Importance of AI and Machine Learning in Data Mining used in the diagnosis methodology by Amalgamation of Indian Traditional Medicine Ayurveda and Modern Medicine

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ABSTRACT

Since the dawn of time, the ancient Indian Traditional Medicine (ITM) practise of ayurveda has been a major part of healthcare delivery in underdeveloped nations. Herbal plants have a rich history dating back to ancient times when they were used to treat a variety of diseases, long before modern medicine was developed. The knowledge of Ayurvedic treatments has, however, been lost in developing nations like India because the Ayurvedic medicines used to treat illnesses have not been adequately documented. People have shifted to allopathy treatment as a result of the lack of evidence, as it provides quick relief and makes use of cutting-edge diagnostic tools to facilitate quicker treatment decisions. In addition, Allopathy Treatment keeps detailed records of its disease management methods. In order to meet their medical needs, people are increasingly turning to allopathic medicine. Also from the last two years, the pandemic of COVID-19 has turned the entire universe into an immune system, the body's defense system against microorganisms that cause sickness, and also other organisms that may cause due to touch, inhale of air in the day to day life. Thus in the proposed model, we focus on the development of a Centralized Expert System in which integration of best methodologies used in both Ayurvedic and Allopathy will be useful in fast decision making for disease treatment. The system must also incorporate searching of herbs with a proper link, information validation, information extraction automatically from other collaborative resources and it must also incorporate user management using Artificial Intelligence(AI), Machine Learning(ML), and Deep Learning(DL) Algorithms. Thus providing an integrated Centralized Expert System with AI, ML, and DL on Ayurvedic and Allopathy will sure create the awareness of both Medicinal treatments, which will be useful in creating a healthy society, less expensive, fast diagnosis process, and environmental friendly.

Keywords: Ayurvedic, Allopathy, Herbal plants, Expert System, Artificial Intelligence

I. INTRODUCTION

Ayurveda is an elaborated system that is used in healing many diseases past many decades in India. The chronological evidence of Ayurveda can be seen in many ancient scripts. It is mentioned over 6000 years ago in the Rig Veda among one of the Vedas that, Ayurveda can be used to heal many diseases. [1] Ayurveda focuses on the entire body while diagnosis rather than focusing on the particular disease. The specialty of Ayurveda is that it gives the root cause of the particular disease and later treatment is started. Ayurveda gives the process of leading a balanced life [2]. Thus Ayurveda provides us with the knowledge of how to cure disease by considering the root cause of a particular disease. Ayurveda combines many approaches during the treatment, such as changes in lifestyle, herbal remedies, yoga, meditation, which strengthen and purify the entire body. Ayurveda is an old medicinal practice that is gaining popularity due to its reliability and predictable outcomes. Trividha Diagnosis [3] is one of the methods used in the identification of tridosha and imbalance in the tridosha which causes an unhealthy life.

Healthy and unhealthy situations have always been a first priority concern of all human beings. Every field of medical science aims at getting back the healthy life of each individual. Medicines are chemicals or compounds that are extracted from combinations of tested chemicals, herbs used in curing many diseases and give human beings relief from the pain and provide a healthy life. The modern world is diverting towards fast relief medicines for curing many diseases. But most fast relief medicines have many side effects. The diagnosis method of Ayurveda on the other hand very good medicine with fewer side effects. The Ayurveda diagnosis process can be improved by being restructured to meet the rising demand in the modern world or cyber society [4].

A. Principle of Ayurveda and Allopathy diagnosis:

Ayurveda is considered as “Mother of all medicine”. Ayu means “life’, Veda means “knowledge”. Thus Ayurveda is “Science of Knowledge”. Life in Ayurveda is considered as the union of body, sense organs, mind, and soul. Ayurveda Vaidya considers happiness as a healthy life and sadness as an unhealthy life. Thus according to Ayurveda, life is defined as the intellectual synchronization of our four parts, the soul/ambiance, intellect/mental power, senses/wisdom, and body/physic, with the wholeness of Mother Nature and the cosmos [5]. Health is more than just a physical condition. Seasons, planetary shifts of the earth, moon, and other planets, as well as orbiting interactions inside our life, such as our loved ones and friends, coworkers, etc., all interact with us. Every living and non-living creature in the cosmos has an impact on us, and we have an impact on them. The key to living a healthy life is to bring all of this into harmony. According to Ayurveda, all living beings consist of three senses of humor called Vata, Kapha, Pitta, seven basic tissues called Rasa, rakta, Mamsa, Meda, Asthi, Majja, and Shukra, and waste products are sweat, urine, and faeces. Totally these are known as body senses of humor [6], tissues, and waste products of the human body. The imbalance of these is the indication of diseases. The diagnosis in Ayurveda is always done taking the root cause of a particular disease. The Ayurveda physician takes a careful examination of patient-internal physiological and psychological characteristics [6].

