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Integration of Artificial Intelligence in Ayurveda Diagnostics

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A B S T R A C T

Ayurveda, an ancient medicinal practice, has long been revered for its comprehensive approach to healthcare. The incorporation of Artificial Intelligence into the field of *Ayurvedic* diagnosis signifies an intriguing blend of age-old knowledge and advanced technology, with the potential to transform the way we engage with individualized healthcare. The capacity of Artificial Intelligence to analyse extensive data, identify patterns, and provide predictions corresponds effectively with the personalized methodology of *Ayurveda* towards healthcare. This review aims to investigate the ways in which AI is improving the diagnostic process in *Ayurveda*, for improving the accuracy and efficacy of the same. A thorough search of literature was carried out to find relevant studies and articles regarding the fusion of AI and *Ayurveda*. Data from various sources such as PubMed, Google Scholar, and relevant academic journals were gathered and examined to provide a thorough understanding of the subject matter. Utilizing advanced technologies such as the *Prakriti Analyser*, *Nadi Tarangini*, *Tridosho Scanner*, and CureMetrix can significantly improve the diagnostic methods in Ayurveda through the integration of Artificial Intelligence. AI is poised to significantly enhance Ayurveda by increasing the accuracy of diagnosis thereby customizing treatment plans to better meet the specific needs of individuals. This will ultimately make Ayurvedic practices more accessible and efficient.

Key words: *Prakriti Analyser, Nadi Tarangini, Tridosho Scanner, CureMetrix*

INTRODUCTION

Ayurveda is recognized as an ancient science with a history spanning a thousand years. This traditional medical system offers not only health benefits but also promotes overall well-being in individuals. *Ayurveda* is making significant advancements in the realm of healthcare. In a world where reliance on technology is prevalent, the shift towards incorporating *Ayurvedic* principles into healthcare is commendable. Being accurate, practical, and aligned with the community's focus is crucial.

In 1955, the first AI system was created and named Logic Theorist by Allen Newell and Herbert A. Simon.[1] Artificial Intelligence refers to the emulation of human intelligence processes by machines, specifically computer systems. Expert systems, natural language processing, speech recognition, and machine vision are examples of AI applications. Utilizing AI technology can significantly enhance the diagnostic abilities of Ayurvedic practitioners by providing accurate, data-driven information on *Dosha* imbalances, in-depth examination of symptoms, physical characteristics, and psychological conditions and imaging techniques. The purpose of this review article is to explore how Artificial Intelligence (AI) is enhancing the diagnostic

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procedures in Ayurveda to enhance their precision and effectiveness.

AIM AND OBJECTIVE

To explore how Artificial Intelligence is enhancing the diagnostic procedures in *Ayurveda*, with the aim of enhancing their precision and effectiveness.

MATERIALS AND METHODS

A thorough search of literature was carried out to find relevant studies and articles regarding the fusion of AI and *Ayurveda*.

Data from various sources such as PubMed, Google Scholar, and relevant academic journals were gathered and examined to provide a thorough understanding of the subject matter.

Artificial Intelligence

In straightforward terms, Artificial Intelligence (AI) pertains to the field of study and development focused on creating smart machines. These machines are programmed with algorithms or a predefined set of instructions that enable them to imitate human cognitive abilities like learning and problem-solving.[2] AI systems have the potential to anticipate problems or deal with issues as they come up and, as such, operate in an intentional, intelligent and adaptive manner. The power of Artificial Intelligence lies in its capacity to analyse vast and varied datasets to identify patterns and connections. For instance, AI technology can be utilized to condense a patient's complete medical history into a single numerical value indicating a probable diagnosis.[3,4]

Branches of AI[5]

1) **Machine Learning:** It involves creating algorithms that have the ability to learn from data. These algorithms find applications in a wide range of fields such as image recognition, spam filtering, and natural language processing.

2) **Deep Learning:** A subdomain within the realm of machine learning utilizes artificial neural networks to acquire knowledge from data. These algorithms are adept at resolving a range of issues such as natural language processing (NLP), image identification, and voice recognition.

3) **Natural Language Processing:** The field focuses on the interaction between computers and human language. These methods are applied in various areas such as machine translation, speech recognition, and text analysis to understand and handle human language.

4) **Robotics:** Robotics is a branch of engineering that focuses on the design, building, and management of robots. These machines are capable of carrying out automated tasks in a variety of medical procedures such as knee surgeries, gynaecological surgeries, laparoscopic surgeries, kidney surgeries, brain surgeries, and more.

5) **Expert System:** Expert systems are software applications created to replicate the cognitive processes and decision-making skills of human specialists. These systems find utility in a wide range of fields such as healthcare, finance, and customer support for tasks like medical diagnostics, financial strategizing, and client assistance.

