Personalized Medicine Recommendation System Using Machine Learning

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Abstract. Personalized medicine recommendation systems are increasing in popularity to predict diseases and provide customized health advice on diet, workout plans and medication. 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. Through the use of machine learning algorithms like Decision Tree, Random Forest, K-Means Clustering, and Hierarchical Clustering, these systems analyze patient inputs such as lifestyle data, symptoms, and health metrics for accurate predictions of diseases and holistic recommendations on health. This inclusive process ensures each person receives tailored support to enhance the entire management of their health. The system's ability to suggest accurate diets, proper workouts, and appropriate drugs depending on the condition of the user significantly enhances its contribution toward more healthy lifestyles. The variety of algorithms increases accuracy and reliability as well because each model contributes uniquely in analyzing various aspects of patient data. This study presents a framework that demonstrates the system's efficacy in providing personalized disease predictions and health recommendations, which can benefit the development of preventive care and improve treatment outcomes.

Keywords. Machine learning, Decision tree, Recommender systems, Medicines, Random Forest

I. INTRODUCTION

Healthcare services tailored to individual needs have become on the upsurge as a result of progression in machine learning and acquisition of Electronic Health Records (EHRs). Such records enable healthcare practitioners to enhance disease predictions plus health management recommendations. Nowadays, people are also looking for medical information on the Internet, with more than half of the Internet audience (55%) searching for information on symptoms, treatments and medications in particular. Healthy system is developing considering larger emphasis on medical diagnosis, changes in lifestyle and preventive medical care. The classical view of health care, in relation to the average population, is useful, but as a rule, omits specific medical history and the genetics of each individual. For example, advanced Machine Learning models, such as Decision Trees, Random Forests or K-Means, Hierarchical Clustering and other similar algorithms are powerful enough to provide an analysis of patient information in order to evaluate the possibility of diseases development. These algorithms make it possible to form a complex of predispositions for nutrition, exercise and medicine for a particular patient. Thus, the main aim of this study is focused towards building of an all-inclusive personalized health recommendation system that is fortified with the appropriate machine learning models.

II. LITERATURE SURVEY

Yan Chao Tan et al. [1], proposed a Prescription help for clinicians using a symptom set-based drug recommendation framework with patient privacy protection. They specifically proposed Symptom- based Set-to-Set Small and Safe medication suggestion, which includes a unique set-to-set comparison module, symptom set module, and drug set module (4SDrug). This study has some flaws, such as the failure of the proposed approach to forecast diseases. There are no dose recommendations in the proposed approach.

S. M utagen et al. [2], a Pipelines for drug research and development are large, intricate, and dependent on a variety of factors. Machine learning (M L) techniques provide a collection of tools that help improve discovery and decision-making for well- defined issues with a large amount of excellent data. Opportunities to employ machine learning occur at many phases of drug development. Target validation, the discovery of prognostic biomarkers, and the analysis of digital pathology data in drug trials are some examples. The contexts and methodologies of applications have varied, with some methods producing precise forecasts and insights.

S. Garg, Anjum Unisa et al.[3], proposed a medicine recommendation system that uses cutting-edge methods such as machine learning, data mining, and others to uncover interesting information buried in medical data and reduce mistakes made by doctors while prescription medications. System is comprised of the database module and the data preparation module.

A. Abdelkrim et al. [4], A new feature selection strategy based on random forests is suggested for an efficient classification problem. They compare our feature selection strategy to base-line support vector machine and artificial neural network classifiers. The prediction of Drug-Target Interaction Using Weisfeiler-Lehman Neural Machine is another machine learning application given in the paper.

M. D. Hossain et al. [5], a system that recommends medications and can greatly lessen the workload of specialists. Researchers developed a system for suggesting drugs in this study that uses patient evaluations to anticipate sentiment using a number of vectorization approaches such as Bow, TF-IDF, Word2Vec, and manual feature analysis. System can assist various classification algorithms in suggesting the best treatment for a particular disease. To evaluate predicted sentiments, precision, recall, f1score, accuracy, and AUC score were utilised.