- Allopathy, also referred to as western medicine or conventional western medicine, uses an evidence-based strategy and employs standard medications to diagnose symptoms [7]. Dr. Samuel Hahnemann coined the phrase "allopathic medicine" to refer to the treatments used in the nineteenth century. Hypothesis, testing, observation, and their decision are all steps in the systematic process that modern medicine uses [8]. However, rather than addressing the root cause, it is mainly concerned with treating the patient's symptoms. Modern medicine's diagnostic strategy treats each individual body part separately and sees the patient's body as a machine.
- Philosophy of modern Medicine: Modern medicine philosophy is in the prevention of suffering of human beings by just considering the symptoms and the cause is not dealt with in detail. Modern medicine unlike traditional medicine is made of chemicals, and some using of plants. The main idea behind modern medicine is to give patients immediate relief by getting rid of the disease's primary cause [8].

From the above information collected for the proposed method, many benefits and drawbacks of Ayurveda and Western Diagnosis were observed in their respective roles.

B. Benefits and drawbacks of the Ayurveda Diagnosis approach

- Ayurveda’s main benefit is it has fewer side effects because all the medicine products are obtained by using the essence of fruit, spices, vegetables, and natural herbs.
- Heals the body holistically and not just considering symptoms
- Diet and yoga is a part of Ayurvedic treatment
- The Ayurvedic medicine and diagnosis are cost-effective
- some of the diseases like piles, Rheumatoid arthritis, jaundice, skin diseases, etc. have been successfully cured by the best Ayurvedic medicines.

Drawbacks of Ayurveda:

- The Ayurveda treatment is relatively slow.
- Ayurveda cannot be suitable for many diseases and situations where surgery and modern diagnostics test tools are required in emergency cases.
- Lack of dosage instruction.
- Improper medication interaction
- Lack of research laboratories to validate the drugs

C. Benefits of Allopathy/Modern Medicine

- Allopathy medicines give fast relief.
- Allopathy medicines are very when emergency treatment is required.
- Allopathy/Modern medicine is completely evidence-based. Medicines are checked in the laboratories, validated before giving as a medicine to a patient or for particular diseases.
- Diagnosis process is simple and easy to understand because modern medicine uses the best technologies during the analysis.
- The brilliance of modern medicine lies in its diagnosis abilities, its emergency care in the form of surgery using the best technology therapies.

Drawbacks of Allopathy/Modern Medicine:

- Modern Medicines have more side effects since the medicines are made from chemicals.
- Treatment only addresses symptoms and not the root cause of the diseases.
- Modern medicine system gives only temporary relief to certain diseases.
- The diagnosis and treatment are very costly. Some of the surgeries and treatments cannot be affordable for poor people.

D. Importance of AI and ML in the field of healthcare

The invention of science and technology in our daily life has resulted in new ideas and products in the field of healthcare also. The advanced technologies used in the diagnostic instrument to smartphone connection, mobile health devices such as iECG, handheld

ultrasound, and Lab on a chip technology, best machine learning algorithms to improve and fast diagnosis approaches. In the healthcare sector, the applications of artificial intelligence (AI)-based deep learning and machine learning have attracted a lot of attention, particularly in screening potential active ingredients, targets, and action pathways of single drugs or prescriptions, as well as optimizing disease diagnosis and treatment models.

II. LITERATURE SURVEY

A Challenge in the existing field of Ayurveda is the extraction of required data and proving with the evidence without changing the basic principle of Indian Traditional Medicine. [9]. The documentation of the Diagnosis of a patient is maintained in the form of written documentation.

Usually, the information regarding the diagnosis is being passed from generation to generation through the interaction from one person to another. There may be many chances of data loss due to this. Thus Why don't we bring the technology in maintaining the documentation as evidence for further reference by future practitioners? This leads to no loss of data [9].

Diagnosis in the Ayurveda is done through root cause. It differs from person to person. But in Allopathy the diagnosis and treatment are done considering the particular disease. For example, if we take the treatment of diabetes the allopathy doctor decides the treatment based on the report of blood and urine test. But in Indian Traditional Medicine this type of report generation will not be sufficient to start the treatment. The next challenge is whether practitioners are able to accept the technology [9].

The research conducted by A.C. Dey (1980) in the book "Indian Medicinal Plants utilized in Ayurvedic Formulations" has investigated nearly 500 plus Ayurvedic remedies, encompassing 200 plant species. The description of all the parts of the plant used with the botanical names, its description. In this author gives the description active principal of the plant varies on the bases of its quality factors, parts of the plants. All this parameters of the plant are very important to get the high quality herbal drug [10].

