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AyuPredict – A Disease Prediction Model

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Abstract: *The AyuPredict model is a machine learning-based healthcare system designed to predict diseases and provide Ayurvedic treatment recommendations. This system aims to bridge the gap in healthcare accessibility, particularly in remote areas where medical facilities are scarce. The model leverages unsupervised learning algorithms, such as Random Forest, for disease prediction and supervised learning algorithms, like K-Nearest Neighbours (KNN), for recommending nearby hospitals.*

The system's architecture includes a user-friendly interface, disease prediction module, Ayurvedic treatment recommendation module, and hospital recommendation module. The model's performance is evaluated using accuracy metrics, with the Random Forest algorithm achieving an accuracy of 99.59% and F1 score of 99.58%.

The KNN algorithm is used for hospital recommendations, providing a list of nearby hospitals based on user input. Future scope includes integrating virtual consultation platforms, voice assistants, and multilingual support to enhance accessibility and usability. The AyuPredict model has the potential to revolutionize healthcare services by providing accurate disease predictions and personalized treatment recommendations, ultimately improving patient outcomes

Keywords: Disease Prediction, Ayurvedic Treatment, Random Forest, K-Nearest Neighbour, Healthcare Model

I. INTRODUCTION

In recent years, the intersection of artificial intelligence (AI) and healthcare has led to significant advancements in disease prediction and personalized treatment recommendations. AyuPredict is an innovative model that leverages these advancements, integrating machine learning algorithms to predict diseases based on user-input symptoms and recommending Ayurvedic treatments. This approach not only offers an alternative to conventional medical practices but also aims to address healthcare accessibility issues, especially in remote areas where medical facilities are limited. A Disease Prediction Model is a software which has a user-friendly interface that interacts with the user by allowing users to select symptoms from a dropdown box. Our AI model serves the purpose of diagnosing diseases whenever the user will select the symptoms they are suffering from. Users can input their symptoms into the system, which then processes this information to predict potential diseases. The interface is built using Streamlit, an open-source Python framework that facilitates the creation of interactive web applications for data scientists and AI/ML engineers to deliver dynamic data apps with only a few lines of code.

The model employs the Random Forest algorithm, an unsupervised learning technique known for its robustness and high accuracy in classification tasks. Additionally, the system suggests Ayurvedic home remedies tailored to the predicted disease, providing users with immediate and natural treatment options. One of the key advantages of AyuPredict is its dual capability of disease prediction and hospital recommendation. By incorporating the K-Nearest Neighbours (KNN) algorithm, the model can recommend nearby hospitals based on the user's location. This feature is particularly beneficial for users experiencing severe symptoms who may require prompt medical attention. The integration of these functionalities into a single platform ensures that users receive comprehensive healthcare support, ranging from preliminary diagnosis to suggestions for professional medical assistance.

The development of AyuPredict involved a thorough literature review to identify existing methodologies and technologies in healthcare chatbots and disease prediction models. Studies have shown that AI-driven chatbots can significantly enhance the accuracy and efficiency of disease diagnosis. For instance, Jegadeesan et al. (2023) utilized

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Natural Language Processing (NLP) for symptom extraction and disease classification, achieving an accuracy of 82%. Similarly, Perera (2022) demonstrated the efficacy of an advanced symptom checker that employed neural networks and fuzzy systems, achieving an overall accuracy of 82.2%.

Despite these advancements, many existing models focus primarily on conventional medical treatments, often neglecting alternative medicine approaches such as Ayurveda. AyuPredict addresses this gap by integrating Ayurvedic treatment recommendations, thus offering a holistic healthcare solution. Ayurveda, an ancient system of medicine, emphasizes the balance of bodily systems and the use of natural remedies. By incorporating Ayurvedic treatments, AyuPredict not only provides users with immediate relief options but also promotes long-term wellness and disease prevention.

The architecture of AyuPredict is designed to ensure ease of use and accessibility. The user interface allows for seamless interaction, where users can select symptoms from a predefined list. Once the symptoms are input, the Random Forest algorithm processes the data to predict the disease. This prediction is then cross-referenced with a database of Ayurvedic treatments to provide personalized recommendations. For users requiring further medical assistance, the KNN algorithm generates a list of nearby hospitals, thus bridging the gap between self-care and professional medical care.

