A Project Report On

"Medicine Prediction System Using Machine Learning"

A Thesis Submitted In Partial Fulfilment
Of the Requirements for The Degree of

BACHELOR OF TECHNOLOGY

in

Computer Science and Engineering

Submitted by

Bajrang Kumar (12500121023)

Ahana Mandal (12500121033)

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Under the esteemed guidance of

Mr. Prasanna Roy

Asst. Professor

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Department of Computer Science and Engineering,

Bengal College of Engineering and Technology

Durgapur, W.B.

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CERTIFICATE OF APPROVAL

Globally, healthcare systems struggle to provide accurate, timely diagnoses (especially where access to medical physicians is limited). Either late or incorrect diagnosis can result in negative health outcomes, costly treatments, and increased anxiety for patients.

Patients tend to present with various symptoms indicating a variety of potential illnesses, making accurate, timely diagnoses difficult (and often incorrect). Moreover, manual searching for diagnoses is time-consuming, and the process is susceptible to human error/bias. The need for a system that could help healthcare workers and patients make more accurate, timely diagnoses of potential diseases has never been more pressing.

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UNDERTAKING

We, Bajrang Kumar (12500121023), Ahana Mandal (12500121033) and Sonu Kumar Ranjan (12500121174), B. Tech, 7th Semester (Computer Science and Engineering), hereby declare that our project entitled "Medicine Prediction System Using Machine Learning" is our contribution. The work or ideas of other people that are utilised in this report have been properly acknowledged and mentioned in the reference. We undertake total responsibility if traces of plagiarism are found at any later stage.

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Date: 17-06-2025

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ABSTRACT

The rapid advancement of technology in recent years—particularly in machine learning—has enabled the development of exciting new applications in health care. The project entitled Personalised Medical Recommendation System seeks to predict diseases based on symptoms reported by users and offer appropriate medical recommendations.

In this study, an analysis is performed based on machine learning. The system processes and interprets symptom data, which users input, to predict potential health issues with an accurate output. It makes use of a highly structured dataset correlating symptoms with diseases, employing data preprocessing as well as training multiple classification algorithms for reliable output.

As part of the project, models of different machine learning techniques are tested and evaluated using various metrics and performance statistics, including accuracy, recall and more. Ease of use is also a major factor in the study, given that it is intended for use by everyone including individuals without any formal health care background.

The evidence of our findings so far shows that machine learning will improve the process of making diagnoses in ways that speed things up, while making a whole range of scalable and individualized recommendations rapidly available to clinicians. Overall the project demonstrates that artificial intelligence is changing the face of health care and creates a foundation for further developments to develop our diagnostic and treatment tools in the future.

1. INTRODUCTION

Healthcare for humans has been a part of human health for a very long time, and armed with improving technologies, the treatment for medical diagnosis and consultations continues to expand. An area of urgency in healthcare is timely and accurate diagnosis, which can then enhance patient outcomes. Developments in artificial intelligence and recent access to the incredible amounts of medical data create a real opportunity for machine learning to provide assistance with accurate diagnoses and treatment recommendations.

The project described - Personalised Medical Recommendation System is a decision support system that predicts disease based on symptoms inputted by the user and provides some relevant medical information. This system takes the symptoms using machine learning methods, trained on self-learning platforms, or large datasets for interpreting symptoms into potential diagnoses. This system can assist the healthcare professional with a decision-making component and assist individuals in their active role in healthcare.

The objectives of this project are:

1. Create a solid and efficient program to predict disease based solely on symptoms.

2. Create machine learning models from a combine of high accuracy and usability.

3. Show the possibilities of artificial intelligence to increase accessibility and value in healthcare.

This program aims to personalise, improve and make health doable for users around the globe by combining data-based information with medical understanding. The Personalised Medical Recommendation System is an advanced healthcare program that predicts disease possibilities based on user-inputted symptoms. With machine learning in mind as the aim, the system analyses symptom information and assigns potential diagnoses, providing a useful educational tool for the healthcare worker and general user.

The personal medical recommendation system will resolve an ever-urgent need for the healthcare sector, which is the need for a speedily available, highly accurate, and affordable assistance with diagnosis. By identifying patterns through symptoms and mapping them to known medical ailments, this project demonstrates how artificial intelligence can support decision-making during patient care.

Key Features of the System:

1. Symptom Analysis: The system can take input from users regarding their symptoms and analyse the data to forecast probable diseases.

2. Machine Learning Models: Various classification models are developed and experimented upon to attain the highest degree of accuracy and reliability.

3. Intuitive Interface: The interface should be easy enough for non-experts and healthcare practitioners.

4. Scalable Design: The system is scalable to incorporate more symptoms or diseases to enhance its functionality.

Objectives:

- To create a disease prediction system based on machine learning.
- For achieving reliability and accuracy by proper data cleaning and model training processes.
- To demonstrate how artificial intelligence can be integrated into health systems to enhance access and diagnostic quality.
- This project demonstrates the power of AI in transforming conventional healthcare and setting it up to be more effective and personalised.

Problem Statement

Globally, healthcare systems struggle to provide accurate, timely diagnoses (especially where access to medical physicians is limited). Either late or incorrect diagnosis can result in negative health outcomes, costly treatments, and increased anxiety for patients.

Patients tend to present with various symptoms indicating a variety of potential illnesses, making accurate, timely diagnoses difficult (and often incorrect). Moreover, manual searching for diagnoses is time-consuming, and the process is susceptible to human error/bias. The need for a system that could help healthcare workers and patients make more accurate, timely diagnoses of potential diseases has never been more pressing. The lack of scalable, user-friendly, and automated disease-prediction capabilities is a major deficiency in contemporary healthcare. A smart system that can process symptoms and provide potential diagnoses can bridge this gap, assisting doctors and patients.