In the book "Material Medical of India and their therapeutics" by author name Rustam jee Naser Jee Khory (1981), discusses the organic drugs which are extracted from the vegetables that are grown organically. This book gives the history of the plants kingdom. These plants described in this book are used in the treatment of diseases and for practices in the research works [11].

The author of "Plants of Quran," Dr. Mohd. Iqtedar Hussain Farooqi, presents a thorough investigation of the plants mentioned in the divine text of the Quran [12]. The author gives in-depth explanations of these plants, including their botanical traits, chemistry, characteristics, and numerous applications. In particular, the book explores the fascinating descriptions of important plants like Sidratul Muntaha, Kafur of Paradise, Zaqqum of Hell, and Mannasalva for Bani Israil, providing important and insightful knowledge about the plant kingdom. For professionals and those who want to learn more about the significance and uses of these plants in relation to references found in the Quran, this wealth of information is a great resource.

Getting information is not the main point but the side effects of each plants if any must also be considered by the practitioners. The author by name Ban C.Beyerstein(2000) in his book called "Herbal Hazards" gives the more information of the herbal side effects. In his book he describes that herbal medicines manufacturers should have the well-set laboratory research, screening of all facilities must be done before the license is issued. [13]. Also the report "WHO strategies of medicines "(2001) has taken the responsibility to authentication of Herbals, that are used in the manufacturing of the Herbal Medicines. The WHO (World Health Organization) Main focus in to authenticate it terms of its safety, efficacy and quality, policymaking of all the Herbal used in the Medicines. [14].

The proposed identification of Doshas provided by Alex Hankey is scientific evidence based on system analysis and relative to coenzyme. Tridosha concept shown by Joshi R.R involves sound empirical basis that will be used for scientific establishment of Ayurveda in a new light. Ayurvedic treatments may vary from the way clinical trials are done with allopathic medicine. However, we need to develop appropriate models and demonstration of sufficient scientific evidence for the various therapies of this ancient system [16].

Classification of human subjects is done via decision tree approach by Farooque according to Unani mizai, and classification of subjects done through SOM Algorithm according to Sasang typology [17]. The diagnosis of diabetic mellitus was demonstrated by Srideivanai N and R. M. Chandrasekaran for the creation of expert clinical systems using clustering and classification techniques [18]. Classification of Parkinson diseases is done using data mining algorithms by Suganya and C. P. Sumathi [19]. All these techniques together were used by C. Kalaiselvi and G. M. Nasira to predict Heart diseases and cancer [20].

Riccardo Bellazzi and Blaz Zupan [21] concluded that to analyze medical data and construction of medical prediction models, data mining methodology and technical solutions is useful. Ayurvedic concept of personalized medications involves crucial step of Determination of Prakriti. Researchers developed wide variety of methodologies such as pulse detection, psychometric scaling, and development of questionnaires and software like AyuSoft. Free Radical theory of diseases proposed by Tripathi Y.B. is based on tridosha theory of Ayurveda that comes up with a comprehensive review of the state of the art of predictive data mining in clinical medicine and offers procedures to conduct data mining studies in this field.

Nagesh Gandagi and Shubhangi Patil on their research studies on" Concepts between Ayurveda and Allopathy in relation with treatment" [24], explains about the advantages of using the Ayurvedic Medicines compared with the Allopathy. In this paper the authors give the principle working of Ayurveda and the way treatment is done. They also describe the different ways of treatment panchabhuatic theory and prakruti concept. Also discusses about the Allopathy and the side effect of the Allopathic treatment and medicines [25].

Ruchika Nandha, Harpal Singh on their research paper [26] has given the comparison of the Ayurvedic and the Allopathy treatment. The principal of how both these methods works. The advantages and disadvantages of both the treatment. They have mentioned in their work that if the integration of both the areas are done by considering the best methodology in their respective field then one can develop the system that are less expensive and less toxic and will be helpful for the society.

The authors Supiah Mustaffa, Ros'aleza Zarina Ishak, Lee Chee Kiam, Michelle Lim Sien Niu, Mary Sintoh, Nor Ezam Selan [27] have established the Herbal Medicine Knowledge Base System (HMKS) project to meet the needs of Ayurvedic Practitioners. This system is developed using the semantic technology. In this system the knowledge is represented using the Resource Description Framework (RDF)[28] knowledge is discovered using the reasoning capabilities. The HKBK system uses four category of knowledge, Herb, Traditional

Medicine, Process and Pharmacology [29]. This system also incorporates the features like navigation, search, validation of data [30] and the ontology management [31].

