An Amalgamation of Ayurveda and Evidence-based Medicines with Artificial Intelligence and Machine Learning: A Synergistic Approach for Less Expensive and Effective Diagnosis Approaches

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Abstract

Technology plays a very important key role in various diagnosis processes. For example, capturing the patient information, maintaining the electronic health records for further diagnostic references, improving the clinical diagnosis process, and reducing diagnostic errors when technology is applied in the right ways with proper knowledge of technology. In this proposed work, the design of the integrated analysis process of Ayur'veda and Western method of diagnosis by using the current technologies such as Artificial Intelligence and Machine Learning techniques are discussed. This integration process ensures that technologies simplify the timely and accurate diagnosis process. Integration of the Ayurveda and Evidence-based western medicines has become very much necessary and important in today's situation. But, during this process, one should not disturb the basic principles of both Indian Traditional Medicine and Evidence-based medicine. During integration, the best of best diagnosis approaches in both the fields are chosen with disease management, disease prevention, and protection which create a healthy society by developing healthcare with less expensive and less toxic. The amalgamation approach will be more effective than concentrating on just one diagnostic method.

Key Words: Amalgamation, Ayurveda, Evidence-based Medicine, Artificial Intelligence, Machine Learning.

DOI Number: 10.14704/nq.2022.20.5.NQ22224 **NeuroQuantology 2022; 20(5):684-695**

Introduction

1. Data Science in the Field of the Health Sector

Data science is a multidisciplinary area in which we can extract useful knowledge from structured and unstructured data sets by using the data mining technique. The invention of AI Artificial Intelligence Techniques, ML and Deep Learning has made the Data science more powerful and dynamic. In the dynamic digital age, a combination of science, technology, and medicine has discovered innovative data systems to improve statistics, healthcare and medication distribution, and wellbeing evidence reportage on medical conclusions. Using Boolean operators, the data-mining tool enables accurate knowledge searches. [1] Complex searches can be used to search for information about diseases, causative factors, symptoms, treatment guidelines, medicines, nutritional recipes, lifestyle modifications, and treatment processes.

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Relevant conflicts of interest/financial disclosures: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.
Received: 25 March 2022 **Accepted:** 29 April 2022

The huge dataset is of from various domains based on its domain, scope, and the type that is been used in different fields [2]. As per the information generated from the world economic forum [3] 500 million tweets each day, 294 billion E-mails, Facebook data of size 4PB, data of about 4TB from automated cars, 65 billion messages from WhatsApp, and huge data from YouTube and 5 billion searches are made each day. It's been estimated [3] that by the end of 2025, 463EB per day will be generated from different resources. This analysis made data huge in the form of 4 V's such as Volume, Variety, Velocity, and Veracity. Also Covid-19 pandemic increased the medical data set in the huge amount, especially in the medical field. The survey [4] shows that by 2027, the overall Big Data in the cyber security market will grow to $64.4 billion.

Data-Science in the Medical field uses data analysis from different resources like physicians, Electronic Health records, Laboratories, Search Engines, Research Studies, wearable Diseases, etc… as shown in Figure [1].