In developing AyuPredict, several Python libraries were employed to enhance the model's functionality. Libraries such as Pandas and NumPy were used for data manipulation and processing, while Scikit-learn provided the necessary tools for implementing machine learning algorithms. Data visualization tools like Matplotlib and Seaborn were utilized to evaluate model performance and accuracy. The use of joblib and pickle libraries enabled efficient model saving and loading, ensuring that the system can quickly process user inputs and generate accurate predictions.

The AyuPredict can be further developed by integrating additional features to further enhance its utility and accessibility. Potential developments include the incorporation of virtual consultation platforms, where users can schedule one-on-one sessions with Ayurvedic experts and other healthcare professionals. Additionally, the integration of voice assistants and multilingual support will make the system more accessible to a diverse user base. By continuously evolving and incorporating user feedback, AyuPredict aims to remain at the forefront of AI-driven healthcare solutions, ultimately improving patient outcomes and promoting holistic health.

Table 1: Abbreviations Used:

Sr.no	Abbreviation	Full Form
1	AI	Artificial Intelligence
2	ML	Machine learning
3	KNN	K- Nearest Neighbor
4	CNN	Convolutional Neural Network
5	NLP	Natural language Processing
6	NLU	Natural Language Understanding

II. LITERATURE REVIEW

The literature survey done on various papers show following results:

[1] Research gate: R Jegadeesan, Dava Srinivas, N Umapathi,G Karthick, N Venkateswaran,"PERSONAL HEALTHCARE CHATBOT FOR MEDICAL SUGGESTIONS USING ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING"

In the above paper, they used Natural language processing (NLP and NLU) for providing text-to-text assistance. The bot also suggested some medical advice. The disease classifier diagnosed diseases in two ways, severe and mild. If the diagnosed disease is severe the user is suggested to consult a doctor as soon as possible. The chatbot considered text as

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well as speech as input for the model in questions and answers interaction. The model algorithm was retrieval based with accuracy of 82%.

[2] NITC:Ananda Perera Primary Care Medicine St Joseph's Hospital (Pvt) Ltd., Negombo, Sri Lanka, "Demonstration and Validation of an Advanced Symptom Checker"

This paper is a comparison study of a Healthcare chatmodel ISABEL and model developed by the i.e. CAMEOS CHECKER. The model included a proper login system with username and password. The CAMEOS checker also suggested names of drugs to cure the diagnosed disease. It has a proper select box to choose the symptoms that the user is suffering from. The comparison study showed the CAMEOS CHECKER was more accurate than ISABEL checker.

[3] IJSER: M.V. Patil, Subhawna, Priya Shree, Puneet Singh "AI based healthcare chatmodel system"

In this paper there was a developed website and an android application of the chatmodel. They used Natural language processing (NLP) for questions and answers interaction between user and chat model. Model consisted of various libraries of python like Pandas, Numpy, Scikit for the development of disease diagnosing models.

The chatmodel interacted with 'yes' or 'no' commands. The model also mentioned the list of other symptoms which were not mentioned by the user before the disease was diagnosed.

[4] Dr. Sheetal Dhande Dandge, Bhumika Rangari,Khushi Jalan, Mitali Agrawal, Sanjana Maheshwari, Shruti Agrawal, "Implementation of Health-Care Chatmodel usingPython"

The paper included a rule-based approach model for diagnosing the disease. The model used Naive Bayes Classifier for diagnosing an accurate disease. The chatmodel used NLP (Natural Language Processing) for interaction with users. The chatbot was built using libraries chatterbot and flask. The dataset was in YAML format and disease was predicted by solving a query on the basis of Knowledge base. The accuracy of the model was 65%.