J. Shang, M ong li le, et al. [6], Graphs are used to depict the proposed system, drug interactions from an external drug database, and drug co-occurrences from the EHR. PREM IER surpasses material removal medicine recommendation algorithms in tests using M IM IC-III and a sensitive outpatient dataset, achieving the best balance of accuracy and drug-drug interaction.

Sun, J., Gamenet, et al. [7], proposed system will apply data fusion to reduce the needless strain on the system's processing resources and enhance the effectiveness of the suggested system in anticipating and advising this potentially fatal condition. To forecast disease, an ensemble machine learning model is trained. Utilizing a well-known disease dataset, this adaptive method is evaluated, and the results are contrasted with the most current advances in the field.

A. Sedik, Constanze Knahl, et al.[8], Authors undertake a study of the literature on current medical recommender system solutions, characterise and contrast them according to different aspects, and suggest potential future research areas.

Himanshu Gupta et al. [9], propose a strategy for determining the condition based on the patient's symptoms and then recommending the appropriate treatment. To accomplish the goal, a Decision Tree Map, Naive Bayes model, and Random Forest algorithm are used. This work investigates the development of a system that performs the twin duties of sickness prediction and pharmaceutical suggestion in order to improve the performance of the current system.

S. Dongre, Mahima; Nayak, et al. [10], Drug recommendation systems are created to help users choose the best medication for a specific health problem based on reviews made by other users on various medications for various specific condition. The purpose of this recommendation system is to examine the dataset using data mining concepts, sentiment analysis, and visualisation, and to recommend drugs based on each patient's health condition, ratings, and reviews using machine learning techniques, content, and collaborative filtering methods.

Paula Carracedo-Reboredo et al. [11], The purpose of the drug disclosure is to monitor new medicines with clear treatments. The approaches employed in this study have recently attracted significant attention in software engineering, as has the majority rules system's fast progress of AI techniques. In order to meet both the new problems and the objectives of the Advanced Medicine Initiative, a reliable, efficient, and fundamental computing approach must be established. Predictive models based on AI have been helpful up until this point in the pre-clinical stage. The price and amount of time needed to produce new medicines are considerably reduced by this process. This audit focuses on the most recent instances of research using this new technique. An industry -wide inquiry will provide light on the best outcomes, where chemo medicines will be produced in the future, and where they will end up. The focus of this audit will be on atomic data visualisation as well as biological problems investigated by machine learning algorithms that have recently been used to identify medications.

Ro han Gupta et al. [12], Medication readiness and advancement is an important aspect of drug organisations' and drug researchers' research. Nonetheless, incompetence, item delivery, efficient use of time, and significant costs create impediments and difficulties that affect science and disclosure. Furthermore, genomic, proteomic, microarray data, and solid, massive clinical medication data are interfering. with the medication recognition organisation. AI and ability knowledge play a significant role in revelation and improvement. Finally, neural organisations and top -down learning calculations have shifted areas. Peptide blend, analytic based, variation-based ligand, harmfulness expectation, drug control and discharge, drug screening, pharmacological activity, useful connections - drug, polypharmacology, physicochemical movement. In this segment, historical evidence emphasises the use of specialised insight and in-depth research. Similarly, the ability to extract, group, and manage new data has significantly improved the calculation plan. As a result, innovation and significant progress consider better medication planning and disclosure, which will eventually influence individuals.

METHODOLOGY

The BNN model is currently being used to recommend the drug. BNN represent all of t he random variables in the problem, as well as the conditional dependencies between them. However, neural networks are extremely complex, and their accuracy is low. Using CNN, the correct dosage was not suggested. The time complexity of this type of drug recommender system is high**.**

Proposed System

Many health severities occur because of a lack of immediate health consultancy and the right amount of drug dosage intake. Identifying the right disease based on the symptoms is happening only with offline doctor consultancy. Identifying the right drug for the combination of diseases is needed to avoid side effects. The proposed online drug recommender system provides immediate health consultancy and it also suggests the right amount of drug dosage, identifies the disease based on symptoms, and suggests a drug for the combination of diseases. This recommender system fulfills the basic first aid needs of patients. Users can use the web for the basic emergency first aid.

