patient's health results as well as coming up with safer and better treatments.

Objectives

The main purpose of the medicine recommendation system in Nepali health care facilities is to increase the appropriateness, efficacy and safety of prescriptions given in the country. This system is designed for the healthcare providers, particularly for those working in the resource poor and/or rural settings, to provide medications recommendations relevant to the patient's information including symptoms, medical history and local drug formulary. In this way, the system aims at avoiding cases of adverse drug reactions, ensuring that suitable treatment plans are available for any clients and also making changes in the quality of health care in Nepal.

- Enhance Prescribing Accuracy
- Improve Patient Safety
- Support Resource-Limited Areas
- Increase Treatment Efficiency
- Ensure Accessible Healthcare
- Elevate Overall Healthcare Quality

Scope and Limitation

Scope

Diet suggestion: Suggests diet according to the disease predicted by the model.

Workout suggestion: Suggests workouts according to the predicted disease.

Precaution: Suggests what user should do to minimize the risk of more infection according to the data available.

Continuous Learning and Updates: Incorporate a mechanism for continuous learning, allowing the system to update and refine its recommendations based on new medical research and data.

Limitation

Limited symptoms and disease: the model we are using consist of only 132 symptoms and 41 diseases.

Data quality and availability: The effectiveness of the system depends on the availability and accuracy of patient data, which might be incomplete or inconsistent in some regions.

User input: user must input symptoms correctly else the system will produce error.

Methodology

To complete the project, the Agile development approach was followed whereby the work was completed in cycles or sprints with feedback between phases. This was done from close collaboration with the proxy client (supervisor), tweaking the requirements and iterating. Such factors consisted of decision-making regarding project setting, probable number of iterations and timeframes likely to be used. The Agile method allows controlling the process and make necessary changes following new needs and requirements, thus, the focus was on the user.

At initiation and planning phase of the project, objectives were defined, and functional specifications were developed. This was succeeded by the requirement analysis that had major activities of planning for the strategic direction of the system and tracking of progress. During this phase, an idea about the structure and working of the system was developed having known all the requirements that had been collected. The subsequent development phase followed strictly the design plan, while the use of specification fabrication and integration phases and one or more Development / Test Phases ensured that performance problems could be systematically investigated and resolved. This type of approach helped to incorporate changes throughout the subsequent iterations and improve the software that matched with the needs of the project and stakeholders feedbacks.

Figure 1 Agile Methodology

a. Requirement identification

i. Literature Review

A literature survey for an intelligent medicine recommendation system involves conducting a comprehensive review of existing research and academic literature in the field. The survey begins by defining the research objectives and identifying relevant literature sources such as academic databases, research journals, and conference proceedings. Selected papers are then reviewed in detail, focusing on research methodologies, data sources, machine learning algorithms employed, explainability approaches, and evaluation methodologies. The survey identifies key approaches and algorithms used in intelligent medicine recommendation systems, evaluates the extent of explainability and interpretability in recommendations, and assesses personalization and adaptability. Research gaps, limitations, and challenges are identified, and the findings are synthesized and summarized to guide the development of the intelligent medicine recommendation system. The survey culminates in documenting the findings and producing a comprehensive report that serves as a valuable reference for future research and informs the direction of the intelligent medicine recommendation system.

A predictive model that recommends medications with previously unachievable precision and personalization can be created by utilizing the power of data-driven insights taken from comprehensive patient health records and medical histories. Medication errors can be decreased with the use of technologies like recommender systems and data mining. [1]

The medical suggestion system can be valuable when pandemics, floods, or cyclones hit. In the age of Machine Learning (ML), recommender systems give more accurate, precise, and reliable clinical predictions while using less resources. The medicine recommendation system gives the patient reliable information about the medication, the dosage, and any possible adverse effects. Medication is given based on the patient's symptoms. Drug recommendation systems provide precise information at any time while improving the performance, integrity, and privacy of patient data in the decision-making process. Recommender system, the decision tree produces the most accurate results. In times of medical emergency, a drug recommendation system is helpful for giving patients recommendations for safe medications. [2]

A medicine recommendation system using collaborative filtering is an approach that leverages the collective knowledge and preferences of a group of users to make

personalized medication recommendations. Collaborative filtering is a technique commonly used in recommendation systems to identify similarities and patterns among users based on their historical behavior or preferences. [3]

ii. Requirement Identification

The requirements can be functional and non-functional.