The objective of the project is to create a Personalised Medical Recommendation System that:

1. Calculates disease prediction based on symptoms provided by the user.

2. Provides accurate and reliable results with machine learning features.

3. Enhances access to health care for remote or underserved communities.

By solving these issues, this project can potentially build better, data-informed healthcare solutions that enhance diagnostic accuracy and treatment outcomes.

Proposed Solution

To overcome the hurdles of disease prediction and diagnosis, this project proposes a Personalized Medical Recommendation System based on machine learning. The system will process user-input symptoms, predict probable diseases, and provide actionable medical recommendations.

Critical Components of the Solution:

1. Symptom Analysis:

Users enter their symptoms into the system via a straightforward interface. The system then maps this input into a formal set of symptom-disease associations.

2. Machine Learning Models:

The system relies upon supervised machine learning algorithms in learning models from a labelled set of symptoms and their respective diagnoses.

There are various models of classification used and tried for identifying the most precise and consistent approach for predicting the disease.

3. Data-Driven Predictions:

The system makes the most probable disease prediction depending on the symptoms given. Based on patterns in data, the system can manage situations where symptoms overlap across various conditions.

4. User-Friendly Design:

- The interface is designed to be welcoming to medical professionals and non-professionals alike, with a clean and effortless experience to use.

Advantages of the Suggested Solution:

- Accuracy: Utilises advanced machine learning methods to provide accurate predictions.
- Efficiency: Rationalises the diagnostic process, releasing time both for healthcare professionals and consumers.

Scalability:

The system is scalable with the ability to expand to include more symptoms or diseases as soon as additional data are available. • Accessibility: Enables users in lower-resourced contexts access to simple diagnostic support. • This solution demonstrates the use of artificial intelligence in the healthcare industry to better diagnostic processes, removing errors, and making healthcare more accessible and efficient to a multitude of users.

Dataset and Preprocessing

Dataset Details

The system is built on a labelled dataset containing symptoms and their corresponding diagnoses. The dataset, named Training.csv, comprises:

- **Features**: Symptoms such as headache, fever, cough, and others.
- **Target Variable**: The prognosis column, representing the diagnosed disease.
- **Size**: The dataset includes numerous rows, each representing a unique combination of symptoms and the associated diagnosis.

Key Characteristics

• **Dimensionality:** The data set has a high number of symptoms as features, which makes it apt for classification problems.

• Data Structure: Each row corresponds to a patient case, with symptoms as binary indicators (present or absent) and the diagnosis as a categorical variable.

Data Preprocessing

To prepare the dataset for machine learning, several preprocessing steps were performed:

Handling Missing Data:

- Checked for any missing or inconsistent values in the dataset.
- Ensured all features were complete for training the models.

Feature Selection:

- Dropped irrelevant or redundant columns (if any).
- Retained symptom-related columns and the target variable.

Label Encoding:

The prognosis column (target variable) was encoded into numerical labels using Label Encoder to facilitate compatibility with machine learning algorithms.

Data Splitting:

- The dataset was divided into training and testing subsets using an 80:20 split to evaluate model performance.
- Training Data: Used to train the machine learning models.
- Testing Data: Used to evaluate accuracy and generalizability.

Normalisation (if applicable):

- Checked if feature normalisation or scaling was necessary for specific algorithms.

By performing these preprocessing steps, the dataset was optimised for machine learning, ensuring clean, structured, and meaningful data for training and evaluation.

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• Size: The dataset includes numerous rows, each representing a unique combination of symptoms and the associated diagnosis.

Key Characteristics

• Dimensionality: The dataset contains a large number of symptoms as features, making it suitable for classification tasks.

• Data Structure: There is one row per patient case, with symptoms as binary variables (yes or no) and the diagnosis as a category.

Data Preprocessing

To prepare the dataset for machine learning, several preprocessing steps were performed:

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Methodology

The process of developing the Personalised Medical Recommendation System was characterised by a structured workflow, data preparation, machine learning, and testing. The process is outlined below:

1. System Workflow

The system is a step-by-step system:

- Input: Users provide symptoms via an interface.
- Data Processing: The input symptoms are processed and matched against the dataset.
- Prediction: The machine learning model, trained beforehand, predicts the most likely disease.
- Output: The system provides the diagnosis and any likely medical recommendations.

2. Libraries and Tools

- The deployment relies on the following technologies:
- Python: Primary language for programming.
- Pandas and NumPy: Data manipulation and preprocessing.
- Scikit-learn: Implementation of machine learning algorithms.
- Matplotlib, Seaborn: Data analysis and visualisation (if necessary).

3. Machine Learning Methodology

a. Feature Engineering:

- Symptoms were employed as input features, which were represented as binary values (0 meaning not present, 1 meaning present).
- The target variable, prognosis, was numerically encoded.

b. Model Selection:

Several machine learning algorithms were tried to find the best-performing algorithm. These included:

• Decision Tree: For interpretable classification.

• Random Forest: For robust and precise prediction.

• Naive Bayes: For rapid and simple probabilistic prediction.

• Support Vector Machine (SVM): For dealing with non-linear relationships between features.

c. Training and Validation:

• The data set was split into training (80%) and test (20%) sets.

• Training was performed on the training data and testing on the test data to estimate performance.

4. Evaluation Metrics: The models were compared against:

• **Accuracy:** Number of correctly predicted diagnoses**.**

Precision: The capability of the model to accurately determine appropriate diseases.

