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Personalized Health Recommendations-based on Ayurveda using Machine Learning

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***Abstract*—Ayurveda, the ancient Indian system of medicine rooted in the wisdom of the Atharva Veda, emphasizes harmony and balance within the body. It integrates natural remedies, including dietary adjustments, herbal treatments, and yogic breathing practices, to promote overall well-being and address health concerns. Ayurveda fundamentally treats people as individuals, knowing that different people have a differently structured individual body: a concept called prakriti. This research now combines the wisdom of Ayurveda with the power of machine learning, creating a system to predict an individual's prakriti, dominant dosha, and Agni, based on responses to a simple questionnaire. A descriptive survey was conducted among healthy students from both genders aged between 18 and 30 years. Doshas and Prakriti were evaluated using a 40-item self-assessment questionnaire validated in previous study. Different machine learning techniques, including ensemble learning were used to make the system accurate and reliable. The models delivered a good amount of accuracy in predicting prakriti with 81%, dominant dosha with 80%, and Agni with 78%. Using these predictions, the system provided recommendations on diet, lifestyle changes, yoga, and other Ayurvedic practices. This system was implemented in Python and made interactive with a user-friendly interface. How modern technology can work alongside traditional Ayurvedic principles to help improve overall well-being is shown by this research.**

***Index Terms*—Ayurveda, prakriti, dosha, Agni, machine learning, personalized healthcare.**

I. INTRODUCTION

Ayurveda, often referred to as the "science of life," encompasses the well-being of all living beings, including humans, animals, and plants [12]. General medical system follows generalized treatment plans. This implies a one-size-fits-all approach to treatment, but Ayurveda takes a different path. It emphasizes personalized care, tailoring treatments to each individual's unique body nature, known as Prakriti or Body Constitution.

A. Prakriti

As per Ayurveda, every individual has a unique constitution, or Prakriti, akin to a fingerprint, which is determined at birth. The physical constitution, or Deha Prakriti, defines an individual’s psychological and physical traits [10]. Maintaining balance within one’s Prakriti is vital for good health, as imbalances in Agni (digestive fire) can lead to various physical and mental health issues.

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Restoring balance and returning to one's original Prakriti is essential for achieving well-being, which can be accomplished through lifestyle changes and dietary adjustments. Ayurveda provides a range of personalized treatments and recommendations, including modifications in food habits, herbal remedies, and therapeutic practices like yoga and meditation, to restore the balance of doshas.

Prakriti plays a critical role in guiding personalized treatments in Ayurveda. Understanding one's Prakriti empowers individuals to plan their lifestyles for better health, while it enables Ayurvedic practitioners to design effective, customized treatments.

By tailoring lifestyle changes to an individual's unique constitution, practitioners can help cultivate a peaceful, balanced, and healthy life. Ayurveda categorizes individuals based on the dominance of the three doshas—Vata, Pitta, and Kapha—into seven psychosomatic types: Vata, Pitta, Kapha, Vata-Pitta, Vata-Kapha, Pitta-Kapha, and Samadosha (balanced). Individuals often exhibit a dominance of one or more doshas, which guides their classification and personalized care.

A deeper understanding of Prakriti enables individuals to appreciate their bodies' unique needs, paving the way for personalized care and well-being. It supports not only the maintenance of health but also enhances personal, family, and professional life. Personalized healthcare in Ayurveda revolves around tailoring health advice and treatments to suit an individual's specific characteristics, ensuring holistic well-being.

B. Agni

In Ayurveda, Agni is a fundamental concept that represents the digestive and metabolic fire within the body. It is considered the cornerstone of health, as it governs the processes of digestion, absorption, assimilation, and transformation of food into energy. A balanced Agni is crucial for maintaining overall physical and mental well-being, while imbalances in Agni can lead to various health disorders. Various Agni and dosha linked with it along with characteristics

II. LITERATURE REVIEW

Ayurveda, an ancient Indian medical system, emphasizes personalized healthcare based on individual constitution (Prakriti) and the balance of three doshas—Vata, Pitta, and Kapha. Recent advancements in machine learning (ML) have been applied to automate prakriti prediction and provide personalized health recommendations. It is not only used for disease classification from MRI images[13] but also used for non-image data analysis.

Studies have explored various ML models for prakriti prediction. Madaan and Goyal[2] used ensemble techniques like CatBoost, achieving high accuracy in prakriti classification. Choudhari and Thakur[1] integrated deep learning to provide personalized diets based on prakriti and seasonal factors. Bidve et al[3] addressed overlapping doshas using Multinomial Naïve Bayes and K-modes clustering, emphasizing precise prakriti categorization. Rajasekar et al.[4] applied ensemble learning with SVM, Naïve Bayes, and AdaBoost for accurate Ayurvedic diagnostics. Bheemavarapu and Rani[5] highlighted the automation of prakriti assessment using ensemble models like XGBoost and CatBoost.