Functional Requirements

- User registration and authentication
- Login option for the registered user
- Edit profile details
- Change the login password
- Search for symptoms
- Get suggestions according to the outcome

Non-Functional Requirements

- Easy to navigate user interface
- Reliable and quick responses
- Work on every device

b. Feasibility study

Feasibility analysis is important in arriving at a decision with an objective of establishing whether or not to undertake any projects. It assesses such factors as technical, economic, legal, operational and scheduling in a bid to determine the likely risks and resources. Thus, through the analysis of the cost per benefit, it provides the rationale for the expenditure and ensures that meets the objectives and Standard Operating Procedures and regulations. The foregoing process affords a best practice for planning and makes decisions that are knowledgeable in their execution.

i. Technical Feasibility

The technical feasibility to develop a recommendation system that matches the medicine that can be prescribed for patients using Python, Flask and machine learning is possible. scikit-learn libraries are also used to work and implement the ML models of Python. Flask offers an elaborate architecture for extensive websites, and gives necessary tools to add and process user information. This duo facilitates the management of data, models

incorporation as well as horizontal scalability when deploying a solution, and therefore suitable in building a reliable and efficient recommendation system.

ii. Operational Feasibility

An operational feasibility analysis for a medicine recommendation system that will be developed by Python, Flask, and including machine learning Approaches refers to the identification of possible implementation and management issues. Python and Flask have good documentation and community, still they make it easy for the team of developers to develop and deploy, which is quite feasible in case of teams with developers having good knowledge of Python/Flask. For efficient operation of the system by the users user training is vital and Flask framework supports the creation of user- friendly applications. Care and feeding are needed for bugs and fixes as well as upgrades, and Python and Flask are stable and give long-term performance predictability as well as continual community-improvement.

iii. Economic Feasibility

Recommendation of a medicine also requires the economic consideration of development, deployment, and sustaining costs and revenue projection for a medicine recommendation system using Python, Flask, and machine learning. Python and Flask do not attract licensing fees, making it possible for developers to reduce on initial costs of development. Implementation costs refer to the attempts to incorporate the system with other healthcare structures and technologies, however this can be resolved by Flask's framework and Python efficiency. Other costs are other operational costs like the server hosting costs, cloud storage, etc. however the installation of Flask is platform independent and the performance of Python is also good thereby controlling these costs. Also, user training and support activities help to increase the receipt and efficacy of systems and may result in high rates of return on such investments with reference to the overall decrease of prescription mistakes and the efficiency of the health care system.

iv. Schedule

The process of creating and applying a medicine recommendation system can be subdivided into several phases. Project Planning carries on to Project Initiation to set goals and to collect necessities. This is then succeeded by Feasibility Analysis, to test for technical, operational and economic feasibility. System Design focuses on planning of architecture of the system and the user interfaces. Development is concentrated on

constructing the non-visual parts, adding the data analysis with the help of artificial intelligence algorithms, and establishing the product interface. The verification is done through unit, integration and user acceptance tests. Lastly, Deployment condensates to sending the system live, in addition to training the users with regards to the new system referred to as Post-Deployment Support so as to oversee performance outcomes of the system and further operation.

ID	Title	Start Date	End Date
1	Initiation and Planning	3-Aug	11-Aug
2	Analysis	12-Aug	21-Aug
3	Design	21-Aug	3-Sep
4	Development	4-Sep	21-Oct
5	Implementation and Testing	22-Oct	29-Oct
6	Documentation	15-Aug	2-Nov