[5] ICCMC, Dhiraj Dahiwade, Prof. Gajanan Patle, Prof. Ektaa Meshram, "Designing Disease Prediction Model Using Machine Learning Approach"

In this paper, the authors proposed a general disease prediction model based on user symptoms. They worked on model h KNN and CNN algorithms to enhance the accuracy of disease prediction. By using a comprehensive diseases dataset, they integrated information about the individual's living habits and medical checkup history for accurate predictions. The CNN model yielded an accuracy of 84.5%, also demonstrating lower time and memory requirements than CNN. After disease prediction, the system assesses the associated risk level, categorizing it as either lower or higher for general diseases.

Table 2: Literature Survey (Comparison Study)

Sr	Authors	Description	Methodologies	Results/findings
1.	Jegadeesan Ramalingam, Umapathi Nagappan, Karthick Ganesan, Natesan Venkateswaran	The research paper discusses an AI-powered healthcare chatbot using NLP to identify diseases, provide medical suggestions, and offer alternative treatments like Ayurveda and Homeopathy	●NLP ●Machine Learning ●Retrieval-based algorithm ●Symptom extraction ●Disease classification ●Database storage	Disease predictions are provided only when symptoms are reported with a confidence level exceeding 80%, resulting in an accuracy level of approximately 82%, significantly higher than existing systems
2.	Ananda Perera Primary Care Medicine St Joseph's Hospital (Pvt) Ltd., Negombo, Sri	The goal of the project was to develop an advanced symptom checker, CAMEOS-CHECKER, using AI. The models utilized included neural networks, fuzzy systems, Bayesian probability calculations	Dataset -based on clinical scenarios extracted from the electronic medical records of the author's practice, which covers a primary care morbidity spectrum closely related to that of the	showing high sensitivity, positive predictive value, and accuracy, but lower specificity and negative predictive value. The sensitivity was 83.33%, specificity 50%, positive

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Sr	Authors	Description	Methodologies	Results/findings
	Lanka, bedeananda@gmail.com		community self-care spectrum. Models -neural networks, fuzzy systems, Bayesian probability calculations, and rule-based production systems	predictive value 97.56%, negative predictive value 11.11%, and overall accuracy 82.2%
3.	M.V. Patil, Subhawna, Priya Shree, Puneet Singh	Implementation of a healthcare chatbot using AI to provide medical advice and diagnose diseases. The models used in the study include Python, Pandas, NumPy, Scikit Learn, and Decision Tree Classifier	●Python ●Pandas ●NumPy ●Scikit Learn ●Decision Tree Classifier	The results found in the paper demonstrate the effectiveness of the chatbot in identifying diseases based on symptoms and providing relevant information to users
4.	Dr. Sheetal Dhande Dandge,KhushiJalan,BhumikaRangari,MitaliAgrawal,SanjanaMaheshwari,Shruti Agrawal	The research paper discusses the implementation of a healthcare chatbot using Python, aiming to create a web-based interface that assists patients in diagnosing common health issues by providing symptom-based answers	Uses NLU and the Naive Bayesian Classification Algorithm as models for the chatbot system	a chatbot that assists patients in diagnosing health issues based on symptoms provided, enhancing patient-doctor interactions and saving time for both parties
5.	Dhiraj Dahiwade, Prof. Gajanan Patle, Prof. Ektaa Meshram	aims to predict diseases accurately based on patient symptoms using KNN and CNN algorithms	Dataset - patient disease data obtained from the UCI ML website, consisting of disease lists with their corresponding symptoms Models - KNN, CNN	accuracy - 84.5 with CNN and highlighted CNN outperformed KNN in accuracy and time efficiency for disease prediction

III. METHODOLOGIES USED

For Disease prediction we used an unsupervised learning algorithm Random Forest. Random Forest is a machine learning algorithm that operates by constructing multiple decision trees during training and outputs the mode of the classes (classification) or mean prediction (regression) of the individual trees. It enhances the performance of decision trees by reducing overfitting and improving generalization through the use of ensemble learning and random feature selection.

For providing a list of hospitals nearby we used a supervised learning algorithm,that is KNN. K-Nearest Neighbors (KNN) is a simple machine learning algorithm used for classification and regression tasks. It classifies or predicts the value of a new data point based on the majority class or average value of its 'k' nearest neighbors in the feature space.