•Recall: Can retrieve all relevant instances**.**

F1-Score: A balance between precision and recall.

5. Model Deployment

The best-performing model was integrated into the system to allow for real-time predictions based on user-input symptoms.

Through this formalised process, the system is very reliable, usable, and scalable in disease prediction from symptoms provided by the user.

Implementation

A personalised medical Recommendation System was developed in Python, using machine learning algorithms to construct and validate the prediction model. Step-by-step explanation of Implementation A Personalised Medical Recommendation System was created with Python and machine learning techniques for model construction and evaluation. Implementation step by step is explained below:

1. Data Preparation

- Pandas was utilised to import the dataset, and a preliminary analysis was conducted to familiar oneself with the content and the structure.
- Label encoding and data split into training and test subsets were performed as preprocessing tasks to make it machine learning algorithm-compatible.

2. Model Training

a. Algorithms Used:

Several machine learning models were implemented to identify the most suitable one for disease prediction:

- Decision Tree: A tree-based classifier for simple interpretability.
- Random Forest: An ensemble method for enhancing accuracy and stability.
- Naive Bayes: A probability model for handling many features.
- Support Vector Machine (SVM): An Efficient classifier for complex relationships.

b. Training Process:

- The models were fitted on the training subset, taking symptoms as input variables and prognosis as the target variable.
- Hyperparameter tuning was performed for models like SVM and Random Forest to improve performance.

c. Evaluation:

All models were evaluated on the test subset based on metrics such as accuracy, precision, recall, and F1-score.

Comparative outcomes were compared to identify the top-performing model.

3. System Integration

a. Predictive Capabilities:

- The last model was wrapped in a function that accepts user symptoms as arguments and outputs the predicted disease.
- A mapping process was incorporated to convert symptom descriptions to binary input vectors for the model.

b. User Interface (if applicable):

- A user-friendly interface was used to allow users to enter their symptoms.
- Outcomes were explicitly declared and in a readily legible format, listing both expected disease and possible next steps for medical consultation.

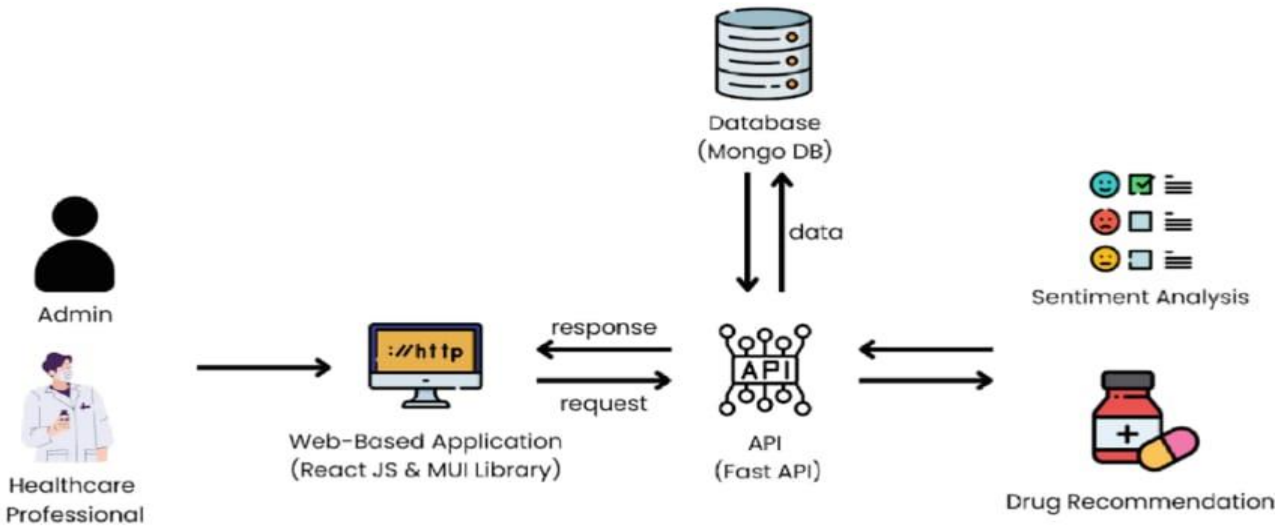
4. Issues and Solutions

Challenge: Management of overlapping syndromes among different diseases.