Figure 2 Time Schedule for Project

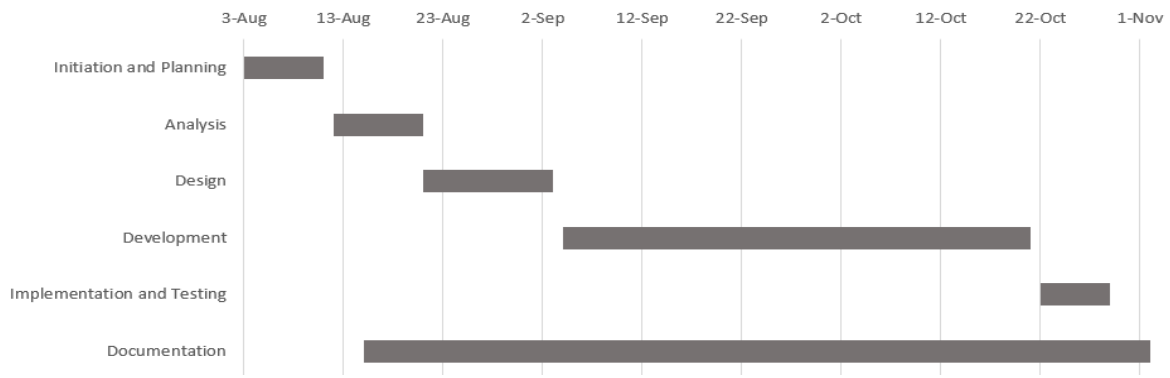

Figure 3 Gantt chart for proposed system

c. High level design of system

i. Designs of diagrams

Flowchart

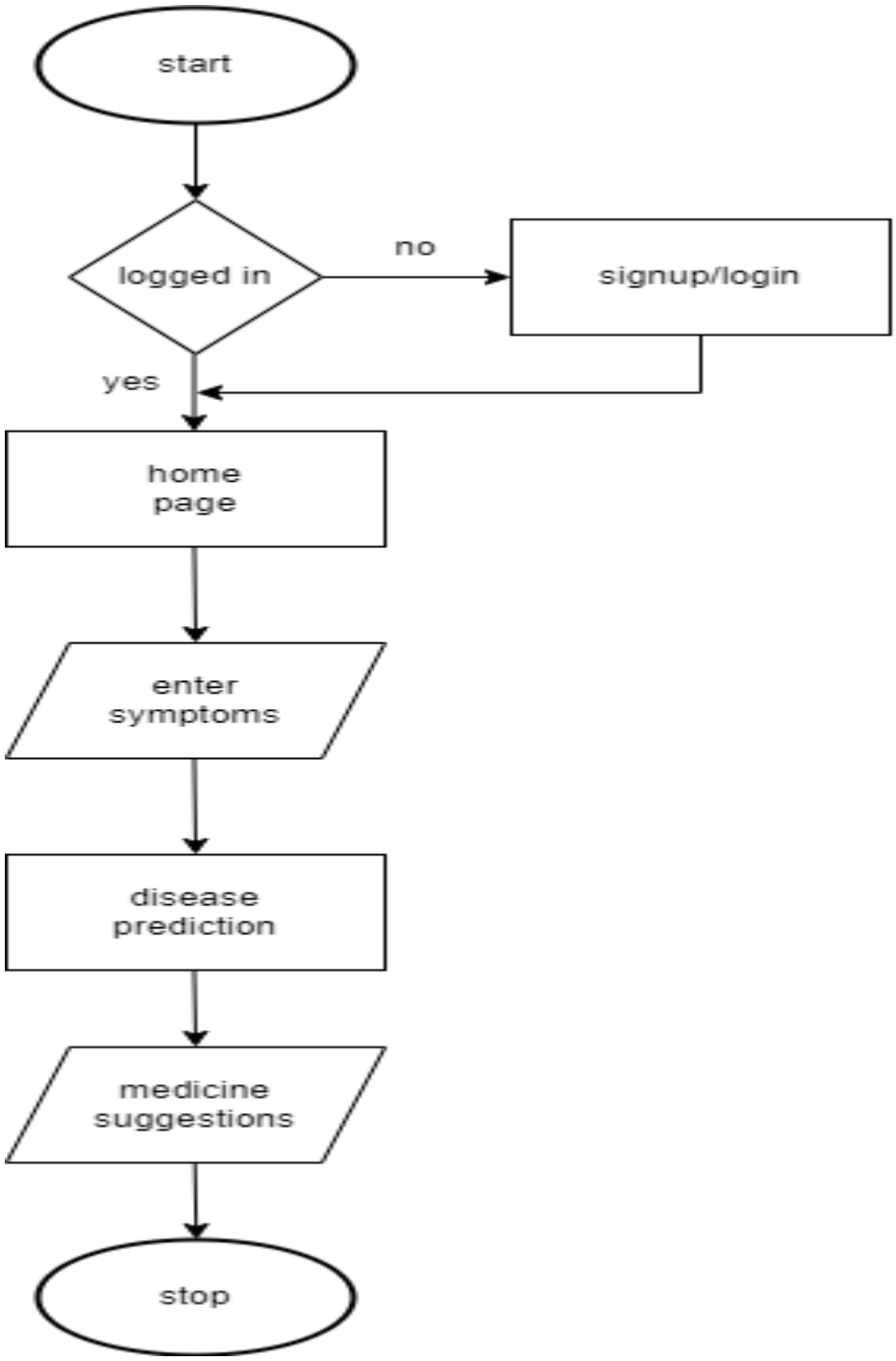

Figure 4 flowchart for proposed system

Zero level DFD diagram

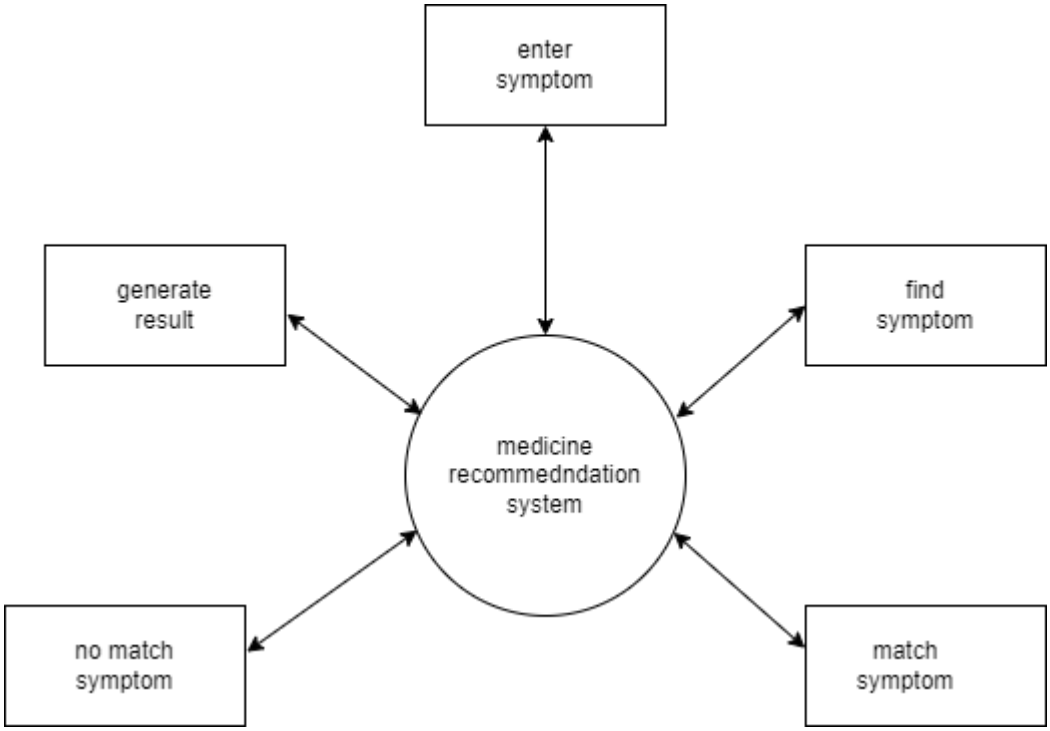

Figure 5 zero level DFD diagram for proposed system

State machine diagram

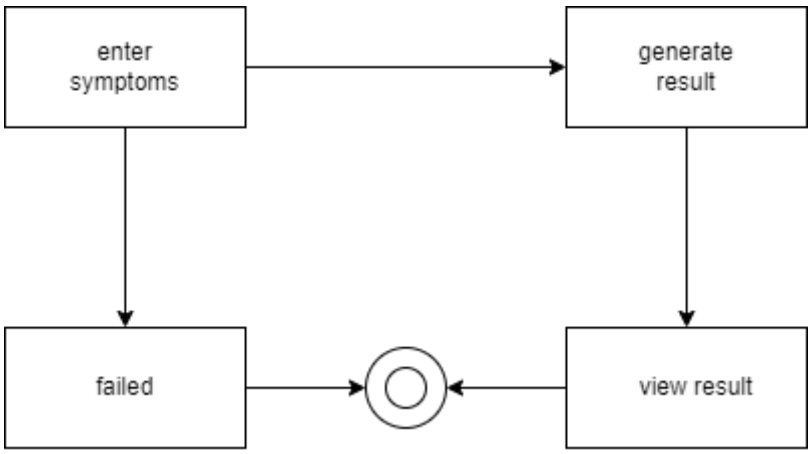

Figure 6 state machine diagram for proposed system

Sequence diagram

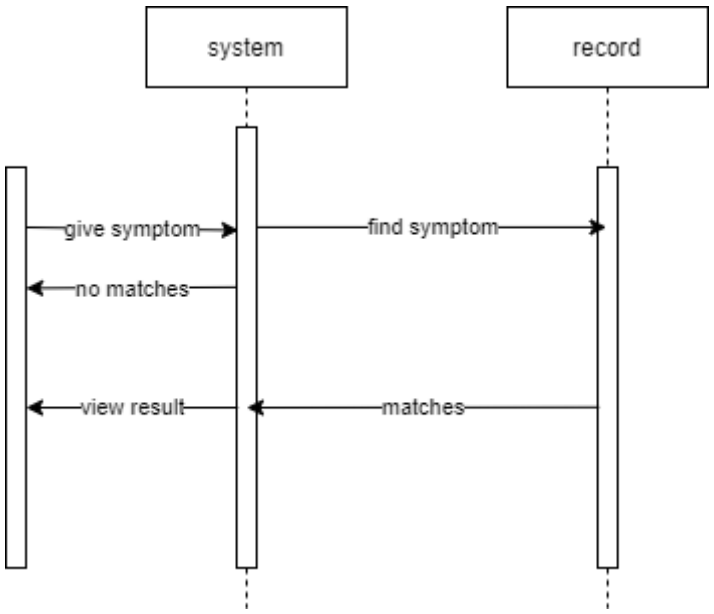

Figure 7 sequence diagram for proposed system

Activity diagram

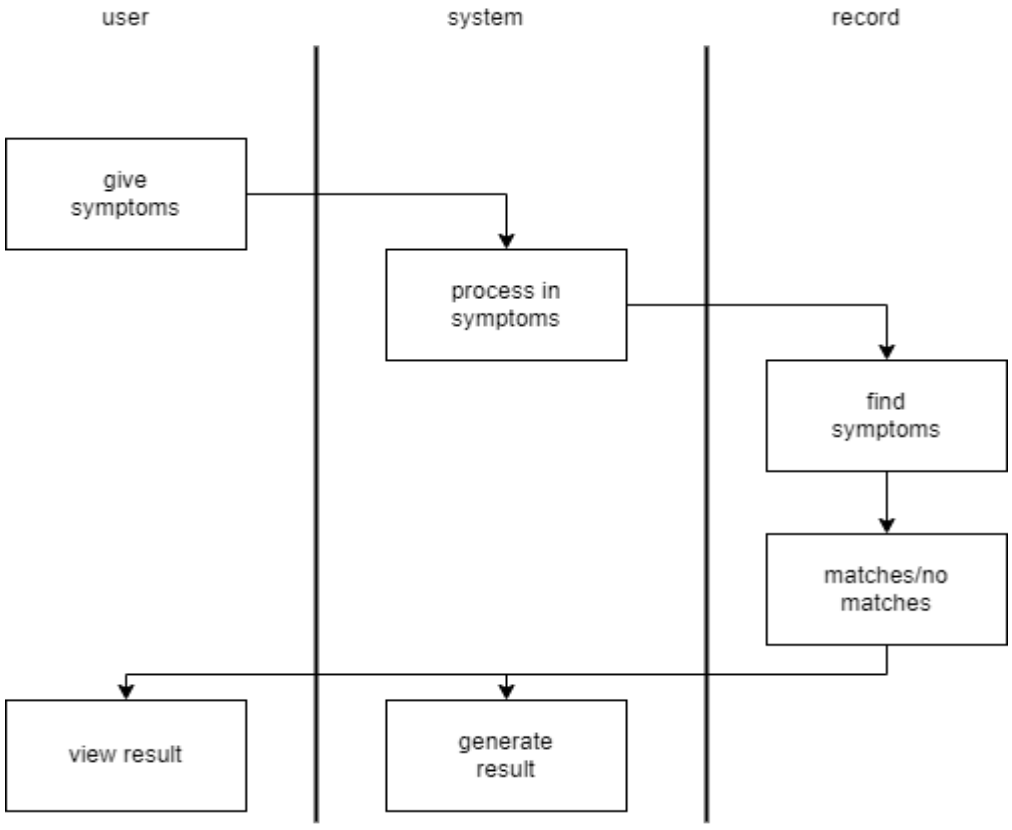

Figure 8 activity diagram for proposed system

ii. Description of algorithm

Support vector classification

Support Vector Classification (SVC) is a machine learning algorithm used for binary and multi-class classification tasks. It works by finding the optimal hyperplane that maximizes the margin between different classes in the feature space. SVC is effective in