The Decision Tree will be used to train models and more efficient models will be used. For user interaction we will be creating a healthcare model with conversational interface deployed using Streamlit. Along with the model, some Python libraries are required, such as Pandas, NumPy, seaborn, joblib,pickle, matplotlib and Scikit-learn, for implementing machine learning algorithms. Python libraries required for healthcare model development include Streamlit for creating user interfaces for front end development.

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Matplotlib and seaborn were used for Data visualization to check accuracy of models and also build confusion matrices. Joblib library is used to save random forest algorithms and KNN model algorithms and load them into the frontend.Pickle library is used to load saved algorithms from model to pass the input received in frontend

IV. DATA PREPROCESSING

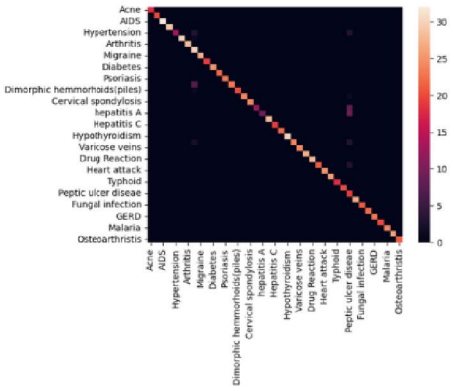
All of the values in the dataset are numerical i.e 0‘s and 1’s. The target column, which contains the disease names, is text data which is called categorical data. The categorical data is then label encoded to become a numerical form.
Depending on the type of data, the dataset must address missing data values using mean imputation or more complex procedures for data cleansing. It is necessary to remove all duplicate data formats and units for consistency and efficiency.

V. MODEL DEVELOPMENT

After cleaning the data, it will be used for working on the model part. Then it will be using Fold cross-validation to assess the machine-learning models. Model will be making use of a Decision Tree and Random Forest Classifier for cross-validation.

The Decision Tree Classifier:

For disease prediction and suggesting home remedies we are using The Decision Tree Classifier. Unlike deep learning methods, the Decision Tree Classifier is a non-parametric supervised learning algorithm used for classification tasks. It constructs a tree-like structure by recursively splitting the dataset based on features, aiming to maximize information gain or minimize impurity at each node. The final classification is determined by traversing the tree from the root to a leaf node, where each leaf corresponds to a class label.
Furthermore, the accuracy of the Decision Tree classification model is 95.833%, and its F1 score is 95.781%.



Decision Tree Heat Map:
This heatmap visualizes the importance of features in the Decision Tree Classifier.
Each cell represents the significance of a feature in the classification process, with color intensity indicating its importance level.
The visualization provides insights into the key features driving the classification decisions of the decision tree model.

Fig. 1. Decision Tree Heat Map

The Random Forest Classifier:

For disease prediction by taking symptoms from users and to suggest home remedies for the predicted disease we are using The Random Forest Classifier.
It is a deep learning machine learning classification method that uses a multitude of decision trees in its deep learning architecture. The outcomes of these weak decision trees are merged since all deep-down decision trees are weak learners. The final prognosis is the mode of all the prognoses.
Furthermore, the accuracy of the Random Forest classification model is 99.59%, and its F1 score is 99.58%.

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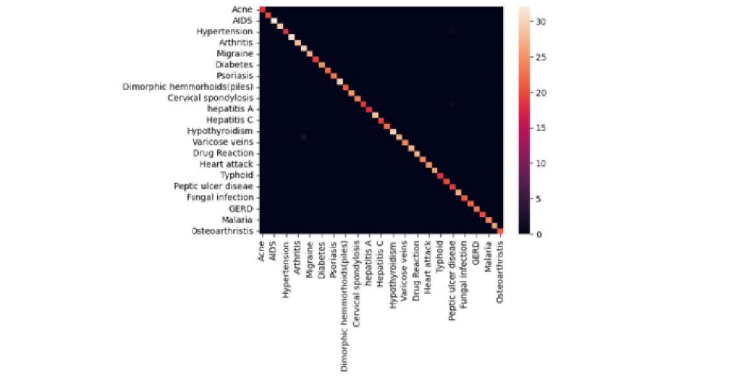

Random Forest Heat Map
This visualization depicts the feature importance scores generated by the Random Forest algorithm in our disease prediction model.
Each cell represents the significance of a feature in predicting disease occurrence.
The color intensity indicates the importance level, aiding in identifying key predictors for accurate disease prognosis.