Wachana Tungkwampian, Anuchai Theerarungchaisri and Marut Buranarach. researchers have focused on developing the Thai Herbal Medicine Ontology (THMO). This gives the huge knowledge on herbs and how it is used in the treatment to cure many diseases in their regional places [32,33]. They have developed the model on the clinical level. It assists the practitioners in terms of finding the information by means of a concept-based search system. In this the researchers have given the principal worked behind the Traditional Indian Medicine and the Traditional Chinese Medicine and suggested how the THMO can be used by the practitioners to treat the different diseases.

The catalog provided by "Central Council for Research in Ayurvedic Sciences Ministry of AYUSH Government of India New Delhi (2015)" [34], provides rich knowledge on the Indian Traditional System that has been provided in the huge number of publications on ITM in both national and international journals. This Catalogue also gives many research scholars to share their ideas and upload the works they have done in this area. This catalog gives rich knowledge of information especially by considering the specialized particular herbs, their uses by considering the specific disease.

Patwardhan, Bhushan in their study [35] explains how the integrated diagnosis model benefits the medical research scholars, practitioners, physicians, in terms of fast analysis, and predicting of diseases and best prescriptions. The author extends Ayurveda practitioners must collaborate their strategy with current innovative technologies like "Horizon 2020", which involve three P's are predictive, preventive, and personalized medicine.

A. Why not Ayurveda (Indian Traditional Medicines) be Integrated with Allopathy (Western Medicine)?

Since the 2019 year-end when the Covid-19 pandemic, the entire universe looked into the importance of immunity and strength of the human body. During the pandemic period, both Ayurvedic and Moderns medicines became the most favorable topic of discussion when it came to body immunity and strength. Both the diagnosis fields put their best medication in terms of their respective diagnosis during pandemics. After the invention of vaccination also it was found that most of the people suffered from Covid-19. It was observed that after Covid-19 was cured completely, few people suffered from the cardiac attack. Researchers discovered that the incidence of several diseases, such as heart failure and stroke, were significantly greater among persons who had recovered from Covid than in people who had not. The logic behind this explained by Dr. Panda was "The lungs are known to be affected by Covid. Our lungs receive oxygen from the air we breathe. When the lungs fail to function properly, the heart becomes strained and needs to work harder. This increased oxygen demand may induce heart rhythm problems, which could lead to a heart attack or heart failure"[36]. Thus we can reduce this type of situation by introducing one of the therapies of Indian traditional medicine Yoga. By introducing breathing exercises of pranayama and kapalabati along with the modern medication, the breathing problems reduce and can avoid cardiac attacks. This is just one simple example of the integration of two approaches.

Ayurvedic and Allopathy medicines is having their advantages and disadvantages in their respective fields. Taking the best of these two medicines can benefit many people in many ways. An Expert System can be generated by combining the traditional based medicines therapies with the high technology-based treatment and analyzing the diagnosis process using the technology Artificial Intelligence, and best Machine Learning and Deep Learning algorithms in integrated medicine. This should be developed without disrespecting both types of medicines. This system provides care in disease management, disease prevention, preservation, protection, and health up-gradation. Integration of the Ayurvedic Medicines with the Allopathy Medicines gives benefits to the society which will be cost-effective.

III. PROBLEM STATEMENT

- Ayurvedic Diagnostic is still complex because of its holistic and patient-centric approach.
- Diagnosed research areas are less explored in the field of our ancient traditional medicine Ayurveda. There are no standard protocols to explore diagnosis evaluation of drug measurement and evidence-based drugs.
- There is no standard method for reasoning, based on the scientific knowledge of diseases and their manifestations for arriving at a particular disease. This may lead to many reasons such as variance in diagnosis approach individually
- Ayurvedic medicines are based on the actions of Prakrithi or the imbalance of tridoshas.
- In Ayurveda, the medicines are not based on the patient's disease. Thus there is no standard tool or technology that incorporates the diagnosis and treatment in the field of Ayurveda. However, it is necessary to develop a diagnostic tool for validating, predicting, and treatment of a particular disease.

A. The main objectives of my research work is as follows:

1. To encourage cooperative programs/research projects to share Medicinal Plants related information that is available in the local, regional, national, and international organizations like AYUSH/NMPB/MoEF, DBT, DST, and other similar organizations.
2. Build the knowledge-based system that analysis the Tridoshas of each individual and, the tool that will use modern technology that has been used in Allopathy Practitioners to make decisions faster to treat a patient.
3. To share the information regarding the evidence of diseases cured in the field of both Ayurveda and Allopathy medicines, and built an integrated Knowledge-based system that will be useful for the society in terms of being cost-effective and environmentally friendly.

