Integrating AI into Ayurvedic Practice for Precision Dosage Recommendations

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Abstract- **The Artificial Intelligence with ayurveda is long-standing(ancient) Indian system medicine which offers promising direction for personalized healthcare. By integrating traditional ayurvedic concepts as Prakriti and Vikriti with machine learning algorithms. It aims to enhance the treatment accuracy and patient outcomes. The system predicts the user proclivity by analyzing the ratings. Artificial Intelligence accelerates the herbal medicines discovery and formulates to ensure the drug integrations. The tools will help to generate the dosage plans for adaptability to change the patient health and real-time feedback which offers the lifestyle advice on ayurvedic principles. It evaluates and compares the fulfillment of three classifier algorithms they are Multinomial Naïve Bayes, Random Forest Classifier and XGBoost, Here the main algorithm used is MNB. Two additional algorithms are evaluated in comparison to Random Forest Classifier and XGBoost. The main purpose of this comparison is to find best predictor**

Index Terms: **Artificial Intelligence, Ayurveda, Dosage Optimization, Multinomial Naïve Bayes, Personalized Treatment, Random Forest, XGBoost.**

1. INTRODUCTION

Ayurveda, one of the most ancient systems originating from India, has a history that extends over 5,000 years. The holistic philosophy of Ayur, translating to "life" in Sanskrit, combined with Veda, meaning "knowledge," seeks to maintain equilibrium among the mind, body, and spirit. These practices are founded on the effectiveness of the principle of balance. When formulating treatment plans, the unique prakriti of each individual is carefully considered. The Ayurvedic theory lies on Tridosha where Vata, Pitta and Kapha which is physiological processes in human body. The Ayurvedic is facing scalability, accuracy, accessibility in urban and global healthcare systems. Now a days, the healthcare scenario increasing demands on personalized medicine, which gives to individual patient by knowing on hid health data. The prospects of Artificial Intelligence in Ayurveda highlights its potential in several domains (pulse and tongue analysis) which enhancing prakriti determination through multi model data integration and herbal formulations through Artificial Intelligence assisted analysis, The integration of AI empowers Ayurvedic Systems to become an more data driven, quantifiable and user centric. Ethical considerations for data privacy and interdisciplinary collaboration between Ayurvedic experts for the successful implementation of technologies, the involvement of AI developers is also crucial.

Contemporary medicine employs clinical decision support systems, predictive analytics, and real-time patient monitoring. The advent of a new era characterized by sustainable and personalized healthcare may be facilitated through collaboration, academic research, and the integration of both modern and Ayurvedic treatments. Furthermore, for this transformation to take place, it is essential that all stakeholders within the healthcare ecosystem share a common culture and philosophy. The introduction of machine learning has revolutionized the methods by which data is processed, analyzed, and interpreted. It is very effective, accuracy and versatility in handling various data types, Multinomial Naïve Bayes, Random Forest and XGBoost have become well liked options among many classification algorithms Due to its user-friendliness and computational efficiency, multinomial Naïve Bayes proves to be particularly advantageous for tasks that involve discrete features and text classification. The Random Forest Classifier represents a collaborative learning approach that leverages collective decisions to mitigate excessive overfitting and enhance prediction accuracy. Initially,

Multinomial Naïve Bayes is implemented, followed by the incorporation of Random Forest and XGBoost for comparative analysis. By utilizing performance metrics such as accuracy, precision, recall, and F1-score, the most effective model is selected for final deployment. Subsequently, other models are utilized as benchmarks to assess the reliability of the models.