Fig. 1. Random Forest Heat Map

On the basis of comparison study of the algorithms i.e. Decision tree and Random Forest Classifier, it is found that the accuracy of Random Forest Classifier is more than the Decision Tree Classifier. Therefore, Random Forest Classifiers will be used in the model for predicting disease.

The K-Nearest Neighbors (KNN) Classifier:

This algorithm is used for listingnames and addresses of nearby hospitals on the basis of input provided by the user when a city name is asked**.** Unlike deep learning methods, KNN is a straightforward instance-based learning algorithm used for classification. It works by calculating the distance between the input data point and its neighboring points in the feature space. The class label of the majority of the nearest neighbors determines the classification outcome for the input data point.

VI. SYSTEM ARCHITECTURE:

The system architecture of the AyuPredict healthcare model is described below along with a figure.

User Interface: A user-friendly interface that allows users to interconnect with the model and healthcare model

Healthcare mode: It includes components for intent identification and entity extraction, all presented through a Streamlit-based user interface.

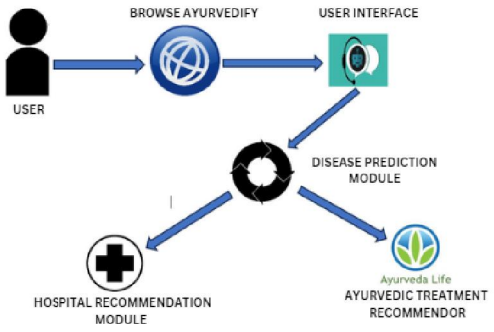

Fig. 3. System Architecture Diagram

Disease Prediction Module: This module includes Machine learning models and models for connection with healthcare model.

Ayurvedic Treatment Recommendation Module: It includes text analysis, recommendation engine and APIs for connection with healthcare model.

Hospital Recommendation Module: The module includes KNN algorithm, Hospital Datasets, Recommendation.

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VII. WORKFLOW

At the beginning the user will enter more than 2 symptoms into the healthcare model. The text processing will be facilitated.

The Disease prediction model will take symptoms as the input and predict disease by cross checking the dataset connected to the model. The disease prediction model will display disease and ask users the severity of the mentioned symptoms to recommend further suggestions.

If the user claims to experience a more severe rate of symptoms, they will be recommended to visit a doctor. The Hospital Recommendation module suggests hospitals nearby the user's city, providing options for immediate medical assistance. If the user would like to have some natural treatment and suggestions the Ayurvedic Treatment Recommendation module will recommend ayurvedic treatment to the user.