B. Methodology

The proposed model offers a fusion of the most effective aspects of Ayurvedic and Modern Medicine, and its assessment is conducted through the implementation of machine learning algorithms. To construct the dataset concerning chronic diseases, valuable data is sourced from various reputable channels, including Ayurvedic Vaidya's, PubMed, Google Scholar, Scopus, and Science Direct. The extraction process involves using specific keywords such as "Ayurvedic Diagnosis," "Modern Medicine Diagnosis," and "Diagnostic Tools" to gather pertinent information on medicines and diagnosis methods. In Figure 1, we illustrate the comprehensive analysis of various diseases utilizing the AI model, which represents the integrated approach. The intricate workings of the proposed model are elaborated in detail within Figure 1. The data compilation encompasses the diagnosis methods employed in both Ayurveda and Modern Medicine, derived from diverse resources as previously mentioned.

Preprocessing of Data and Data refinement:

Preprocessing of Data [Figure 3]:

To find the most discriminating variables, a meticulous data refinement process is used during the data preprocessing stage. There are many steps taken in order to accomplish this. First, variables with singular values are found because they can be filtered out and may not have a significant impact on the performance of the model. Furthermore, irrelevant variables that have no connection to the target label are also taken out of the dataset. As a result, only the most pertinent and useful data is kept for model training.

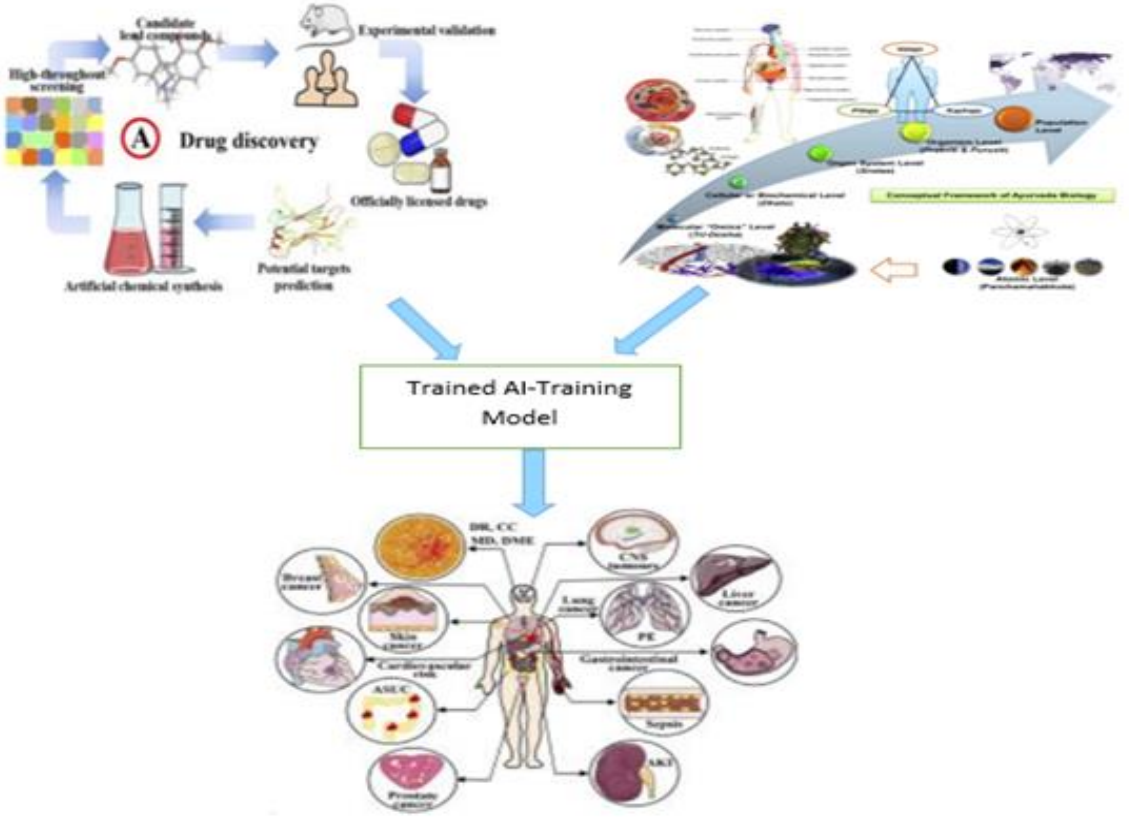

Figure 1: Integrated Diagnosis process of Disease using AI-Trained Model

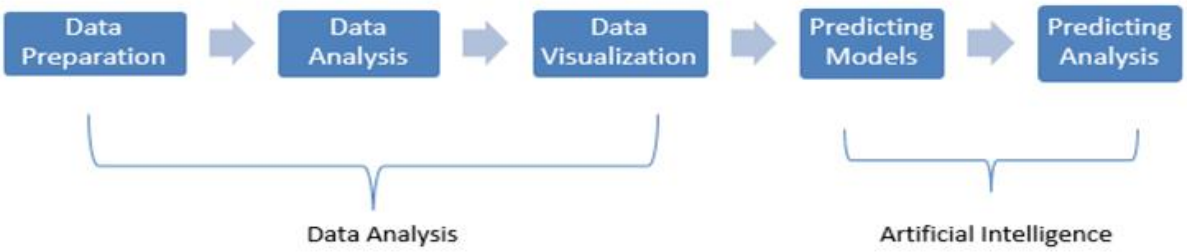

Figure 2: Data Science Using Artificial Intelligence Technique

Data Set Division:

Following the data preprocessing, the dataset is split into two distinct subsets: the training dataset and the testing dataset. The training dataset is employed to train the model, while the testing dataset is used to evaluate its performance. An 80%-20% split is adopted, with 80% of the samples allocated to the training dataset and the remaining 20% to the testing dataset. This partitioning ensures a robust evaluation of the model's generalization ability.

Model Evaluation:

To assess the diagnosis ability and performance of different algorithms, evaluation metrics such as the confusion matrix and Receiver Operating Characteristics (ROC) are employed. The confusion matrix provides valuable insights into the model's classification accuracy, precision, recall, and F1-score. On the other hand, the ROC curve illustrates the trade-off between true positive rate and false positive rate, enabling a comprehensive assessment of the model's discriminative power.

In machine learning techniques, the evaluation matrix known as the Confusion Matrix is a fundamental tool for analyzing the performance of algorithms. It provides a clear representation of the model's classification results. Within the Confusion Matrix, four key components are distinguished:

True Positives (TP): These are instances where the algorithms correctly identify positive cases, and they are genuinely positive.

True Negatives (TN): These are instances where the algorithms accurately identify negative cases, and they are genuinely negative.

False Positives (FP): These are undesirable cases where the algorithms erroneously classify instances as positive when they are, in fact, negative.

False Negatives (FN): These are positive cases where the algorithms falsely classify instances as negative.

By examining these components, one can gain valuable insights into the model's performance in terms of correct and erroneous classifications, aiding in the evaluation and optimization of algorithms for various tasks and applications. The Confusion Matrix serves as a foundational tool in assessing the effectiveness and reliability of machine learning models.

Methodology Model Architecture:

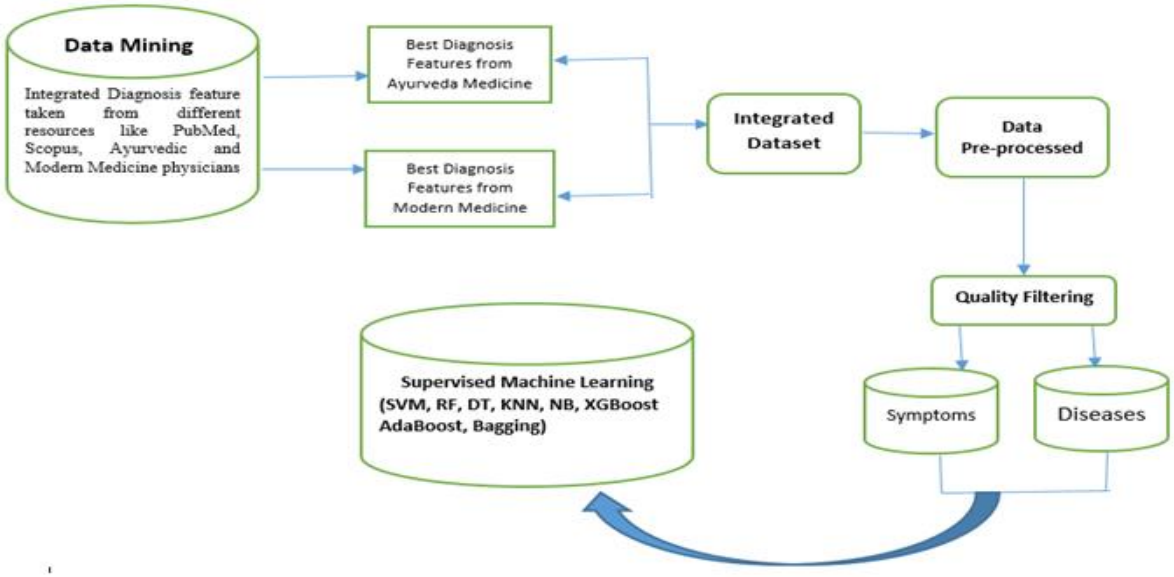

Figure 3: Model Architecture

The proposed model employs several performance measures based on the Confusion Matrix to evaluate different machine learning algorithms. These measures play a crucial role in assessing the model's effectiveness and accuracy. The performance metrics used in this study are as follows:

a. Accuracy: The accuracy measure determines the correct predictions among all the values in the dataset. It is computed as the ratio of True Positives and True Negatives to the total number of instances: Accuracy = (TP + TN) / (TP + TN + FP + FN).