Ohol[6] connected prakriti with Agni (digestive fire), emphasizing its role in metabolic health and immunity. The work highlighted the need to consider Agni variations for personalized recommendations. Sevastyanov and Shchetinin[7] addressed imbalanced data challenges using SMOTE, ADASIN, and feature selection techniques like Random Forest and Boruta, improving accuracy in multiclass classification. Kumar et al.[8] reviewed preprocessing methods, including oversampling and cost-sensitive learning, to improve classification metrics. Chujai et al.[9] explored ensemble strategies like boosting and bagging for unbalanced datasets, showcasing the effectiveness of decision tree ensembles.

Jaiswal[10] proposed a stacking ensemble model for rainfall prediction, which aligns with advancements in ML strategies. Rotti et al.[11] conducted a cross-sectional analysis integrating traditional Ayurvedic assessments with software tools like AyuSoft, achieving 80% concordance between Ayurvedic practitioners and AI predictions. These efforts bridge traditional Ayurveda with modern technologies, enhancing the accuracy and applicability of prakriti-based diagnostics and treatments.

III. PROPOSED METHODOLOGY

We have used ensemble learning to develop this system. Fig.1 given below shows the complete end-to-end workflow of proposed system. User addresses all questions that based on user's appearance, behaviour and situational for example 'How is your physique?', 'Your weight', 'How is your complexion?' and on.

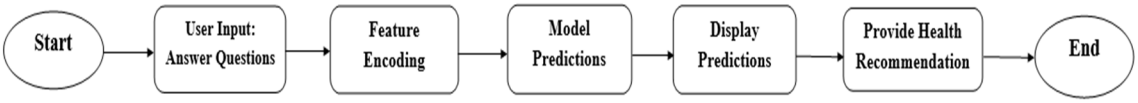

Figure. 1. End-to-end workflow of system

A. Data Collection and Dataset Creation

Performed a survey in an institute. Collected data from 867 participants, including students and faculty members at an institute. Created a structured questionnaire with 35 multiple-choice questions, designed with the help of Ayurvedic experts. Each option is linked with Dosha. These questions covered various aspects of participant's physical traits, behaviors, eating habits and lifestyle all of which influence their Prakriti, Dosha, and Agni.

B. Data Preprocessing

As responses contains categorical data, there was need to convert it into numeric data before building the machine learning models. There was need to handle missing values in dataset. Also need to understand class distribution to understand class imbalance. For this, we processed the data in the following ways:

- Encoding: Converted responses into numerical values using a technique called Label Encoder.
- Handling Missing Data: There were no missing values in our dataset, so the data was complete and clean.

C. Model Development

Trained models using various individual algorithms. The accuracy was not satisfactory. Also, there were clear imbalance in class distribution. To tackle this problem, we used ensemble machine[9] learning specifically stacking classifier [10] as shown in Fig.2 to predict prakriti, dominant dosha, and Agni. The process involved:

- Base Learners: Used seven different machine learning algorithms: Naïve Bayes, Support Vector Machines (SVM), Decision Trees, KNN, Random Forest, Gradient Boosting, and XGBoost.
- Meta Learner: Used Random Forest as a meta learner to combine the predictions from all the base models.
- Hyperparameter Tuning: Used RandomSearchCV to optimize the model hyperparameters.
- Evaluation: Measured how well the models performed using accuracy scores and classification report, which help identify any errors in classification.

TABLE I. PERFORMANCE OF MODELS AFTER USING ENSEMBLE LEARNING

Model Name	Train Accuracy	Test Accuracy
Prakriti	94%	81%
Dominant Dosha	96%	80%
Agni	93%	78%

D. Implementation

Implemented the system using Python. Developed frontend using Streamlit framework.

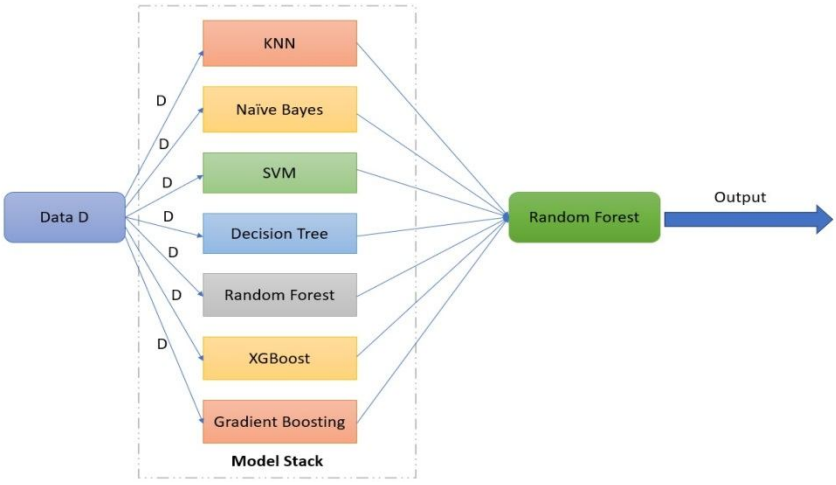

Figure. 2. Stacking classifier

E. Recommendation Generation

Once the predictions were made, the system generated personalized recommendations based prakriti. These recommendations include Dietary Guidelines, Activities to do, Yoga and Rejuvenations.