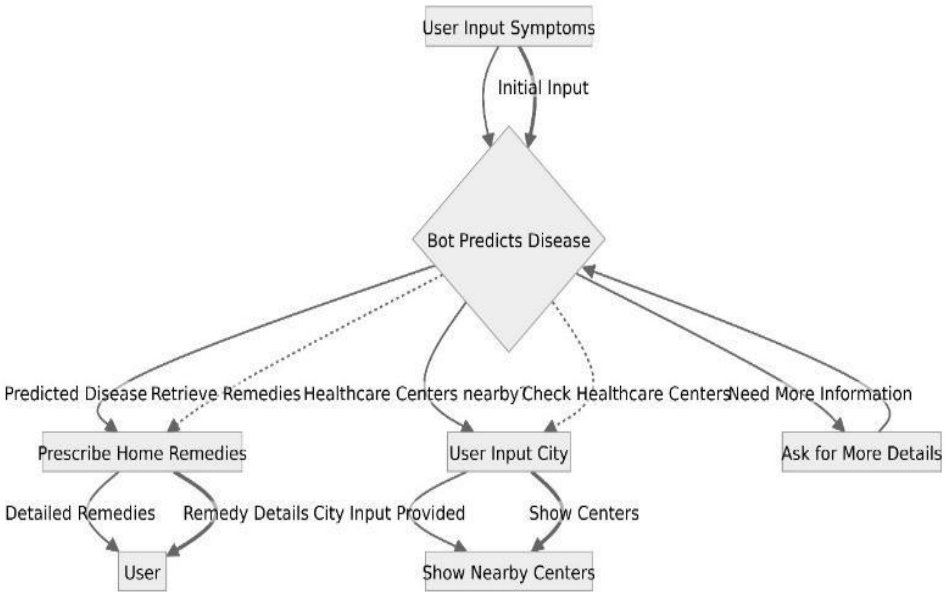

Fig. 4. System Workflow diagram

VIII. RESULTS AND OUTCOMES

Accuracy comparison of Decision Tree and Random Forest Algorithm.

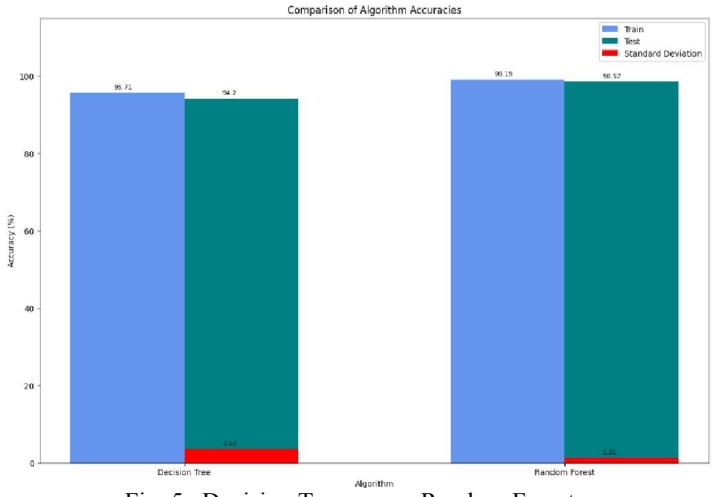

Fig. 5. Decision Tree versus Random Forest

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The accuracy of Random Forest algorithm:

```
rnd_forest = RandomForestClassifier(random_state=42, max_features='sqrt', n_estimators= 500, max_depth=13)
rnd_forest.fit(x_train,y_train)
preds=rnd_forest.predict(x_test)
print(x_test[0])
print(preds[0])
conf_mat = confusion_matrix(y_test, preds)
df_cm = pd.DataFrame(conf_mat, index=df['Disease'].unique(), columns=df['Disease'].unique())
print('F1-score% =', f1_score(y_test, preds, average='macro')*100, '|', 'Accuracy% =', accuracy_score(y_test, preds)*100)
sns.heatmap(df_cm)
```

```
[3 5 3 5 4 4 3 2 3 0 0 0 0 0 0 0 0]
Migraine
F1-score% = 99.58380389536958 | Accuracy% = 99.59349593495935
```

Fig. 6.1.F1 score of a disease

The output of the Random Forest Algorithm model. The model provides predicted disease name, description of Disease and recommends ayurvedic and home remedies to the user.

```
predd(rnd_forest,sympList[111],sympList[46],sympList[48],sympList[8],sympList[6],0,0,0,0,0,0,0,0,0,0,0,0,0)
```

Python

```
The Disease Name:  (vertigo) Paroymsal  Positional Vertigo
The Disease Discription:  Benign paroxysmal positional vertigo (BPPV) is one of the most common causes of vertigo — the sudden sensation that you're spinning or t
Recommended Things to do at home:
consume fresh ginger or drink 1 teaspoon of ginger juice on empty stomach
drink a glass of water mixed with coriander powder  and gooseberry powder kept overnight
shankhapushpi
calamus or vacha tonic
```

