

Machine Learning Models Used For Prakriti Identification Using Prasna Pariksha In Ayurveda – A Review

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Abstract — Machine Learning (ML) helps in automating manual works. Work automation is done by developing ML models based on existing data as per the requirement. ML models are also helping healthcare domain experts in different aspects. The traditional medical system of Ayurveda is using ML models to understand human nature, to identify the root cause of a disease, to know the type of disease, and to automate specialized treatment plans. Identification of the Prakriti or the body constitution of a person is the first step in the system of Ayurveda. Based on Prakriti, disease diagnosis is performed and required personalized treatment is provided. Prasna Pariksha is one of the parikshas that is used to assess the Prakriti of a person. Development of a ML model for Prakriti identification using Prasna Pariksha helps individuals as well as Ayurvedic practitioners. These models help individuals to know their body nature and to change their diet and lifestyle in order to lead a healthy life. These models also assist Ayurvedic practitioners in disease diagnosis and treatment. This article is presenting a review on the ML models developed using Prasna Pariksha for Prakriti identification.

Keywords — Machine Learning, Health Domain, Ayurveda, Prakriti, Prakriti Identification, Prasna Pariksha

I. INTRODUCTION

Machine Learning (ML) is a subdomain of Artificial Intelligence (AI) which uses data and different techniques to make machines learn like a human and to increase their accuracy [1]. It is having many applications in different domains. Data Science uses ML to perform data analysis. The machine model trains a machine with available historical data, then the machine understands the insights and generates knowledge and later the developed model is used to do predictions or interpretations. ML is automating different tasks in different domains to increase efficiency and performance. ML is also helping experts of healthcare domain in their work automation. ML can be used to identify unseen patterns in medical data and to provide the capability to perform disease diagnosis. ML algorithms can also be used for the development of efficient decision support systems [2].

Ayurveda is an Indian traditional medical system that gained more importance during the Covid-19 period. Because of side effects and the increased cost of English medicine, preference to Ayurvedic medicine is increasing day by day. The main aim of Ayurveda is the maintenance of good health and increasing the quality of life [3]. In India, Ayurveda is in use for five thousand years. It uses medicinal herbs, metals, and non-metals to treat common ailments. Automatic detection of medicinal herbs can be done with the help of ML [4].

According to Ayurveda, making little changes in an individual's lifestyle and food preferences may decrease the susceptibility to diseases. Ayurveda is having a great history. But, the advancement of modern medicine brought a drastic change in usage of Ayurvedic medicine. Because of the integration of modern medicine with modern technology and fast results, the usage of modern medicine is more than Ayurveda. As well as the number of expert Ayurvedic practitioners is also very less compared to General Medicine practitioners. Because of, Covid-19 the individual preferences are changing and Ayurveda is getting more focus. As a result, there is a huge demand for Ayurvedic practitioners, drugs, and cosmetics.

This review is organized into seven sections. Section II describes ML and different types of ML, Section III details about Ayurveda and Prakriti, Section IV deals with the importance of Prakriti in disease diagnosis and different parikshas, Section V deals with Machine learning in Ayurveda-based disease diagnosis, Section VI details the review of literature relating to the usage of Machine learning in automation of Prasna Pariksha and Section VII concludes the review.

II. MACHINE LEARNING

Machine learning can be defined as a branch of study that makes the computers to get the ability of learning without detailed programming [5]. According to [6] [7], in data science, ML is used to perform two basic operations: regression and classification. ML in data science is having many applications like identification of names of person/place in text, identification of person/things in images, voice recognition, classification of birds based on whistle, predicting the probability of purchasing an item A along with B, prediction of the sales/revenue of a company, identification of diseases based on blood reports, X-ray report, scanning report, and other tests. A data scientist builds a model that analyses the data given to it and performs predictions or interpretations of given data. If the model interprets the data it is called root cause analysis.

A. Types of machine learning

There are different techniques or algorithms used to perform ML. Based on the usage of labeled data and the targeted output by the algorithms, ML can be divided into different types as mentioned in Fig.1.