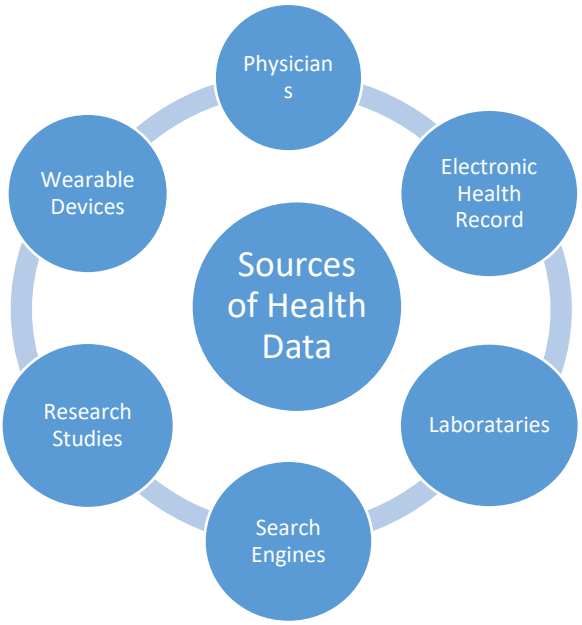

Figure 1. Sources of Health Data

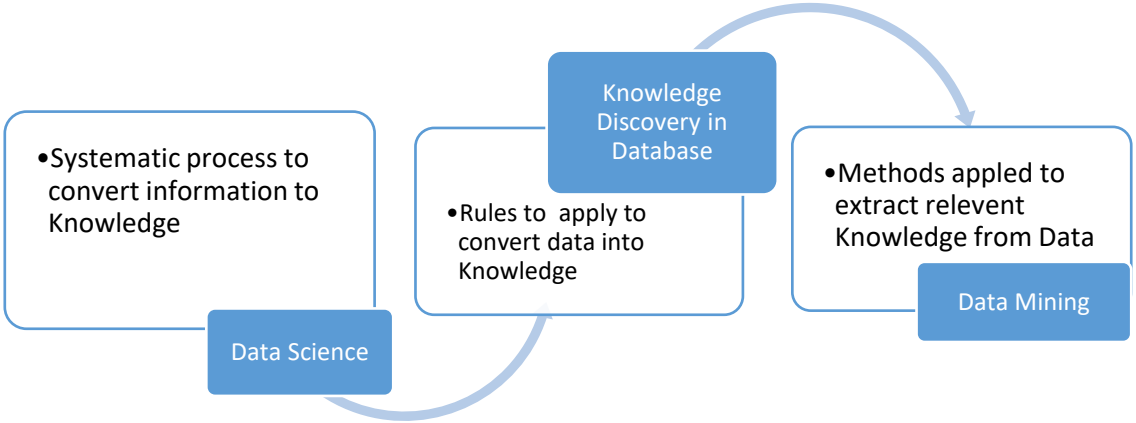

Figure 2. Data Science –Knowledge Discovery- Data Mining

The interrelated process of Data Science, useful Information Discovery in Databases, and analysis of data using data mining is shown in Figure 2. Data Science is a huge data field where knowledge is discovered from the existing database and methods are incorporated to extract the relevant data from the existing structure and unstructured data set. A detailed explanation of Knowledge Discovery in Database processes like data selection,

pre-processing, transformation, data mining, and evaluation was given by Fayyad et. al. [5].
Knowledge Discovery in Database becomes slow and error-prone due to the fast increase of data from all resources. We can overcome this disadvantage by applying Big Data Analysis techniques and incorporating AI, ML, and Deep Learning algorithms as shown in Figure 3.

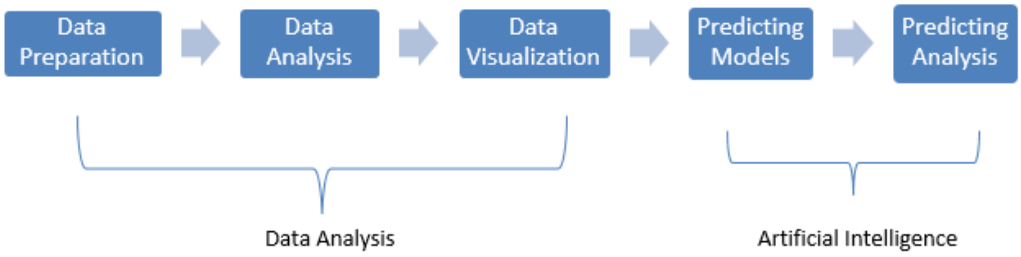

Figure 3. Data Science Using Artificial Intelligence Technique

Data Science along with Machine Learning, Deep Learning which is subset of AI can provide a cost-effective diagnosis and treatment in the medical field. Thus the invention of AI gave a new way of analysis of huge data in Data Science.