A large number of medications used in clinics and health centres in our daily lives are difficult to distinguish. It can also be unpleasant to realise every day unless you know exactly what you are doing. Drug is possibly the most important way to improve your well-being and prosperity. Standards are initially used to define a certain model. With the use of structured data, machines may now learn to illustrate and perform simple estimations using K-means clustering, Hirerical clustering. They developed models that may forecast the usage of drugs and their behaviours using SVM. The model can also suggest medications for a particular patient.

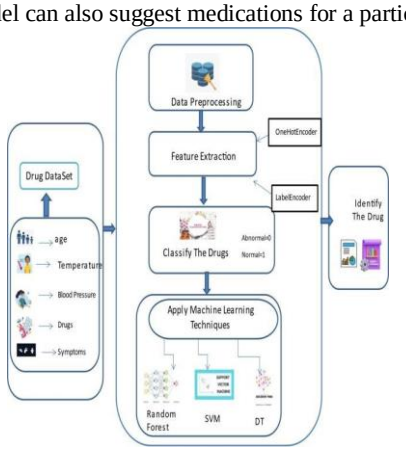


FIGURE 1. Process Workflow

The Three stages make up the medication recommender system's process. The data set must be uploaded first. The data collection includes characteristics like age, medication, dose, and conditions. Pre-processing of data happens after the data set has been submitted. Data pre-processing is the cleaning and filtering of data. It identifies and rejects null values, empty values, and repetitive rows from the decision-making process, resulting in high accuracy. The feature extraction approach converts unprocessed raw data into numerical features that may be handled while retaining the original data set's content. Following that, the medicine is categorised according to symptoms,blood pressure and sugar levels. There are two divisions in the categorization of medications. Different medications are administered to individuals with normal and abnormal illnesses. We employ machine learning methods to choose the best medication, diet and workout plans.

Algorithm:

data <- preProcessing(data)

//Loading pickle files diease <- disease.pkl drug <- drug.pkl dosage <-dosage.pkl diet <-diet.pkl workout <- wp.pkl

for x in request.form.values()

feature <- [np.array(x)]

disease_pred<-disease.predict(features) drug_pred <- drug.predict(features)

diet_pred <- diet.predict(features)

wp_pred<-wp.predict(features) return drug_pred+disease_pred+diet_pred+wp_pred End for

RESULTS

A. Generating accuracy for the trained and test results

TABLE 1. Accuracy of 4 algorithms

Model Type	Accurracy
Decision Tree classification	99.3
K-means clustering	91.23
Random Forest	97.2
Hierarchal clustering	92.73

TABLE 1. can predict the accuracy values for the four algorithms, with Decision Tree classification having the highest accuracy when compared to the other models.

B. Classification Report

The classification report of 4 algorithms models based on the review dataset.

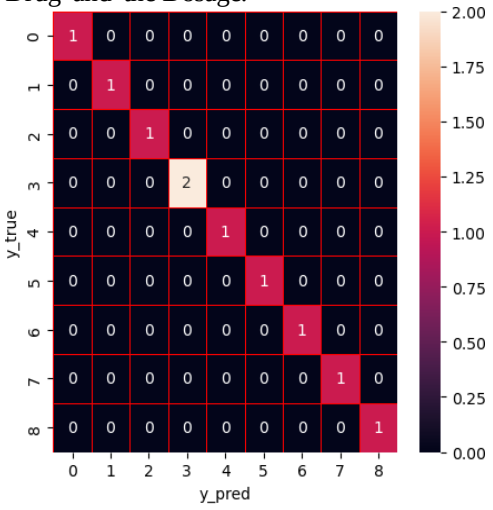
Table 2. Classification report of precision and recall