b. F1 Score: The F1 score is the harmonic mean of precision and sensitivity (also known as recall). It provides a balanced assessment of the model's performance, considering both false positives and false negatives. The F1 score is calculated as follows: F1 score = (2 * TP) / (2 * TP + FN + FP).

c. Precision: Precision measures the ability of the model to correctly identify true positive cases among all instances classified as positive: Precision = TP / (TP + FP).

d. Sensitivity / Recall: Sensitivity (also known as recall or True Positive Rate) focuses on accurately categorizing positive cases from the entire dataset of positive instances: Sensitivity = TP / (TP + FN).

e. Specificity: Specificity quantifies the model's ability to correctly predict negative cases from the dataset of negative instances: Specificity = TN / (TN + FP).

f. False Positive Rate: The False Positive Rate indicates the proportion of negative instances falsely classified as positive by the model: False Positive Rate = FP / (FP + TN).

The ROC curve is another critical tool used for diagnostic test evaluation. It is created by plotting the True Positive Rate against the False Positive Rate at various threshold settings [38]. The area under the ROC curve (AUC-ROC) serves as a valuable metric for assessing the predictability and discriminative power of different machine learning classifiers.

In summary, the proposed model utilizes these performance measures to comprehensively evaluate the efficiency and accuracy of various machine learning algorithms, ensuring robust analysis and comparison of their diagnostic capabilities.

CONCLUSION

The Expert System gives the platform to preserve, explore, the data that is used in the Ayurvedic and Modern Medicines. It must serve as a Knowledge system tool for many medical practitioners, research scholars, drug companies. And the advantage of integrating Allopathy with the Ayurvedic medicines by choosing their advantages and disadvantages in their respective fields with the application of best technology like AI, ML, and Deep Learning, which gives the best information to start the treatment fast and more accurate. Hence Modern Technologies are needed in the medical field to explore the data and to use it in an efficient way for the treatment of a particular disease. Integration is not just binding the medicine given by both physicians with trial and error methods. Integration of both medications from Ayurvedic and Modern medicine must involve using the best possible treatment based on the patient's individual condition. Integration should be analyzed with the technologies like Artificial Intelligence, Machine Learning, and Deep Learning that give the best medicine to treat a disease. The integration should be successful from both Ayurvedic and Modern Medicine which should take care of patient safety, the most cost-effective approach.