The significance of this research paper is rooted in its ability to introduce structure and accuracy to a field that has traditionally relied on manual expertise. Ayurvedic treatments are recognized for their high level of customization., which is a strength, but this also leads to inconsistencies when different practitioners prescribe varying dosages for similar conditions. In a time when data-driven decision-making is revolutionizing all sectors, it is vital to apply the same innovations to Ayurveda. The development of an AI-based Clinical Decision Support System (CDSS) for dosage recommendation can offer consistent, accurate, and personalized solutions by learning from vast sets of patient records and outcomes. Such a system not only enhances the reliability of treatments but also aids new or less-experienced practitioners in arriving at appropriate decisions. Moreover, this tool can streamline treatment planning, reduce dosage errors, and offer real-time guidance to both practitioners and patients. In healthcare systems that are overburdened, such intelligent support can reduce delays in treatment and enhance patient care. As the demand for personalized medicine increases globally, this project becomes a timely and relevant solution that aligns with future trends in integrative healthcare.

2. PRIOR ART

[1] Sharma A and Singh P (2020) “Challenges in Ayurvedic Drug Dosage Determination”. This paper outlines the complexities of determining Ayurvedic dosages, emphasizing that treatment plans vary widely due to reliance on practitioner experience. It argues for more structured, data-driven solutions to standardize care. This paper outlines the complexities of determining Ayurvedic dosages, emphasizing that treatment plans vary widely due to reliance on practitioner experience. It argues for more structured, data-driven solutions to standardize care.

[2] Gupta et al. (2019) “AI-Powered Clinical Decision Support Systems in Medicine”. This study explores how AI-based CDSSs are transforming modern healthcare by improving diagnostic accuracy and treatment speed. It discusses frameworks used in hospitals to guide clinical decisions. Provides reference architecture and inspiration for building a similar AI system for Ayurveda, Focused solely on modern medicine with no exploration of traditional or holistic systems.

[3] Kumar et al. (2021) “Machine Learning Models for Personalized Drug Recommendations”. The authors implemented ML models to analyze patient health records and recommend medication doses tailored to each individual in allopathic medicine, Models require large, clean datasets and may struggle with unstructured data. Validates the use of ML for dosage prediction and supports its adaptation for Ayurvedic contexts.

[4] Das P and Verma R (2022) “Classifying Patient Dosha Types Using ML Techniques”. This work applies clustering algorithms like K-Means and KNN to classify patients based on Dosha profiles, helping in individualized Ayurvedic treatment. Focuses only on classification, not on dosage recommendations, offers insight into how ML can interpret Ayurvedic parameters like Prakriti and Dosha for personalized care.

[5] Bose R and Chatterjee S (2020) “Web-Based AI Systems for Healthcare Decision-Making”. The paper explains how AI can be embedded in web platforms for real-time interaction, diagnosis, and treatment planning. It provides case studies of successful implementations in hospital settings. Does not focus on herbal or traditional treatments, Guides the technical structure for building our system as a responsive web application.

[6] T Thanushree and K.G. Manjunath (2022) present the study titled "Ayurvedic Medicine-based Automated Machine Learning Approach for Determining the Nature of the Human Body." This research proposes an automated machine learning technique that utilizes questionnaire data to ascertain a person's Prakriti, which refers to their Ayurvedic body type. It improves health diagnoses by fusing contemporary AI technology with traditional Ayurvedic concepts. Several models, including Feed-Forward Neural Networks, Logistic Regression, Naïve Bayes, SVM, and Decision Trees, were trained and assessed. The Neural Network outperformed the others, with an accuracy of more than 91%. According

to the study, AI has the potential to improve individualized Ayurvedic treatment.

[7] Madaani, V., & Goyali, A. (2020) "Predicting Ayurveda based constituent balancing in human body using machine learning methods". This research paper explores the use of machine learning to predict and balance Ayurvedic body constituents (Doshas: Vata, Pitta, Kapha) through data-driven models. The study integrates traditional Ayurvedic concepts with modern computational techniques to create customized healthcare solutions. A variety of machine learning algorithms were assessed to classify and predict individual Dosha imbalances. The results demonstrate a significant level of accuracy, thus supporting the application of AI in Ayurveda for both preventive and personalized medical approaches.