2. Ayurveda

The science which tells about life or "Ayu" is Ayurveda. Ayurveda is considered a science of life that is eternal. The knowledge or "Veda" is nothing but the knowledge of happiness (good health) and unhappiness (unhealthy) along with this Ayurveda describes the root cause of disease. The history of Ayurveda can be traced back to various periods, the earliest being the Veda Purana in the ancient era, when the Aryan's compiled the four Veda's, with the most references in the Rigveda and Atharvaveda [6]. In Atharvaveda anatomical structure of the human body, metabolism, digestion, blood circulation, diseases, and their cause, mineral and surgical techniques, different types of worms and diseases caused by them along with the diagnosis and treatment have been described in the Atharvaveda. Classification of plants, their uses in the treatment of particular diseases is all described in Atharvaveda. It is believed that Ayurveda, or Traditional Medicine, was transformed to sages from Gods , who then passed it on to others. Ayurveda is thought to have originated from heaven by Lord Brahma, who later passed the knowledge on to Dakshaprajapati and then to AshwiniKumaras. Later on, on Earth, when diseases were at their peak, Maharishi Bharadwaj learned Ayurveda from Lord Indra. From then on, Sage Atreya received Traditional Medicine knowledge and passed on to Agnivesha. Agnivesha wrote the Agnivesha Tantra, also known as the Charaka Samhita (fifth Century BC). Kashiraj Divodas Dhanvantari learned Ayurveda from Lord Indra and passed it on to Sushruta, who wrote the Sushruta Samhita4 (sixth – fifth century BC) [7].
Ayurveda an Indian Traditional Medicine (ITM) is played an important role since the ancient period in providing health care in developing countries. Before the invention of Modern Medicines, Herbal plants have a great history from the ancient period that was used in the treatment of many diseases. In developing countries like India, this information of the Ayurvedic treatment is been lost due to improper documentation of the Ayurvedic medicines that were used in curing many diseases. Lack of this evidence, people are diverting towards Allopathy Treatment, which is fast in relief, well-equipped technologies that are used in the diagnosis of many diseases which makes the decision faster to start the treatment. And well documentation is been maintained regarding the treatment of many diseases.
Examining the patient by Ayurveda vaidhya's is not just by examining on a particular disease ,the diagnosis process will be to both mind, body and soul [8]. The prediction of diseases and treatment process in our Traditional Medicine is from the root cause by predicting imbalances in the Tridosha such as Vata, pitta, Kapha. The bodily processes, anatomy, analysis, medication, and treatments are all based on the examination of imbalance in Tridosha. Every dosha is thought to have inherent characteristics that manifest themselves in an individual's physical, psychological, and physiological characteristics [9]. The authentic Ayurvedic manuscript by Charaka's and Sushruta's Samhita explicitly explains how to identify dosha properties through signs and symptoms that make human being vikriti. Tridosha analysis assists in prioritizing any nurturing,

preventative, and curative programme specific to a person. As a result, a tridosha-based prescription can aid to improve a regimen's therapeutic impact while lowering the drug's unpleasant side effects.

3. Allopathy /Modern Medicine

Modern Medicine is also known as Allopathy, is an evidence-based system that has the proof and successful clinical trials [10] on the medications they use. The term Allopathy was coined by Samuel Hahnemann in the year 1810. The diagnosis method of modern medicine physicians is disease-oriented. A physician checks the symptoms and writes the prescription. Allopathy follows the three main steps that include Hypothesis, Experimentation, Observation, and Conclusion [10]. Thus we can say that Allopathy treatment is a symptotic one i.e. it treats the symptoms but not the root cause. Allopathy approaches like body as a machine. Body parts are treated as isolation. Allopathic medicines unlike the Ayurvedic medicines are made of chemicals and some of the plants used. The Allopathic system is systematic in treatment where the doctor looks at the symptoms and gives the treatment accordingly. The primary concept of allopathy is to provide immediate relief to the patient by destroying the causative organisms of the disease. The advantages of Allopathy are, gives fast relief, is good in treating life-threatening diseases. Allopathy medicine uses modern technologies and diagnosis machines efficiently to understand the patient's symptoms.

4. Amalgamation of Ayurveda and Allopathy/Modern Medicine Diagnosis Approach

The medical field is nothing but providing treatment to a patient to overcome health-related issues. which can be used to overcome many health-related problems. An amalgamation of best practices of Ayurveda and Modern medicine is being used as a best diagnosis methodology that can be applied to manage and reduce the risk factors of diseases. The review of the previous works related to integration of Ayurvedic and modern medicine is given in the next session.