REFERENCES

[1]. Charka Samhita Handbook on Ayurveda Volume I.
[2]. Trends and developments of Ayurveda by Hemachandran Nair.
[3]. Bheemavarapu, Lakshmi, and K. Usha Rani. "A Review on Role of Data Science in Ayurveda Based Disease Diagnosis Using Prakriti Type in Trividha Pariksha." *INFORMATION TECHNOLOGY IN INDUSTRY* 9, no. 3 (2021): 1038-1048
[4]. Marques, Oge. "Integrating contemporary technologies with Ayurveda: Examples, challenges, and opportunities." In *2015 International Conference on Advances in Computing, Communications and Informatics (ICACCI)*, pp. 1399-1407. IEEE, 2015.
[5]. http://www.tkdl.res.in/tkdl/langdefault/ayurveda/Ayu_Principles.asp?GL=#q1
[6]. https://www.keralaayurveda.biz/blog/10-effective-ayurvedic-alternatives-to-allopathic-medicines-you-should-know
[7]. https://www.medicalnewstoday.com/articles/allopathic-medicine
[8]. Tewari, S. "Ayurvedic healthcare in India: An alternate to allopath." (2009).
[9]. Charka Samhita Handbook on Ayurveda Volume I.
[10]. A.C. Dey (1980) "Indian Medicinal Plants Used in Ayurvedic Preparations" Dehradun, India.
[11]. Rustom jee, Naserwan jee Khory (1981) "Materia Medica of India & their Therapeutics" Neeraj Publishing House, Delhi, India.
[12]. Dr. Mohammad Iqtedar Husain Farooqui (1989) "Plants of the Quran" Sidrah Publication, Lucknow.
[13]. Bany L. Beyerstein (2000), "Herbal Hazards" www.sfu.ca/mediapr/sfnews/2000/iullv13/beyerstin.htm.
[14]. Emro WHO Int (2001), "The WHO Strategy for Traditional Medicine: Review of the Global Situation and Strategy Implementation in the Eastern Mediterranean Region Health and Human Security" www.emro.who.int/Rc49/Document-49131 .htm.
[15]. Journal of Alternative and Complementary Medicine, The Paradigm, Practice, and Policy Advancing Integrative Health Editor-in-Chief: John Weeks ISSN: 1075-5535 | Online ISSN:1557-7708 | Published Monthly | Current Volume: 25
[16]. Opportunities and Challenges in Ayurveda: Global Perspective Gundu HR Rao* Department of Medicine and Pathology Anesthesiology, Lillehei Heart Institute, Academic Health Center, University of Minnesota, USA *Corresponding Author: Gundu HR Rao, Emeritus Professor, Laboratory Medicine and Pathology Anesthesiology, Lillehei Heart Institute, University of Minnesota, USA. Tel: 301 444 4545.
[17]. Murtaza M. Junaid Farooque[1], Mohammed Aref[1], Mohammed Imran Khan[2] and Shareque Mohammed[2]. "Data Mining Application in Classification Scheme of Human Subjects According to Ayurvedic Prakruti – Temperament". Indian Journal of Science and Technology, Vol 9(13), DOI: 10.17485/ijst/2016/v9i13/84658, April 2016.
[18]. Design and Implementation of Expert Clinical System for Diagnosing Diabetes using Data Mining Techniques Sridevanai Nagarajan and R. M. Chandrasekaran.
[19]. A Novel Metaheuristic Data Mining Algorithm for the Detection and Classification of Parkinson Disease P. Suganya and C. P. Sumathi.
[20]. Prediction of Heart Diseases and Cancer in Diabetic Patients Using Data Mining Techniques C. Kalaiselvi and G. M. Nasira.
[21]. Predictive data mining in clinical medicine: Current issues and guidelines Riccardo Bellazzi Blaz Zupanb.http://www.intl.elsevierhealth.com/journals/ijmi.
[22]. A survey on the need for developing an Ayurveda based personality (tridoshaprakrti) inventory Ramakrishna b, kishore k, Vaidya v, Nagaratna, Nagendra h.
[23]. Basics for the development of prototype research software relevant to infants' prakriti assessment for vikriti management and possible future disorders Srivastava Niraj, Singh Praguna, Gehlot Sangeeta, Singh Sanjay, Singh B.M.
[24]. Amalgamation of Ayurveda with Allopathy: A synergistic approach for healthy society Ruchika Nandha, Harpal Singh
[25]. Concepts between Ayurveda and Allopathy in relation with treatment. Nagesh Gandagi, Shubhangi Patil. Review Article International Ayurvedic Medical Journal ISSN: 2320 5091.
[26] www.evaidyaji.com, www.illuminatedhealth.com, www.virgouap.wordpress.com, www.gosai.com, www.punarnavaayurveda.com.
[27]. Herbal Medicine Knowledge Base System Supiah Mustaffa, Ros'aleza Zarina Ishak, Lee Chee Kiam, Michelle Lim Sien Niu, Mary Sintoh, Nor Ezam Selan Knowledge Engineering Center, MIMOS Berhad Technology Park Malaysia, 57000 Kuala Lumpur, Malaysia.
[28]. Linked Data, http://www.w3.org/DesignIssues/LinkedData.html (Last Visited: June 2012)
[29]. Fang, X., Shao, L., Zhang, H., Wang, S.: CHMIS-C: A Comprehensive Herbal Medicine Information System for Cancer, in Journal of the Medicinal Chemistry 2005, 48(5), pp.1481 – 1488. doi:10.1021/jm049838d (2005)
[30]. World Health Organization: WHO traditional medicine strategy 2002–2005. WHO, Geneva;2002., http://apps.who.int/medicinedocs/en/d/Js2297e/ (Last Visited: June 2012)
[31]. Norta, A., Yangarber, R, Carlson, L.: Utility survey of ontology tools, in International Enterprise Distributed Object Computing Conference Workshops 2020, pp. 207-214(2010)
[32] Gibert TF. Reflections on traditional Chinese medicine and its pharmacopoeia. Ann Pharm from 1998; 56:282–5.
[33].C heng JT. Review: drug therapy in Chinese traditional medicine. J Clin Pharmacol 2000; 40:445–50.
[34]. Research Publications in Ayurvedic Sciences Catalogue of Research information on Ayurveda and Related Sciences. Central Council for Research in Ayurvedic Sciences Ministry of AYUSH Government of India New Delhi 2015.
[35]. Patwardhan, Bhushan. "Bridging Ayurveda with evidence-based scientific approaches in medicine." EPMA Journal 5, no. 1 (2014): 1-7.
[36]. https://economictimes.indiatimes.com/industry/healthcare/biotech/healthcare/is-covid-surging-heart-problems/articleshow/89729995.cms