- 1) *Supervised learning techniques* learn through examples with labeled data, try to find hidden patterns in the given data, and generate labels for new data with human interference.
- 2) *Unsupervised learning techniques* try to identify the hidden patterns in unlabeled data without human interference.

- 3) *Semi-supervised learning techniques* need labeled data with human interference, try to identify patterns, and learn from unlabeled data also.
- 4) *Reinforcement learning techniques* get told when the answer is wrong, but not get told how to correct it.
- 5) *Evolutionary learning techniques* show biological evolution during the learning process like the generation of offsprings with more survival rates in their environment.

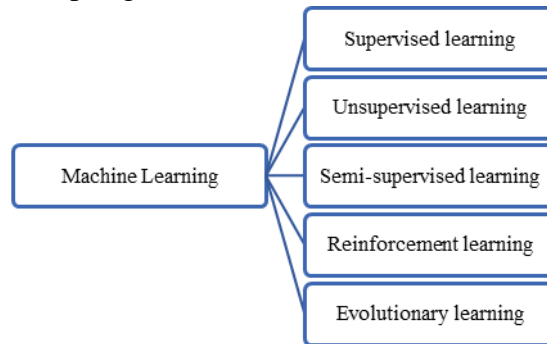


Fig.1. Types of Machine Learning

B. Supervised Learning

It is the common type of ML model that helps to perform root cause analysis or prediction. In this model, a set of data called training data $(\mathbf{x}_i, \mathbf{t}_i)$ with input data (\mathbf{x}_i) along with target data (\mathbf{t}_i) helps to prepare the model. Here, i represent the index of data that ranges from 1 to N . The input data and target data represent vectors means each example data contains values of several features. Its task is generalization means the model should produce sensible outputs for new or unseen inputs.

C. Supervised learning Algorithms

Under supervised learning, we have many algorithms that help to perform predictions through guided learning (Fig.2).

- 1) *Linear regression*: It helps to recognize the connections or associations among dependent and independent variables.
- 2) *Logistic regression*: It helps to find the decision boundary between two classes.
- 3) *Decision trees*: They are used to divide the data recursively based on the input value. Its aim is to predict the output based on a tree structure.
- 4) *Random forests*: They use a collection of decision trees to improve the prediction by reducing overfitting and improving generalized performance.
- 5) *Support Vector Machine (SVM)*: It is used to divide the dataset into two classes by finding a hyperplane.
- 6) *Neural Networks*: They help to identify complex unknown patterns among the input and output variables.

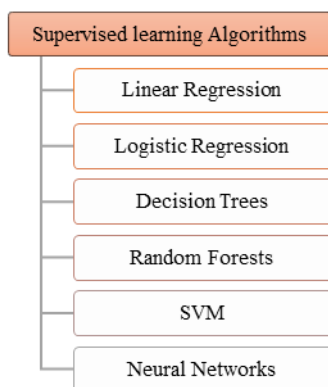


Fig.2. Supervised learning Algorithms

III. AYURVEDA

Ayurveda is defined as the science of life that covers all living organisms: human beings, animals and plants. One of the branches of Ayurveda is Nara Ayurveda. The study of the life of human beings is called Nara Ayurveda. It emphasizes providing total health i.e., Dharma, Artha, Kama, and Moksha. Dharma means doing righteous things, Artha means having wealth, Kama means fulfillment of wishes and Moksha means salvation. General medical system follows generalized treatment plans. It means it follows same method of treatment to all kinds of people. In contrast, Ayurveda follows personalized treatment to treat each person based on his/her unique body nature. This unique body nature is known as Body Constitution or Prakriti [8].