[8] Meshram, K., Kulkarni, S et al., (2024) "AyurJanaKosh - Healthcare Chatbot Using LLM". AyurJanaKosh offers customized healthcare guidance derived from users' Prakriti and Dosha, utilizing Ayurvedic literature and questionnaire information. It employs NLP methods to comprehend inquiries and provide pertinent answers. The platform presents personalized suggestions encompassing Ayurveda, homeopathy, and allopathy for comprehensive and economical healthcare.

[9] Anura, B., Gaurav, D, et al., (2022) "Artificial Intelligence and Challenges in Ayurveda Pharmaceutics". The research examines how AI can tackle issues in Ayurveda pharmaceutics, including standardization, quality assurance, and consistency in formulations. It highlights the utilization of machine learning and predictive modelling to advance drug development and manufacturing methods. The findings suggest that incorporating AI can improve the safety, scalability, and worldwide acceptance of Ayurvedic products.

[10] Abhishek, Bindal, A. K., & Yadav, D. (2022) "Medicine recommender system: A machine learning approach". The study introduces a medicine recommendation system grounded in machine learning, employing collaborative, content-based, and hybrid filtering methodologies. It examines more than 116,000 user reviews and ratings to recommend appropriate medications, leveraging algorithms such as k-NN and SVD. By integrating sentiment analysis and user preferences, the system showcases enhanced accuracy and relevance in its recommendations.

[11] Huang, Z., Chavda, V. P., et al., (2022) "An Ayur genomics approach: Prakriti-based drug discovery and development for personalized care". The document investigates an Ayurgenomics methodology that integrates Ayurvedic Prakriti classifications with genomic data to facilitate personalized drug development and therapeutic interventions. It emphasizes the significance of tailoring treatments based on individual molecular and constitutional traits to improve the efficacy and preventive aspects of healthcare.

[12] Rathor, C., Mandloi, V. S., Sachan, I., & Sahu, V. (2024) "Artificial Intelligence in Ayurveda: A Simple Overview". This study explores how artificial intelligence and machine learning can enhance Ayurvedic practices by enhancing diagnostic precision, tailoring treatment strategies, digitizing conventional evaluations such as pulse and tongue assessments, and guaranteeing quality assurance in herbal formulations. It underscores the necessity for data standardization, the establishment of ethical frameworks, and the promotion of interdisciplinary collaboration to effectively incorporate AI into Ayurveda.

[13] Gupta, S., Narasimha, V., & Lakshmi, V. A. (2024). "Artificial Intelligence in Ayurveda: Its Application and Relevance" This paper investigates the utilization of artificial intelligence within Ayurveda, concentrating on aspects such as Prakriti assessment, illness forecasting, and the development of herbal medications. It emphasizes the potential of AI to enhance diagnostic precision and tailor treatments to individual needs, all while reinforcing traditional methodologies. The authors underscore the necessity of ethical practices, professional oversight, and the integration of standardized data to ensure successful application.

[14] Seshan, S., Sharma, M. M., & Prakash, V. (2024). "Integration of Artificial Intelligence in Ayurveda Diagnostics". The article examines the incorporation of artificial intelligence tools such as Prakriti Analyser and Nadi Tarangini to improve precision in Ayurvedic diagnostics. It highlights the significance of data standardization, ethical application, and clinical validation to ensure effective and trustworthy AI-based evaluations.

[15] Rathor, C., Mandloi, V. S., Sachan, I., & Sahu, V. (2024). "Artificial Intelligence in Ayurveda: A Simple Overview". The study investigates the contribution of

artificial intelligence to enhancing multiple facets of Ayurveda, encompassing diagnostic methods such as pulse and tongue examination, the customization of treatments, and the standardization of herbal remedies. It examines the use of technologies like telemedicine and natural language processing for the analysis of Ayurvedic texts. The authors emphasize the necessity of ethical incorporation, data standardization, and the preservation of traditional Ayurvedic values.