Need For Integrating AI in *Ayurveda*

Artificial intelligence (AI) technologies have the potential to enhance the diagnostic abilities of *Ayurvedic* practitioners by providing accurate, data-driven information on dosha imbalances. These advanced tools utilize sophisticated algorithms to analyse a wide range of patient data, including symptoms, physical attributes, and mental conditions. AI-powered solutions can offer valuable insights for practitioners in the field of *Ayurveda*. Artificial Intelligence has the capability to identify patterns that indicate specific imbalances in *Doshas*. *Ayurvedic* practitioners have the ability to utilize Artificial Intelligence (AI) to evaluate the constitutional type and mental states of patients. This technology allows for thorough diagnosis and facilitates the provision of detailed assessments. The combination of *Ayurveda* and Artificial Intelligence has the potential to offer solutions to various issues through aiding in the early detection of diseases. Providing precise diagnoses,

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determining future outcomes, tailoring medications to individual needs, and improving the overall health knowledge within the community. This fusion will also enhance individuals' educational abilities and knowledge in the field of health sciences. The combination can enhance relationships and facilitate effective communication between patients and doctors.

Ayurveda Diagnosis/*Pariksha*

Various methodologies are employed in the process of conducting *Pariksha*, such as, *Trividha Pariksha* (Three-fold examination) (Table 1),[6] *Ashtasthana Pariksha* (Eight-fold examination) (Table 2),[7] and *Dashavidha Pariksha* (Ten-fold examination) (Table 3).[8]

Table 1: *Trividha Pariksha* (Three-fold examination)

Trividha Pariksha
Darsana
Sparsana
Prasna

Table 2: *Ashtasthana Pariksha* (Eight-fold examination)

Ashtasthana Pariksha
Nadi
Mutra
Mala
Jihwa
Sabda
Sparsa
Drik
Akriti

Table 3: *Dashavidha Pariksha* (Ten-fold examination)

Dasavidha Pariksha
Prakriti
Vikriti
Sara
Samhanana
Pramana
Satmya
Satva
Aharasakti
Vyayamasakti
Vaya

AI Models for *Prakriti* Analysis

In Ayurveda, disease diagnosis starts with the identification of *Prakriti*. 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. They also assist Ayurvedic practitioners 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*.

▪ **Face recognition (*Akriti Pariksha*) -** Gayatri Gadre has developed a computer vision-based facial recognition model for the identification of *Prakriti* by analyzing the facial features of an individual-like hair, eyes, nose, lips, skin color, etc., by using image processing in *Ayurveda*. She used the Celebrity-Face Recognition-Dataset to train and test her model. The dataset was labelled manually with the help of an experienced medical practitioner.[9]

▪ **Questionnaire (*Prasna Pariksha*) -** V. Madaan and A. Goyal had proposed a ML based model to predict the type of *Prakriti* by using ensembled learning techniques; and hyper parameter tuning was done for accurate results. The authors tested the data by using different ML techniques and proved that the ensemble learning techniques are more efficient way of prediction of the *Prakriti*. The authors used a well framed questioner composed of 25 questions to predict the type of *Prakriti*.[10]

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Nadi Pariksha by *Nadi Tarangini*

Nadi Tarangini (NT) is the first ever *Nadi Pariksha* device that captures, analyses and provides detailed *Nadi* analysis reports.[11] Observing, sensing and experiencing and examining *Nadi* gives the physician an enormous insight into the functioning of the various processes and mainly regarding the deviation form desirables. It can reveal various stages of diseases, their stage, manifestations in different organs possibility and span of recover etc. which is only diagnosed by an expert *Vaidya* with years of training and still unknown to many. The *Nadi Tarangini* report provides insights into current and potential health issues, offering suggestions for dietary and lifestyle adjustments. The results of the *Nadi* examination are presented graphically. The System *Nadi Tarangini* consists of a diaphragm element equipped with strain gauge, a transmitter cum amplifier and a digitizer. *Nadi Tarangini* provides a comprehensive and precise 10-page *Nadi* report. It includes a detail analysis of individuals' *Prakriti* and *Nadi* based *Vikriti*. *Ayurvedic* practitioners can access comprehensive information about a patient's *Prakruti*, *Nadi Gati*, *Vikrut Dosha*, *Agni*, *Bala*, *Sama/Nirama Nadi*, 10 pairs of *Guna*, as well as psychological factors such as Stress and Thoughts, Diet, and Lifestyle modifications through the NT report card. The graphical representation and numerical data provided in the report card offer a quick and efficient understanding of *Nadi* analysis.