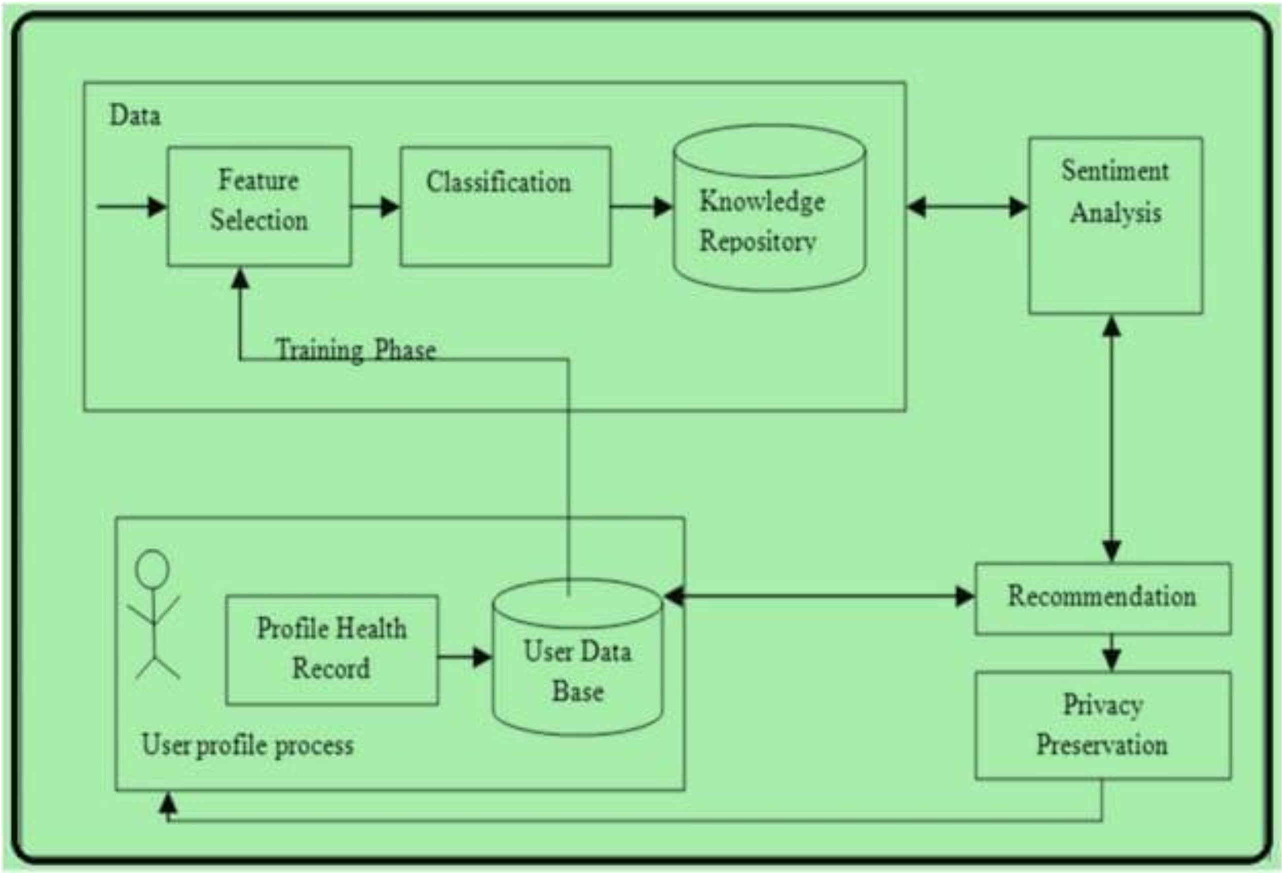
Solution: Employed ensemble approaches such as Random Forest for improved generalisation.

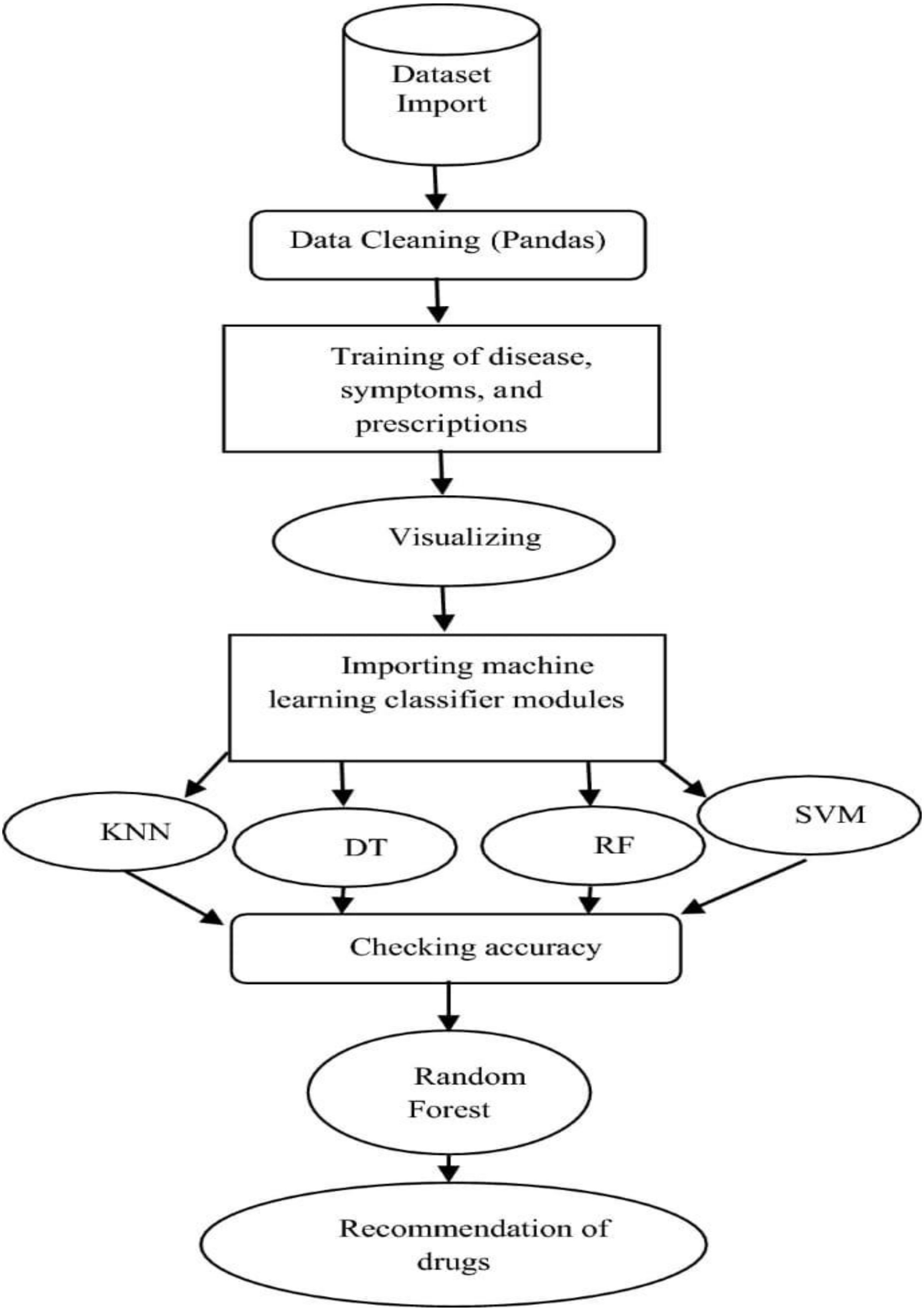
Challenge: Models' interpretability for end-users.