Fig. 6.2. Random Forest Tree output

Output of KNN Algorithm, providing a list of hospitals in a particular city when the user provides the name of his/her city.

```
user_location = 'Pune'
result = get_hospitals(user_location)
print("Hospitals in", user_location)
for hospital, address in result:
    print(hospital, "-", address)
```

```
Hospitals in Pune
Anand Hospital - Shrikrishnapalace,Sn 136,Near Malwadi Police Station Warje,Malwadi
Anand Hospital - Balaji Tower,Mahatma Phule Chowke,Chakan
Anand Hospital - Sector-26,Plot 113, Hutatma Chowk Pradhikaran, Nigdi Pune-411044
Balaji Hospital - Bye Pass Chowk,Nagar Road
Ashwini Hospital - Dattahasta 20/156,Bijali Nagar,Chinchwad
Ashirwad Hospital - 2Nd Floor,Punit Yash Arcade,Near Kothurd Bus Stand,Karve Road
Chaitanya Hospital - Bhagirathi Nagar, Warje Malwadi.
Chaitanya Hospital - Near Chinchwadgaon Police Chowky,Chapekar Chowk,Chinchwad,
Chaitanya Hospital - A/P-Koregaon Bhima, Tal. Shirur, (Pune), Maharashtra
Adarsh Hospital - Sn 11/12,Kondhwa Budruk,Near Katraj Khondwa Road,Near Kaveri Apartments
Ashwini Nursing Home - S.No#51,Plot#16,Dhanori Road,Maharanapratap Chawk,Vishrantwadi
Dhanwantari Hospital - Krishna Prasad Society Plot # 42, Rambaug Colony, Paud Road
Anjali Hospital - #568-Dr.Ambedkar Chowk Opp Delux Cinema Pimpri
Deshpande Hospital - Parekh B Towers, Biaroba Nala, Fatimanagar
Bora Hospital - #589, Ganesh Peth,Dhor Galli
Burute Hospital - B,2-3,Laxmi Classic Poona Alandi Road, Mohanwadi Near Vishrantwadi,Yerwada
Chandralok Hospital - Chaitraban Apt.,Chandrika Society,Bibawewadi Road
Anande Hospital - Near Old R T O Office,Ramnagar, Chandrapur,Near Old R.T.O. Office.
Darekar Hospital - Perne Phata,Poona Nagar Road,Tal Haveli
Dhanshree Hospital - Gp-66, G Block, Midc,Chinchwad, Pune-411019.
Bhakti Hospital - Pune Nagar Road,Sanaswadi Chowk
Bhide Hospital - # 18, Laxmi Park, Navi Pethnavi Peth, Pune-411030.
Chintamani Hospital - Plot # 53,Jedhe Nagar,Bibwewadi
Alatkar Hospital - Bhosale Garden,Opp 111 Bus Stop,Pune Solapur Road
```

Fig. 6.3. Output of KNN algorithm

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User Interface of AyuPredict:

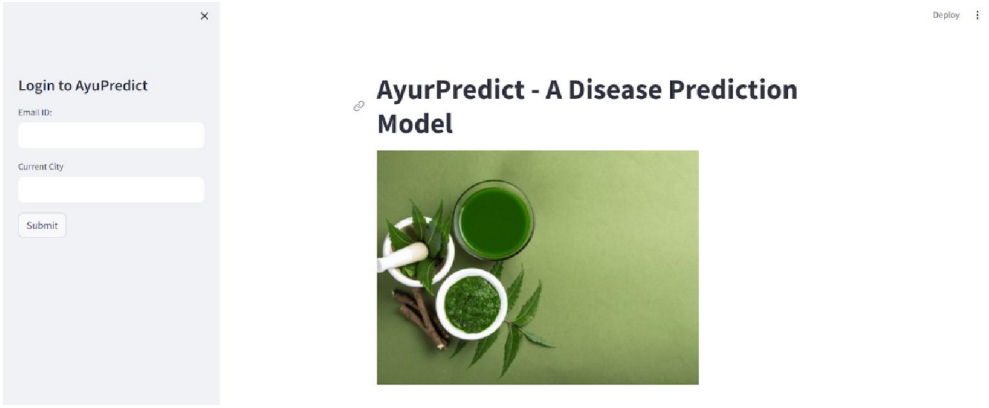

Fig. 7.1. First Page of User Interface

Selectbox provided to the users to choose the symptoms they are suffering from a given large list. They can directly choose the option.