5. Literature Review

Kurande, Vrinda, et al. [11] in their study predict the pulse examination and give the test case report of intrarater and interrater Ayurvedic doctors. This study gives a clear picture of how the pulse diagnostic method is examined by both types of Ayurveda. Cohen's weighted statistics with the hypothesis of homogeneous diagnosis is been used to measure performance measure of both doctors within the same diagnosis in same hospital and also between doctors from different hospitals. According to doctors among those who observed concludes that better training and experience may lead to more efficiency reliability. The author says that the standardization of the pulse examination method must be improved while using the integrated way of diagnosis, adding to this the author says that integrating the new technology will better display the pulse pattern along with the doctor's diagnosis for more efficient results.

Marques, Oge. [12]. this paper gives the importance of using computer science techniques and algorithms, information science and technology, modern engineering in the field of Ayurveda. The author explains several factors on why Ayurveda is becoming more popular in India. The author with reference to different studies makes clear how the use of technology in the Ayurveda diagnosis will make the easy in decision making during diagnosis and also suggest that restructuring of Ayurveda is necessary in order to meet the demands of cyber society.

Wallace, Robert Keith. [13]. their study explains how Ayurveda and genomics can both benefit from one another and evidence-based systems and modern science can assist both Ayurveda and modern medicine with preventive approaches in their respective fields. The author explains how the four P's are predictive; preventive; personalized; and participatory are very efficient in modern medical diagnosis. Also in this study author focus on a new approach in Ayurgenomics, which uses big data and machine learning technologies can improve the diagnosis approach and in fast prediction and treatment of a disease.

Sharma, Rohit, and Pradeep Kumar Prajapati. [14], their study explains how Ayurvedic treatment is well suited with f predictive, preventive, and personalized medicine along with pharmacogenomics. The author explores this area that may aid researchers in identifying genetic factors that may support classification level changes in ordinary persons, potentially leading to various disease Predictions. Further research into amalgamation or supplementing genetics and modern homeopathic discipline with Prakriti is highly anticipated, as it may provide new insights toward the individual healthcare aspiration.

Ruchika Nandha, Harpal Singh [15] in their study explain its necessity for the integration of Ayurvedic and Allopathy. The author explores the integration of Ayurvedic therapies with the modern medical system that must be done without disrespecting any of their diagnosis methodologies. The author concludes that this integration may be useful in disease prediction, diseases prevention with the best results.

Nisula, Tapio[16] in their study have done a survey on how Ayurvedic practitioners have gained popularity by integrating Ayurvedic with biomedicine during their practice. The author also explores the drawbacks of the old diagnosis methodology of Ayurveda. The authors also address how diagnosis tools and technology will have an impact on the medical integration diagnosis in Ayurveda during prescription.

Kataria, Sushila, et.al.[17]. in their study explores the outcome of the Ayurvedic treatment for the mild attack of COVID-19. In this study, the authors address the Ayurvedic formulation of Tinopora cadifalia which is also known as Guduchi and Pippali integrated with modern medicine. The author predicts the impact of the integrated treatment for COVID-19 by considering the parameters like clinical recovery, interaction with Ayurvedic doctors, safety once the patient got discharged after three months. The author further addresses that such integration medicine needs proper evidence to provide effective and safe treatment for COVID-19 disease.

Seetharaman, Mahadevan et. al. [18] in their study explain how the integration of convention medicine with Ayurvedic medicine will also be beneficial in the prevention and treatment of communicable and chronic diseases COVID-19. The author explains in order to avoid future pandemics, a holistic approach to healthcare that emphasizes prevention and immunity building is required. The traditional approach of diagnosis methods such as Ayurveda, Chinese Traditional Medicine, and Yoga, would be included in such a healthcare approach, as would modern medical education and practice.

Kshirsagar and Rao (2021) [19] present recent research on Artemisia derivatives, which are widely used in many traditional medicines for their properties such as antiviral, antifungal, antimicrobial, insecticidal, hepatoprotective, and neuroprotective [34]. Artemisinin, a well-known phytochemicals derived from Artemisia, has been shown to have potent antiviral properties as well as utility against the coronavirus that causes severe acute respiratory syndrome (SARS).