A. Panchamahabhuta

According to [9], Matter is formed with five components called Panchamahabhuta: Prithvi means earth; Ap means water; Teja means fire; Vayu means air; Akasha means an ethereal state of matter. To make the matter animate it requires Kala, Dik, Manas, and Atma. These four components along with Panchamahabhuta are called Nitya dravyas or eternal elements and these nine elements make a living organism. Similar to the formation of the universe with Panchamahabhuta, all living beings are also composed of Panchamahabhuta. These Panchamahabhuta in a living organism are explained with the help of Dosha, Dhatu, and Mala. There are three Dosha called Tridosha (Vata, Pitta, and Kapha), seven Dhatu (Rasa, Rakta, Mansa, Medas, Asthi, Majja, and Shukra), and three Mala (Purisha, Mutra, and Swedha). The body of a human being is governed by Tridosha and is called Deha Prakriti. The mind of a human being is governed by Triguna (Satva, Rajas, and Tamas) and is called Manasa Prakriti. Vata dosha helps for movement, Pitta dosha helps for heat generation and Kapha dosha helps in moisturization. In a human body if the doshas are in balance then the person will be treated as healthy. If there is any imbalance in these doshas then the person will be treated as diseased.

B. Prakriti

Based on the context, the word Prakriti is having different meanings like health, nature, karana, bodily constitution, etc. As per Ayurveda, each person has his/her own unique

Prakriti like a fingerprint and it is determined during his/her birth. The physical constitution or Deha Prakriti determines the psychological and physical features of an individual [10]. Maintaining a balance in the Prakriti of an individual is essential for good health. When there is an imbalance in one's own Prakriti, it may lead to various physical and mental health problems. To make a person healthy his/her original Prakriti needs to be restored. The Prakriti of an individual can be restored by making changes in lifestyle and dietary habits. Ayurveda offers various treatments and lifestyle recommendations to restore the balance of the doshas, such as changes in food habits, herbal remedies, and therapeutic practices like yoga and meditation. This Prakriti plays a key role in prescribing personalized treatment in Ayurveda. The knowledge of Prakriti of an individual makes a person to plan his/her own lifestyle and it is also important for Ayurvedic practitioners to do the personalized treatment. Strong knowledge about the Prakriti of a patient makes the practitioner plan correct and efficient treatment. Knowing an individual's Prakriti can help in maintaining a peaceful and healthy life by doing changes as per the type of Prakriti [11].

C. Types of Dosha Prakriti

According to Ayurveda, people can be categorized based on Tridosha. Based on levels of Tridosha, an individual can be categorized into seven types of Prakriti as depicted in Fig. 3 [11][12].

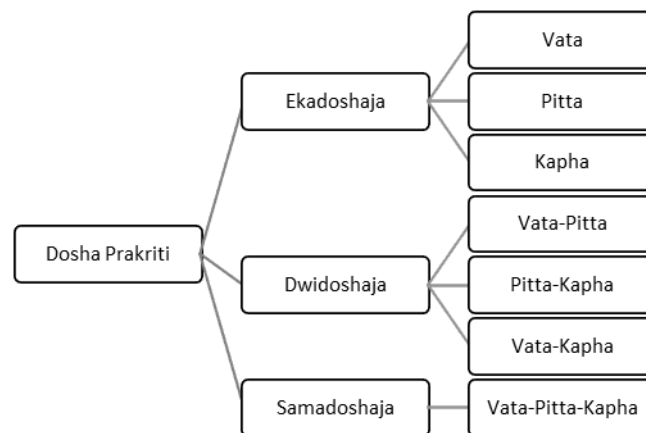


Fig. 3: Dosha Prakriti - Types

IV. IMPORTANCE OF PRAKRITI IN DISEASE DIAGNOSIS

In Ayurveda, disease diagnosis starts with the identification of Prakriti. The identification of Prakriti is considered as the base for disease diagnosis. The understanding of a person's Prakriti is essential to the practitioner to identify the nature of an individual, reasons for the disease, and origin of the disease.

In Ayurveda, disease diagnosis is known as Nidana and the method used to perform diagnosis is called Pariksha. Based on the number of parikshas used during Nidana, Ayurveda describes different types of Parikshas as mentioned in Fig. 4. Each type uses a number of parikshas to determine the disease. These parikshas are more affordable compared to modern diagnostic methods [13].