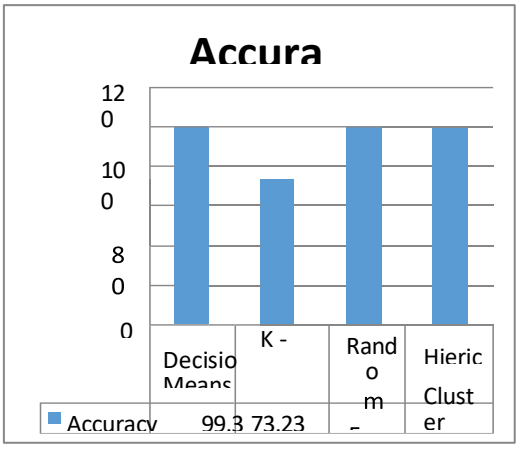
S.No	Model	Precision	Recall
1	Decision Tree	1.00	1.00
2	Random Forest	0.95	0.96
3	K-means Clustering	0.66	0.73
4	Hierical Clustering	0.96	0.97

Table 2 can give the classification report of the 4 models with the respective metrics as precision and recall values. In which Decision Tree has higher precision and recall metrics can obtained.

B. Confusion Matrix

The Decision tree classification algorithm performed better that the remaining models when the vales is set to the Drug and the Dosage.





C. Classification Metrics

	precision	recall	f1-score	support
Aubra	1.00	1.00	1.00	1
Bactrim	1.00	1.00	1.00	1
Campral	1.00	1.00	1.00	1
Clonazepam	1.00	1.00	1.00	2
Ethinyl estradiol / etonogestrel	1.00	1.00	1.00	1
Ivermectin	1.00	1.00	1.00	1
NuvaRing	1.00	1.00	1.00	1
Oxybutynin	1.00	1.00	1.00	1
Suprep Bowel Prep Kit	1.00	1.00	1.00	1
accuracy			1.00	10
macro avg	1.00	1.00	1.00	10
weighted avg	1.00	1.00	1.00	10

FIGURE 3. Classification Metrics for Decision tree

D. Trained and Test accuracy results in Bar chart

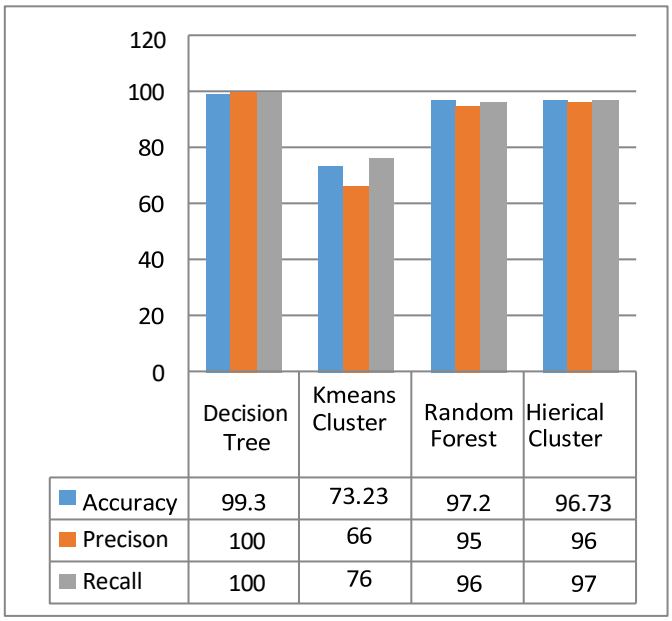
The plots of bar graphs show the accuracy of trained and test values for the four algorithms models.

Here Fig 4 displays the results of training and test data from the dataset, allowing for visualization of the accuracy outcomes. The Naviebayes, Random forest, Logistic regression, and decision tree classifier algorithms produced the following findings.

E. Comparison of algorithms with metrics

For certain values Decision Tree classifier range accuracy of 99.5 than other algorithms and those algorithms got values range of 90- 95.

CONCLUSION



The project presents a personalized medicine recommendation system by a combination of algorithms from machine learning that predict diseases and provide customized healthcare tips, including medication, diet, and workout plans. Notably, the supervised models used in the system-for instance Decision Trees and Random Forests result in high precision for disease prediction, while unsupervised learning techniques, including K-Means and Hierarchical Clustering, are utilized to better classify the group of patients under similar health profiles. This holistic approach enhances patient care by addressing both medical and lifestyle factors. The system's adaptability, driven by patient data, underscores its relevance in personalized healthcare solutions. However, its reliance on static data limits its real-time effectiveness, and future developments should focus on incorporating dynamic health data to provide timely and evolving recommendations.

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