high-dimensional spaces and can be extended to handle non-linear data using kernel functions. For a linear Support Vector Classifier (SVC), the decision boundary is defined by a linear equation. The formula for the decision function f(x) is:

$f(x)=w\cdot x+b$

Where:

w is the weight vector (normal to the hyperplane).

x is the input feature vector.

b is the bias term (also known as the intercept).

· denotes the dot product.

Decision Rule:

If f(x)≥0, classify the input as one class (e.g., +1).

If f(x)<0, classify the input as the other class (e.g., -1).

Random forest

Random Forest is an ensemble learning algorithm that constructs multiple decision trees during training and merges their outputs to improve accuracy and prevent overfitting. Each tree is trained on a random subset of the data, and the final prediction is made by averaging the results (regression) or taking a majority vote (classification).

Classification

$$\hat{y} = \text{mode}\{h_1(x), h_2(x), \ldots, h_N(x)\}$$

Regression

$$\hat{y} = \frac{1}{N} \sum_{i=1}^{N} h_i(\mathbf{x})$$

K nearest neighbor

K-Nearest Neighbors (KNN) is a simple, instance-based learning algorithm that classifies a data point based on the majority class among its k-nearest neighbors in the feature space. It is non-parametric and works well for small datasets, but its performance can degrade with high-dimensional data or large datasets.

Classification

$$\hat{y} = \text{mode}\left\{y_{i_1}, y_{i_2}, \ldots, y_{i_k}\right\}$$

Regression

$$\hat{y} = \frac{1}{k} \sum_{i=1}^{k} y_i$$

Description of data source

The data for this project was obtained from medicine recommendation data set by Noor Saeed and was obtained through platform popular by name Kaggle the dataset has average views and is frequently maintained time to time by the developers and other community members as well. The dataset is very huge and consists of data related to one hundred and thirty-two symptoms and forty-one diseases. Examples of data that can be retrieved from data set is precautions, information about disease and respective workouts and diet to follow.

Expected outcome

Improved Prescription Accuracy: The system provides user with data-driven medication suggestions along with best diet precaution and workouts.

Personalized Medication Recommendations: By analyzing patient symptoms, the system delivers tailored medication suggestions that match the specific needs and health conditions of patient.

Enhanced Patient Safety: The system helps identify potential disease infecting user and suggests accordingly.

Cost Savings: Reducing queuing time for doctor appointment and optimizing medication use can lead to cost savings for patients, potentially lowering overall healthcare expenses.

References

[1] E. K. J. J. K. U. J. Mrs. Lisha Kurian, "Disease Prediction and Medicine Recommendation Systems: A Comparative Analysis on learning algorithms," 2023.

[2] B. S. D. V. C. M. K. P. Silpa, "Drug Recommendation System in Medical Emergencies using Machine Learning," 2023.

[3] D. G. B. Ching-Seh (Mike) Wu, "Medicine Recommendation System Using Collaborative Filtering," 2022.