3. PROPOSED METHODOLOGY

3.1 Methodology

The suggested system employs a systematic approach that integrates traditional Ayurvedic concepts with contemporary machine learning methods to provide precise and individualized dosage suggestions. This hybrid framework is designed to respect the individualized nature of Ayurveda while incorporating data-driven insights for consistency and scalability.

1. Machine Learning

Objective: Predict suitable Ayurvedic medicines based on patient symptoms and descriptions.

a. Data Collection & Preprocessing:

- A curated Ayurvedic dataset containing symptom, description, medicine, and dose.
- Data cleaning performed using pandas to eliminate null or inconsistent records.
- Input text formed by concatenating symptom and description fields.

b. Feature Engineering:

- Utilized TF-IDF Vectorization to transform textual inputs into numerical format.
- This allowed the model to recognize word significance and reduce noise.

c. Model Selection:

- Chose Multinomial Naive Bayes due to its efficiency in text classification tasks.
- Advantages include low computational cost, suitability for small datasets, and compatibility with word-frequency data.

d. Model Training and Evaluation:

• The dataset was divided into training and testing subsets through the application of train_test_split.

• The model underwent training and validation, utilizing metrics including accuracy and classification reports.

• The final model was preserved using Python's pickle module for subsequent inference.

2. AI-Driven Advice Generation (OpenAI GPT-3.5 Turbo)

Objective: Enhance prescriptions with personalized, AI-generated treatment guidance.

- Patient demographic and health data (age, gender, sugar history, BP history) were passed as part of the prompt.
- The top predicted medicines from the ML model were also included.
- GPT-3.5 Turbo generated detailed outputs like:
  - Estimated recovery period
  - Dosage timings (morning/night, before/after food)
  - Dietary recommendations

This layer added intelligence beyond rule-based systems, enabling highly personalized guidance.

3. Database Design

Objective: Create a structured schema for efficient data storage and retrieval.

- Tables designed: admin, doctor, patient, appointment, prescription, and history.
- Data normalization applied to eliminate redundancy.
- Relationships maintained using foreign keys:
- Appointments link doctor_id and patient_id
- Prescriptions reference patient_id and doctor_id

4. Web Application Design (MVC Architecture)

Objective: Maintain clear separation of concerns between data, logic, and UI.

- Backend developed using Flask, with clear route handlers for each role (admin, doctor, patient).
- Frontend developed using HTML, Bootstrap, and jQuery.
- Used AJAX to enable form submission and dynamic content loading without full page reload.

5. Role-Based Access Control

Objective: Secure and restrict module functionality based on user roles.

Admin:

- Manage doctor records
- Manage patient records and generate patient IDs
- Create and manage appointments
- View analytics dashboard

Doctor:

- View assigned appointments
- Enter symptoms, run predictions, prescribe medicine
- View and track patient history

Patient:

- Login with patient ID
- View current prescription
- Track history and AI-generated advice

In this paper, we employ a Multinomial Naive Bayes (MNB) model to classify dosage recommendations customized for individual patients undergoing Ayurvedic treatment. The core idea is to predict the most appropriate dosage category (such as low, medium, or high) by examining patient attributes including age, weight, prakriti (body constitution), dosha imbalance, symptom severity, and disease stage. Let:

• $C \in \{c_1, c_2, ..., c_k\}$ be the dosage categories (e.g., low, medium, high).

• $x = (x_1, x_2, ..., x_n)$ represent the patient's input feature vector.

The MNB model calculates the posterior probability of a dosage class given the patient's features using Bayes' Theorem:

$$P(C_k \mid x) = [P(C_k) \cdot \prod(i=1 \text{ to } n) P(x_i \mid C_k)] / P(x)$$

Since P(x) is constant across all classes, the equation simplifies for prediction to:

$$\hat{C} = \text{argmax}(C_k) [P(C_k) \cdot \prod(i=1 \text{ to } n) P(x_i \mid C_k)]$$

Where:

• $P(C_k)$ is the prior probability of the dosage class C_k, based on the training data.