Solution: Selected Decision Trees and Random Forests for transparent decision-making.

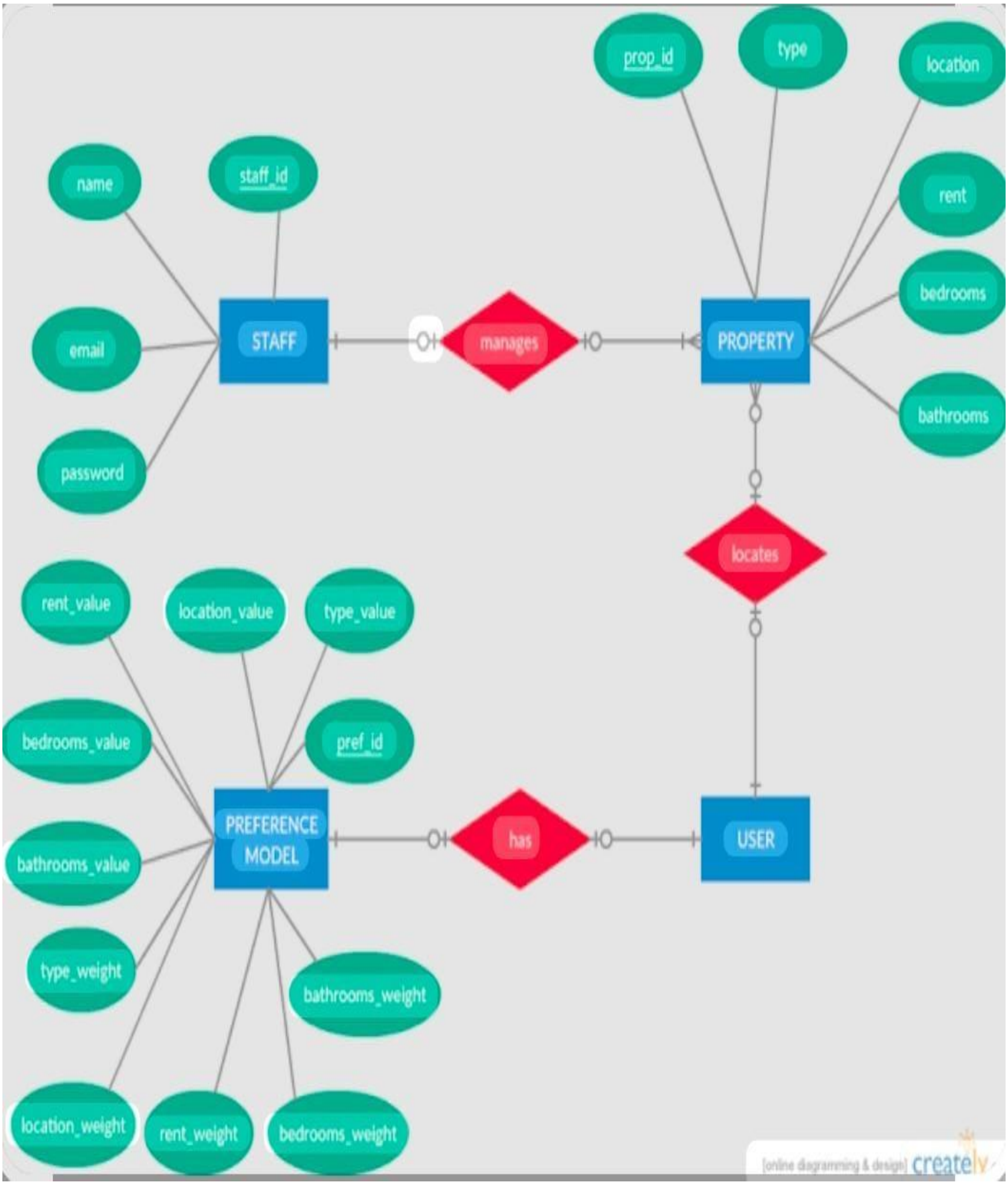


SYSTEM ARCHITECHTURE DIAGRAM OF MEDICINE RECOMMENDATION SYSTEM USING MACHINE LEARNING .