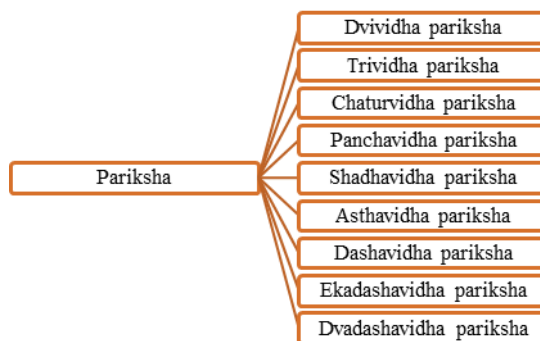


Fig. 4: Types of Parikshas

In Dvididha pariksha, dvi means two and it uses two types of parikshas called Prathyaksha pariksha (direct observation) and Anumana pariksha (inference) to perform disease diagnosis. The first word of the pariksha denotes the number of different types of parikshas used for disease identification. Some other types of parikshas are; Prasna pariksha (asking questions); Sparsa pariksha or Nadi pariksha (pulse diagnosis); Jihva pariksha (tongue examination); Dharsana pariksha (inspection); Shabda pariksha (Sounds) etc. In these parikshas, Prasna Pariksha is one kind of Pariksha. It is used to identify the Prakriti of an individual by using a questionnaire or by asking questions. The practitioner uses a pre-defined set of questions to identify the Prakriti of a person [14-16]. Different practitioners use different types of questionnaires as there is no standard questionnaire.

V. MACHINE LEARNING IN AYURVEDA BASED DISEASE DIAGNOSIS

The availability of expert Ayurvedic practitioners is less as compared to the requirement. There is a need to integrate the latest technologies to fulfill the deficit of experts. This requires the integration of ML with Ayurveda. The usage of ML in Ayurveda is at the infantile stage. So, there is less research in the field of ML integrated Ayurveda. ML models can be used to automate different phases of Nidana like automation of Prasna Pariksha, Nadi Pariksha, Jihva Pariksha, Darshana Pariksha, Drik Pariksha, Shabda Pariksha, etc. ML also helps in planning personalized treatment by automation of different phases of treatment or to use ML model to assist diagnosis and treatment process. Another application is the analysis of patient data to identify unknown patterns and relationships.

The ML models used to automate different parikshas can also be used to identify the Prakriti of an individual. This automation of Prakriti can help an individual to assess his/her own Prakriti and to understand the body requirements as per his/her Prakriti, to change himself/herself to stay away from unhealthy life. They also assist Ayurvedic practitioners to perform Prakriti analysis, to know the mental, physical and emotional features of an individual, to understand the nature of the individual, and to know the susceptibility of an individual to diseases. ML models can also be used to develop diet plans based on Prakriti. They also help to identify hidden patterns in available data. They can help to improve the accuracy of the diagnosis process. ML models can be developed to analyze the data of an

individual like his data obtained through Darsana pariksha, Nadi pariksha or Prasna pariksha. It can help to identify more important features used to perform Nidana.

Like this ML can be integrated with Ayurveda to automate different phases of disease diagnosis, treatment, and personalized medicine.

VI. MACHINE LEARNING IN PRASNA PARIKSHA AND LITERATURE REVIEW

ML models are playing an important role to fulfill the shortage of Ayurvedic experts. These are helping practitioners by decreasing their time for patient analysis, disease identification, and planning of treatment procedure. They also help to increase the confidence levels of the practitioners. Different machine models for identification of Prakriti using Prasna Pariksha are available. These are aiding the professionals during patient analysis. Different authors proposed different AI/ML models. Because of little research in this area of study, the available literature is little. In this section, the existing literature relating to the prediction of Prakriti using PrasnaPariksha with the help of ML-based models are reviewed and briefed in the following paras and the summary of literature is presented in Table 1.

Tiwari. P et al. [17] described a framework to identify type of Prakriti based on physical characteristics of an individual and is useful in precision medicine for the stratification of endo-phenotypes in healthy and diseased populations. They used a supervised learning model to reduce the number of variables used for Prakriti identification. Clustering technique was also used. The major problem faced while building the models is multicollinearity. This problem is due to small sample size with more parameters. To address this problem the authors used LASSO, elastic net, random forests and obtained 88%, 100%, and 93% sensitivity and 100%, 91%, and 90% specificity respectively.