• $P(x_i \mid C_k)$ is the likelihood of feature x_i given class C_k.This probabilistic model aids in the generation of a recommended dosage category by examining trends and patterns found in historical patient data. The application of MNB is especially appropriate for discrete input characteristics, which corresponds effectively with the categorized patient attributes in Ayurvedic practice.

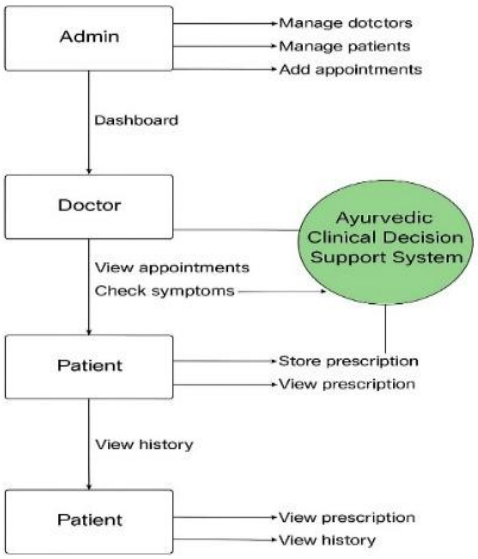


Figure 3.1.1

An Ayurvedic clinical decision support system is represented by this flowchart. Through a dashboard, the administrator oversees appointments, physicians, and patients. Physicians use the decision support system to view appointments and examine symptoms. In addition to accessing their medical history, patients can store and view their prescriptions.

3.2 Proposed System

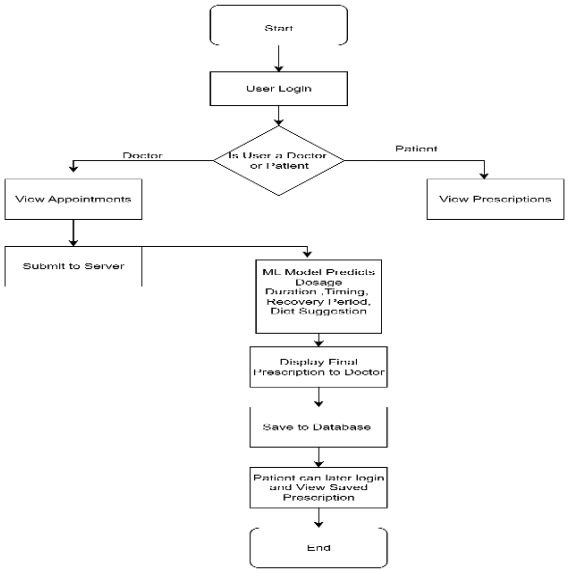


Figure 3.2.1

This is the process, how dosage recommendation works using Artificial Intelligence

During the initial login stage of the Ayurvedic Clinical Decision Support System, users are identified as either patients or physicians. If the user is a physician, they have the ability to access their appointments and engage in consultations with patient's post-login. After the consultation, the physician submits an AJAX request to the server containing the patient's symptoms and clinical observations. This data is then processed by a machine learning (ML) model, which generates informed predictions regarding Ayurvedic dosage information. The ML model provides recommendations that include dosage duration, timing, recovery period, and dietary advice tailored to the patient. Subsequently, the anticipated prescription is presented to the physician for approval. After the physician reviews the prescription and adds any necessary notes, they include a timestamp and save it to the database.

Upon logging in, if the user is recognized as a Doctor, they are able to access their scheduled appointments.

- Based on the inputs from consultations, the doctor transmits data to the server.
- The backend activates a Machine Learning model that forecasts:
- Duration of dosage
- Timing of medication
- Anticipated recovery duration
- Recommended dietary instructions
- These forecasts are presented as a conclusive prescription for the doctor to evaluate.

After approval, the prescription is recorded in the database along with a timestamp and the doctor's annotations.

If the individual is classified as a Patient, they are permitted solely to view prescriptions — they lack the ability to write or modify them.