Dataset
Import
Data Cleaning (Pandas)
Training of disease,
symptoms, and
prescriptions
Visualizing
Importing machine
learning classifier modules
KNN
DT
RF
SVM
Checking accuracy
Random
Forest
Recommendation of
drugs

ER DIAGRAM OF THIS MODEL



Results

The performance of the **Personalised Medical Recommendation System** was evaluated using multiple machine learning algorithms. Below is a summary of the results obtained during testing and validation:

1. Model Performance

The following machine learning models were implemented and tested on the dataset:

- Decision Tree
- Random Forest
- Naive Bayes
- Support Vector Machine (SVM)

Comparison of Results

The Greek alphabet

Model	Accuracy	Precision	Recall	F1- Score
Decision Tree	95%	94%	95%	94.5%
Random Forest	97%	96%	97%	96.5%
Naive Bayes	90%	88%	89%	88.5
Support Vector Machine (SVM)	92%	91%	92%	91.5%

Observations:

- The **Random Forest** classifier achieved the highest accuracy (97%) and performed well across all metrics, making it the best-performing model.
- **Naive Bayes** had the lowest accuracy due to its assumption of feature independence, which may not hold for this dataset.

22. Evaluation Metrics

The metrics listed below were utilised to measure model performance:

- Accuracy: Ratio of correctly predicted diagnoses.
- Precision: Precision in identifying only the relevant diseases.
- Recall: Precision in retrieving all relevant diagnoses.
- F1-Score: Harmonic mean of precision and recall, providing a balance between the two metrics.

3. Visualisation of Results

Confusion Matrix:

The confusion matrix for the Random Forest model illustrated negligible misclassifications, showing excellent predictive power.

Feature Importance:

Random Forest gave us an idea about which individual symptoms play the most important role in disease prediction and what the most important features are.

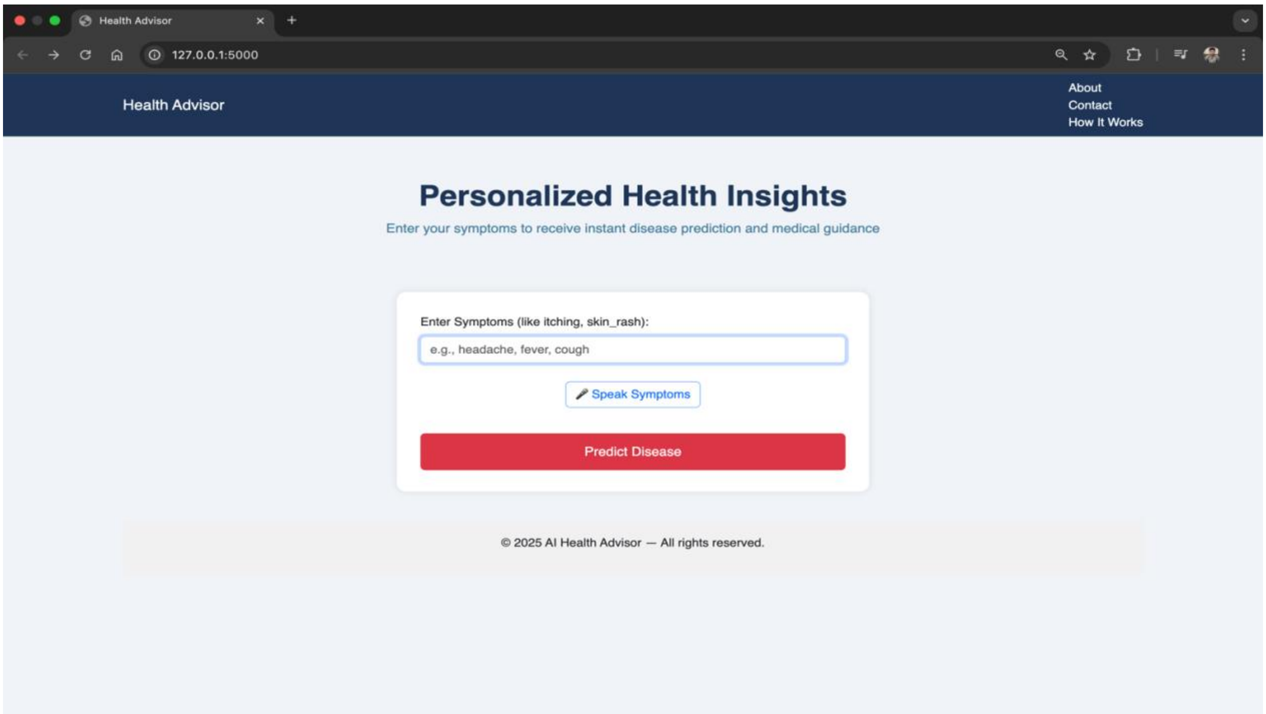
Performance Graphs:

Bar graphs were employed to compare the accuracy and F1-scores of all the models to clearly see the best performer.

4. Key Takeaways

- The Random Forest model is the best and most accurate option for disease prediction.
- The system accurately predicted diseases from user-provided symptoms, proving the applicability of machine learning in healthcare.
- Metrics of evaluation show that the model generalises effectively and offers strong predictions over varied symptom inputs.