IV. Result and Discussion

A. Model Performance

The performance of few individual algorithms satisfactory i.e. Gradient boosting has better accuracy for Prakriti, Dosha and Agni. It was 72%, 66% and 68% respectively. Tab (2) shows accuracies of individual algorithms used in each model.

TABLE II. PERFORMANCE OF INDIVIDUAL ALGORITHMS

Model Name	Prakriti	Dominant Dosha	Agni
SVM	66%	61%	61%
Naïve Bayes	64%	61%	58%
Decision Tree	51%	45%	46%
Random Forest	59%	60%	61%
KNN	53%	49%	47%
XGBoost	70%	45%	63%
Gradient Boosting	72%	66%	68%

Using the ensemble method, which combines the predictions from multiple models, we were able to improve the accuracy compared to using a single machine learning algorithm as we can see in Tab (3).

TABLE III. PERFORMANCE OF MODELS AFTER USING ENSEMBLE LEARNING

Model	**Accuracy**
Prakriti	81%
Dominant Dosha	80%
Agni	78%

Insights from Predictions

- The prakriti and dominant dosha models were highly accurate, showing that the ensemble approach works well for these types of predictions.
- The Agni model also provided valuable insights, helping us understand an individual's digestive capacity, which is crucial for giving personalized diet recommendations.

V. Conclusions

This study demonstrates how combining Ayurvedic wisdom with machine learning can create a powerful tool for personalized healthcare. The system accurately predicted prakriti, dosha, and Agni, and provided actionable recommendations for improving health.

References

[1] Madaan, V., & Goyal, A. (2020). Predicting Ayurveda-based constituent balancing in the human body using machine learning methods. IEEE Access, 8, 65059–65068.

[2] Choudhari, P., & Thakur, M. A. (2022). Food recommender: Deep learning approach for predicting daily diet based on body prakriti. International Journal of Health Sciences, 6(S1), 2553–2559.

[3] Bidve, P., Mishra, S., & Annapurna, A. J. (2021). Enhancing Ayurvedic diagnosis using multinomial naïve Bayes and k-modes clustering. Vellore Institute of Technology.

[4] Rajasekar, V., et al. (2022). Ensemble machine learning methods to predict the balancing of Ayurvedic constituents in the human body. Computer Science, 23(1), 117–132.

[5] Bheemavarapu, L., & Rani, K. U. (2023). Machine learning models used for prakriti identification using Prasna Pariksha in Ayurveda – A review. Mathematical Statistician and Engineering Applications, 72(1), 1942–1951.

[6] Ohol, S. V. (2013). A review on relation between prakriti and Agni. International Journal of Ayurvedic Medicine, 4(4), 264–271.

[7] Sevastianov, L. A., & Shchetinin, E. Y. (2020). On methods for improving the accuracy of multi-class classification on imbalanced data. CEUR Workshop Proceedings, 70.
[8] Kumar, P., Bhatnagar, R., Gaur, K., & Bhatnagar, A. (2021). Classification of imbalanced data: Review of methods and applications. IOP Conference Series: Materials Science and Engineering, 1099(1), 012077.
[9] Chujai, P., Chomboon, K., Teerarassamee, P., Kerdprasop, N., & Kerdprasop, K. (2015). Ensemble learning for imbalanced data classification problem. Proceedings of the 3rd International Conference on Industrial Application Engineering, 449–452.
[10] Jaiswal, P. G., et al. (2023). A stacking ensemble learning model for rainfall prediction based on Indian climate. Proceedings of the 6th International Conference on Information Systems and Computer Networks (ISCON), Mathura, India, 1–6.
[11] Rotti, H., et al. (2014). Determinants of prakriti, the human constitution types of Indian traditional medicine, and its correlation with contemporary science. Journal of Ayurveda and Integrative Medicine, 5(3), 167–173.
[12] Kale, S.G., Mohapatra, R.K., Patel, N.K., Sahoo, A.K. (2023). Identification of Ayurvedic Leaves using Deep Learning. 2023 International Conference on Communication, Circuits, and Systems (IC3S), Bhubaneswar, India, pp. 1–6.
[13] Wajgi, R., Yenurkar, G., Nyangaresi, V. O., Wanjari, B., Verma, S., Deshmukh, A., & Mallewar, S. (2024). Optimized tuberculosis classification system for chest X-ray images: Fusing hyperparameter tuning with transfer learning approaches. Engineering Reports, 6(11), e12906.