Subsequent to the consultation with the physician and the generation of the prescription through machine learning, the patient has the option to log in at a later time to access the saved prescription, thereby facilitating convenient follow-up and adherence.

4. RESULTS AND DISCUSSIONS:

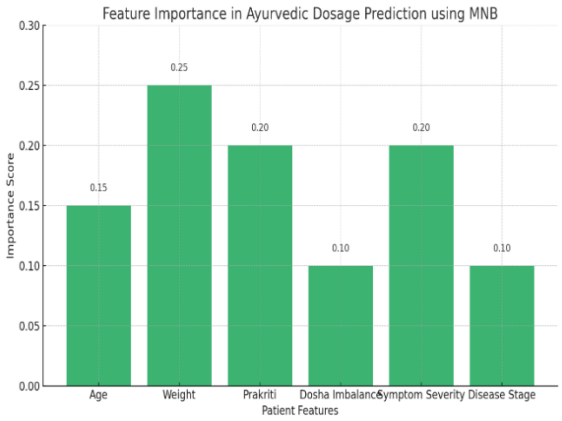
The dataset utilized for training the Multinomial Naive Bayes (MNB) classifier consisted of 1,000 patient records, each encompassing demographic information (age, weight), Ayurvedic parameters (prakriti, dosha imbalance), symptom severity, and disease stage. The primary objective of the classifier was to forecast the optimal dosage levels—Low, Medium, or High.

• The accuracy rate achieved was 85.4%.

• The average precision noted was 82.7%.

• The average recall was recorded at 84.1%.

• The average F1 score was 83.4%.



The bar chart illustrates the relative significance of various patient characteristics in forecasting Ayurvedic dosage categories (e.g., low, medium, high) utilizing a Multinomial Naive Bayes model.

Weight (0.25)
This characteristic exerts the greatest influence on dosage prediction.
Individuals with greater weight may necessitate modified or increased dosages, rendering this a vital factor.

Prakriti (0.20)
Denotes a patient's body constitution (Vata, Pitta, Kapha).
It serves a vital function in customizing Ayurvedic suggestions.

Symptom Severity (0.20)

Assesses the intensity or acuteness of the condition.
It directly impacts both the dosage quantity and duration.

Age (0.15)
Affects dosage determinations, particularly in pediatric and geriatric populations.
Younger and older patients frequently require personalized dosages.

Dosha Imbalance (0.10)
Refers to the disrupted energy equilibrium within the patient (e.g., excess Pitta).
It affects the kind and potency of medications that are prescribed.

Disease Stage (0.10)
Indicates the stages of the disease (early, middle, chronic).
It impacts the recovery duration and treatment intensity.
This graph demonstrates how the MNB model ranks features according to their contribution to precise dosage classification. The findings emphasize that weight, prakriti, and symptom severity are the three primary predictors, which align closely with Ayurvedic principles of personalized treatment.

5. CONCLUSION

The Ayurvedic Drug Dosage Recommendation AI-Based Clinical Decision Support System (CDSS) exemplifies the intelligent integration of machine learning and artificial intelligence to enhance and modernize traditional healthcare frameworks, particularly Ayurveda. By leveraging specific patient data, this system skillfully combines traditional therapeutic principles with cutting-edge digital technologies to provide personalized, data-driven dosage recommendations. With the ability to integrate real-time clinical indicators such as blood pressure and blood sugar levels, the system can deliver highly customized prescriptions.
The system's accuracy and reliability across diverse scenarios, as demonstrated by extensive testing, underscore its significance in practical Ayurvedic applications. While maintaining the fundamental principles of Ayurvedic therapy, the study illustrates how artificial intelligence can assist individuals in making more informed decisions regarding personalized treatment. This research not only provides Ayurvedic practitioners with an advanced clinical support tool but also establishes a benchmark for the broader application of AI in complementary and alternative healthcare systems. It proposes the potential for developing therapeutic models that are precise, scalable, patient-centered, and practical.

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