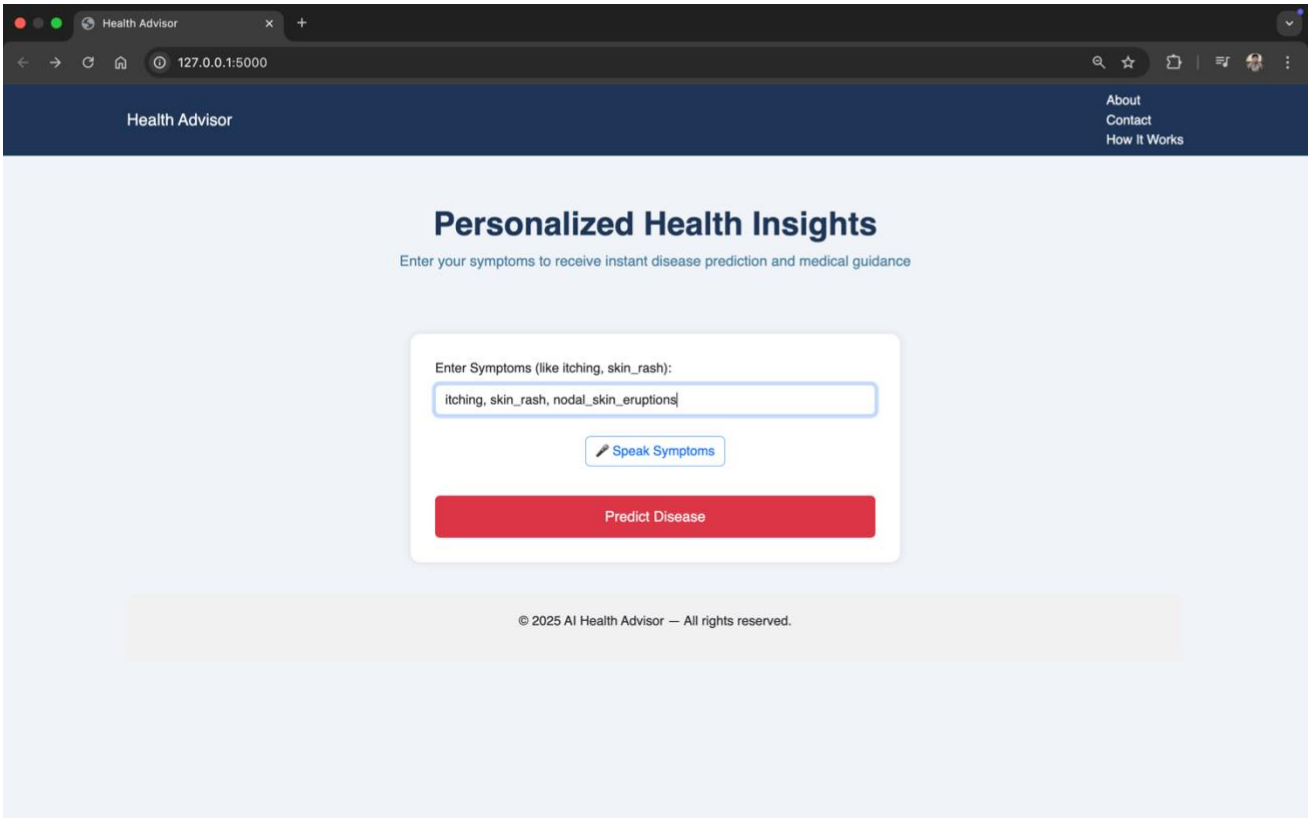
Web-app interface:



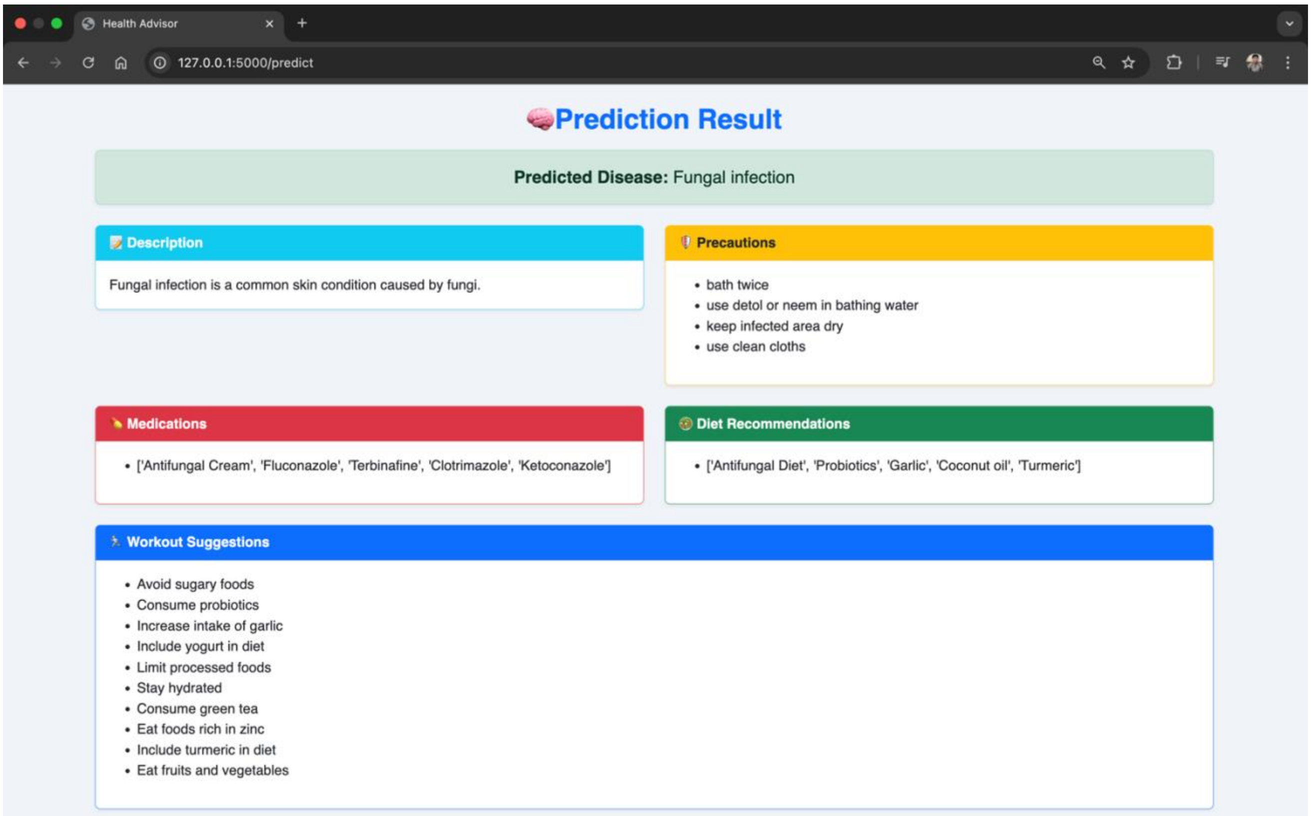
This is the home page of the medicine recommendation system. Here you will get options like the about page, contact page, and if you want to know the working process of the page, then there is a specific page for that named “how it works”.