Ayurveda Tridosho Scanner (Electro *Tridosho* Graphy)[12]

This machine was manufactured under the leadership and supervision of Professor Dr Phool Singh Chauhan of Indian Institute of Technology, Kanpur, India. Trials of the machine were started in 2010. Modifications were implemented in both the hardware and software as needed. *Ayurveda Tridosho* Scanner machine through pulse testing analyse the Three *Doshas*, Seven *Dhatus*, Three *Malas* of *Ayurveda* along with 16 systems of the Human body. The status is copied in Data by machine and this Data is printed in the form of a report. Generally, seven sensors are used for this. Electrodes of the machine are placed at the same places in the same way as the *Vaidya* uses his fingers. In one hand, three electrodes are placed together, and in the other hand, three more electrodes are placed. The seventh electrode is positioned on the middle finger of the left hand. When this process is over, the machine automatically analyses and synthesizes the recorded data and immediately displays the results on the screen to know what is the level of *Vata*, *Pitta*, *Kapha*, seven *Dhatus* and three *Malas* inside the body.

The choice of these media is based on traditional practices and their perceived effectiveness in processing the metal. The use of these substances is rooted in their chemical and physical properties, which assist in removing unwanted materials from the silver and preparing it for further use.
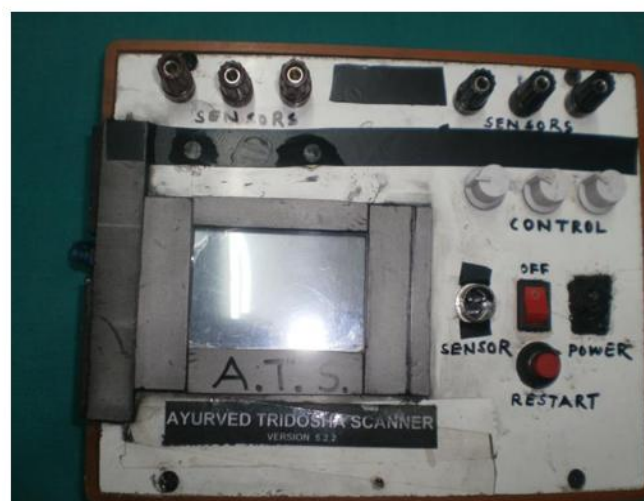

Fig. 1: Nadi Tarangini

Fig. 2 : Front View of Ayurveda Tridosho Scanner

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Fig. 3: Showing Electrodes, Sensors and Accessories

Fig. 4: Placement of Sensors

Fig. 5 : Printed Ayurveda Tridosho Scanner First Page Report

Imaging Technology

CureMetrix[13], Inc., a global healthcare technology company that develops AI-driven software for radiology (especially breast cancer and heart disease detection), has presented research and solution overviews highlighting the value of cmTriage™, cmAssist®, cmDensity™, and cmAngio™ for clinical practices. For example,

cmTriage™ is the initial FDA-approved AI-driven triage software in the United States. It aids radiologists in placing the most concerning mammogram cases at the top of their workload, facilitating quicker case prioritization and turnaround times**.**

cmAngio™ is a cutting-edge AI-driven triage tool designed to aid healthcare professionals in evaluating a patient's likelihood of developing coronary heart disease (CHD) using data from a mammogram. This software generates a CureMetrix Bradley Score™ by analyzing the presence and attributes of breast arterial calcifications identified in the mammogram.

DISCUSSION

Artificial intelligence plays a crucial role in analyzing diagnostic inputs in real-time, offering instant feedback to our healthcare professionals. This leads to improved accuracy in diagnosis, minimizes errors, and speeds up the decision-making process. The machine models that have been created or suggested are designed to automate certain aspects of the *Pariksha* like *Prasna Pariksha* in *Prakriti Analysis*, *Sparsana Pariksha* in *Nadi Analysis*. A thorough exploration of all facets of *Pariksha* is necessary to progress in the integration of artificial intelligence in *Ayurvedic* diagnostics. Standardization of current models is essential for globalizing them effectively. Ensuring the safety and effectiveness of the models is also a critical requirement. When looking ahead at the *Ayurveda* industry's future, it is anticipated that there will be a harmonious integration of modern technology with the preservation of ancient practices.

CONCLUSION

In wrapping up our analysis of Artificial Intelligence in *Ayurvedic* diagnosis, it is evident that we are on the

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cusp of a significant shift in the healthcare landscape. The incorporation of AI into this traditional medical practice signifies more than just a technological advancement; it signifies a connection between age-old wisdom and state-of-the-art progress. Furthermore, as we progress through this process of integration, it is important to stay mindful of the ethical considerations and obstacles that may arise. Safeguarding the core values of *Ayurveda*, protecting data privacy, respecting cultural differences, and tackling regulatory hurdles are all key factors that require continuous focus and discussion. Clinical trials and research are required to fully understand the potential benefits and risks of utilizing AI in diagnostics and health care. Statistical data is required to show the effectiveness, worth, and influence on patient care and results and also, there is a necessity to create affordable artificial intelligence (AI) models and diagnostic tools that can be easily integrated by physicians, healthcare practices, and hospitals for daily clinical applications.

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