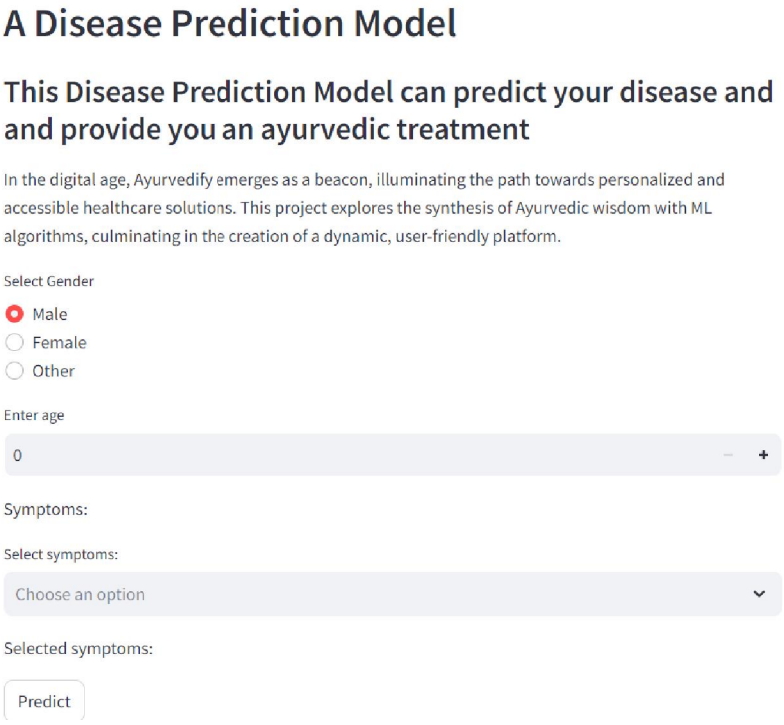

Fig. 7.2. Drop down options to enter symptoms

A box named “Predict” is provided. On clicking, it generates the output. It shows the name of the disease predicted, description of the disease and ayurvedic home remedies to cure the disease.

XI. FUTURE SCOPE

As healthcare models stay on track in medical services aiding patients may be improved, they effectively handle common problems and significantly simplify clinical procedures by ensuring that medical data is promptly accessible; reminding patients when appointments are due and performing preliminary assessments via clinical records.When subjected to strict diet plans, healthcare models can be very useful in giving users personal food suggestions and menus that are in line with their health needs depending on the patient’s nutritional requirements and health history. These AI-

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enabled assistants can recommend customized diet plans physicians have the option to manually enter appropriate diet regimens or use the healthcare models built-in algorithms

Virtual Consultation Platform can be implemented as a platform for users to schedule one-to-one consultations with Ayurvedic experts, nutritionists, and wellness coaches. Enable video conferencing capabilities for real-time interactions between users and experts, allowing for visual assessments and personalized guidance. Conduct comprehensive health assessments during consultations, including pulse diagnosis (Nadi Pariksha) and lifestyle evaluations, to tailor recommendations to each individual.

Further imposing a voice assistant could significantly boost accessibility and usability for patients in a variety of locales; integrating a few different languages such as Telugu, Hindi and other tongues like German and French might ensure that a broader range of users can engage with the system in a manner that is clear.

XII. CONCLUSION

Artificial intelligence has advanced to the point in the modern period that an algorithm can effectively learn from and imitate human conduct or speech, although healthcare models have been available for ten years their use has just lately and continues to rise notably in the healthcare industry similar to how other industries like autos are moving towards automated features.

Patients are also more likely to report their symptoms, have an intelligent agent evaluate them and most of the time receive a valid diagnosis without the need for a visit from a healthcare professional.

If this system is implemented efficiently, it can successfully predict diseases by taking symptoms from the user and provide them with proper Ayurvedic treatment. Additionally, it will recommend nearby hospitals and clinics based on the user's city, providing a list of options for medical assistance. Providing an Ayurvedic treatment will help the users to remove the cause of disease from the root. This model is helpful to many people of different age groups like students living away from home, elders alone in the city who cannot get out of home often.

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