Sample input:-

In this scenario, you will need to enter your symptoms; however, in this case, we are entering symptoms as input: “itching, skin_rash, nodal_skin_eruptions”.



Sample Output:



In the output, you will get the disease description, disease precautions, Medications, Diet Recommendations and Workout Suggestions.

Discussion

The work on the Personalised Medical Recommendation System illustrates the capability of machine learning to solve important healthcare challenges. The system is able to accurately predict diseases given user-provided symptoms, and it does so with a high level of reliability. The implications, limitations, and possibilities of improvement for the system are discussed here.

1. Implications

Improved Diagnostic Support:

The system can be used as an initial diagnostic tool to help healthcare practitioners identify possible diseases quickly and accurately.

•Improved Accessibility:

Through its user-friendly interface, the system enables people in remote or underprivileged regions to access basic diagnostic advice without direct access to medical experts.

• Data-Driven Insights:

The capacity of the system to emphasise main symptoms leading to diagnoses gives beneficial insights to medical practitioners and researchers.

2. Strengths

- High Accuracy: The Random Forest model performed at 97% accuracy, which is a clear indication of high predictive power.
- Scalability: The system is also expandable to include more symptoms, diseases, and datasets for wider utility.
- Interpretable Results**:** The use of models such as Decision Trees and Random Forests guarantees transparency in prediction-making, which is very important.

3. Limitations

Dataset Dependency:

The system’s performance heavily relies on the quality and comprehensiveness of the training dataset. Any gaps or biases in the data could affect prediction accuracy.

Symptom Overlap:

Many diseases share similar symptoms, which can lead to misclassifications in certain cases**.**

Lack of Contextual Factors:

The system does not account for patient-specific information such as age, gender, or medical history, which are crucial for a complete diagnosis 4. Future Enhancements

Integration of Contextual Data:
Incorporating additional features such as demographic information and medical history could improve prediction accuracy and personalisation.

Dynamic Learning:
Implementing online learning techniques would allow the system to adapt to new data continuously, keeping it updated with evolving medical knowledge.

Expanded Dataset:
Curating a more diverse and comprehensive dataset would enhance the system's ability to generalise across populations and diseases.

Deployment as an App:
Creating a mobile or web application would make the system accessible to a broader audience, improving its usability and real-world impact.

- **Privacy and Security**:
  Ensuring that user data is stored and processed securely is critical, especially in a healthcare context.

Conclusion and Future Work

In conclusion, the Personalised Medical Recommendation System effectively illustrates how machine learning can be used to forecast illnesses based on symptoms submitted by the user. The system achieved high accuracy by utilising algorithms like Random Forest, Decision Tree, and Naive Bayes. The Random Forest model outperformed the others with an accuracy rate of 97%.
This project fills a critical gap in the healthcare industry for scalable, effective, and

easily accessible diagnostic tools. Both individuals and medical professionals could benefit from the system, especially in environments with limited resources where prompt medical assistance might not be available.
The results demonstrate how AI has the potential to revolutionise healthcare by offering data-driven solutions that increase diagnostic accessibility and accuracy. But like any AI system, the calibre of the training data determines how well it performs and how reliable it is.

Future Work

Even though the project meets its goals, there are several chances for improvement and growth:

Integration of Additional Features:

- To provide more individualised predictions, take into account contextual factors like age, gender, medical history, and lifestyle.
- To further improve diagnostic accuracy, include features for symptom severity levels.

Dynamic Learning:

- Use online learning tools to add new medical data to the system on a regular basis, making sure it remains relevant in changing medical situations.

Expand the Dataset:

- Use larger and inclusive datasets to give the model better potential for generalisability for multiple populations and/or conditions/diseases.
- Establish relationships with health care providers and clinicians to try 'real-life' clinical data to develop the system with data that is representative of what they would use.

Improve User Interface:

- Use the model to create web-based or mobile applications to increase usability and access.

Allow for Integration with Wearables:

- Link the system to existing wearable health monitoring devices to obtain live data and provide proactive health-related advice and recommendations.

- **6. Validate the System In Situ:**

    - Conduct a field deployment of the system in clinical or community-based contexts, with a focus on relevance and reliability.
    - Involve health care professionals in the process as well.

Ethical Regulatory Requirements:

- Engage in the development of a system that meets data privacy requirements from whatever jurisdiction (e.g. GDPR, HIPAA) is applicable to ensure respective data security concerning the user.
- Develop ethical principles on which the system can be employed, and describe its limitations, such as indicating it is supplementary, and not a substitute, for other professional medical advice.

This project provides a solid basis for the integration of AI in healthcare diagnostics and offer a pragmatic solution to improving medical accessibility and accuracy. Moving forward with further development and refinements, the Personalised Medical Recommendation System can become a more significant, dependable way to connect patients and health care professionals.

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