V. Madaan and Goyal Anjali [18] proposed an Adaptive Neuro-Fuzzy Inference System to predict human Prakriti. This proposed system had an accuracy of 92.1%. They trained the system with 567 healthy individuals with 6 parameters. In [19], they detailed another machine model with ensemble learning techniques for Prakriti identification. They also applied different ML techniques on data along with ensemble learning techniques and identified that ensemble learning techniques are doing Prakriti identification efficiently. They applied XGboost and Catboost algorithms. The performance of the algorithms is optimized by using hyper parameters. The machine models were developed using Python. SVM, Naïve-Bayes (NB) Classifier, K-Nearest Neighbor (KNN), Decision Trees with Bagging, Boosting, XGBoost, and CatBoost and Artificial Neural Networks (ANN) were used. Hyper parameter tuning with Grid search and Random search is used for optimization. The results with traditional ML models were not satisfactory. Hence, hyper parameter tuning was applied. Out of the models CatBoost with hyper parameter tuning performed best with 0.95 accuracy.

Vani Rajasekar et al. [20] had proposed a methodology to predict the Prakriti of an individual using ML models and Ensemble learning techniques with hyper parameter tuning were used. In the proposed method the authors applied SVM, KNN, NB Classifier, ANN, Decision Tree, and Gradient Boosting algorithm Ada Boost. Precision, Root Mean Square Error (RMSE), F-

Score, Recall, and Accuracy are used for the analysis of model effectiveness. Out of the applied algorithms, Ada Boost with hyper parameter tuning gave 0.97 accuracy.

Debnarayan Khatua et al. [21] proposed a methodology to predict the Prakriti using ANN consisting of simple dense layers. An existing dataset used by Tiwari et al. [17] is used with a sample size of 233 relating to the Western Cohort and North Cohort. The authors had chosen the smallest number of nodes and increased the hidden layers to observe the changes. They used 10-fold cross-validation with 80:20 training and test dataset. A model with 16 X 1,8 X 1,3 X 1 layers performed well on Western Cohort and on North cohort. Cross-dataset validation was also done on both datasets. The proposed architecture performs satisfactorily in cross-dataset validation also. As the proposed simple dense neural network needs less computational hardware, it can be integrated with mobile devices. The model is trained to predict only extreme Prakriti.

VII.CONCLUSION

The literature relating to ML models used in Ayurvedic Prakriti identification using Prasna pariksha is reviewed and detailed the concepts of ML, Ayurveda, need for the development of ML models for disease diagnosis and Prakriti identification, and existing literature relating to Prakriti identification using prasna pariksha. As the research done in this area is less there is a need for in-depth research. The requirement for development of more accurate ML models for Prakriti identification is needed. As open Ayurvedic dataset is not available, there is a need for development of an open dataset relating to Prakriti identification. Development of a standard questionnaire for Prakriti identification using prasna pariksha is also needed.

TABLE 1. SUMMARY OF ML TECHNIQUES USED FOR PREDICTION OF PRAKRITI USING PRASNA PARIKSHA

Reference	Sample Size	No. of features	ML Technique(s) used	Tools	Results and Discussions
Tiwari P et.al. (2017) [17]	147	133	Lasso Elastic net Random Forest	R statistical Programming language	3 models performed well with >80% accuracy
Vishu Madan et.al. (2019) [18]	567	28	Adaptive neuro-fuzzy inference system	MATLAB	92.1% accuracy
Vishu Madan et.al. (2020) [19]	405 out of 807	28	SVM, KNN, NB, ANN, XGBoost, Decision Trees, CatBoost, Ensemble learning, Bagging, Boosting, Stacking, Logistic regression, Fuzzy Logic, Genetic algorithms, Xboost	Python – Scikit Learn	CatBoost with hyper parameter tuning performed well with 0.95 accuracy
Vani Rajasekar et.al. (2022) [20]	900	28	SVM, KNN, NB, ANN, Decision Trees, Gradient Boosting algorithms, AdaBoost, Hyper Parameter tuning	Net Beans with Java Programming	Ada Boost with Hyper parameter tuning performed well with 0.97 accuracy
Debnarayan Khatua et al. (2023) [21]	237	Not Available	ANN models	Python	Used to predict extreme Prakriti only

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