Megas et al are a group of people who work together to solve problems. [20] Combining traditional therapy with Anthroposophic therapies, according to the researchers, could be helpful and advantageous for individuals undergoing plastic surgery. In addition to functional and physical approaches, this strategy stresses mental state, creativity, and self-determination. Anthroposophical massage (rhythmical and streaming massage), breathing treatment, ergotherapy, eurhythmy therapy, hyperthermia, painting therapy, clay modelling therapy, music therapy, physiotherapy, and psychotherapy are some of the complementary approaches. In addition to these mind-body techniques, natural goods are given.

Shaq, Abid, et, al. [21] in their study identify significant features and efficient Data mining techniques that can improve the predictability of cardiovascular patient survival. To predict patient survival in this study, nine classification models are used: To address the imbalanced class issue, the Synthetic Minority Oversampling Technique is used (SMOTE). In addition, RF selects the highest-ranked features for training machine learning models. The analysis are matched to those provided by AI algorithms that use the entire set of features. Experiment results show that ETC outperforms other models in prediction, achieving 0.934 accuracies with SMOTE.

Shaohui Wang et.al. [31] in their review elaborates on the diagnosis and treatment of Rheumatoid arthritis (RA) by the integrated diagnosis of western and traditional medicine with an application of AI along with deep learning, cloud computation. In this review, the author predicts effective ethnic drugs can be prescribed with the help of AI technology.

Aggarwal, Bharat B et.al. [32] in their study focuses on cancer treatment using traditional medicine along with modern medicine. This integrated treatment for cancer is very effective with the best results. The review in this article also presents the evidence that the Ayurvedic medicine not only prevents cancer but also gives better results in cancer treatment. Since the Ayurvedic medicine is fewer side effects can be used along with the chemotherapeutic treatment which enhances therapeutic effects and reduces chemotherapy-induced toxicity. Saikat Sen and Raja Chakraborty [32] in this study predict how the integration of traditional herbal medicine in clinical

practices helps in the achievement of the "Health for ALL" concept. Also, author gives reviews on challenges faced in the integrated medicine.

Methodology

The amalgamation of centralized data using data mining, and using the AI-based machine learning algorithms is of great practical significance in the integrated diagnosis process, which helps in better treatment with less cost. The integrated treatment of both Ayurveda and Modern Medicine is proving the best treatment for the diseases like diabetes, cough, cold, arthritis, liver diseases, cancer, piles, etc.

Machine Learning techniques are based on a set of well defined rules which includes sets of mathematical methods that describes the relationship between the variables while predicting the results. The model proposed in this predicts the particular disease depending on the dataset extracted from the best diagnostic features of both Indian Traditional medicine and Evidence based medicine diagnosis process. The primary concern of using the ML algorithms is to predict the result in more accuracy. The ML algorithms is divide into three categories, Supervised Machine Learning, Unsupervised Machine Learning and Supervised Machine Learning

Supervised ML[22] refer to the technique in which the model is trained on the different features or input data along with the known output. In Medical field this is related with the symptoms of particular diseases. So once the model is trained successfully, it will be capable of predicting the particular diseases on the given input.. The prediction made by using Supervised ML can be in the form of discrete e.g. positive or negative, or prediction can be continuous e.g. using the score from 0 to 100. Thus the prediction made from discrete is referred as Classification algorithms. In our proposed model different classification algorithm are applied to predict the result.

Support Vector Machine Supervised ML Algorithm (SVM)

The SVM algorithm is among the categories of aligned machine learning algorithms used for different line and non-line layouts. The SVM algorithm starts to map each data set in the N-dimensional features space where the "N" is the sum of the number of features. It later detects a hyperplane that divides the data into two classes while increasing the distance along with both classes and reducing the classification errors [34]. The middle class distance is the distance between the decision hyperplane and the immediate event a class member is a part of. In SVM, each data point is first organized as a point in a n-dimensional space with features such as a specific integration. For differentiation, a hyperplane with a large margin of difference between the two categories is available.

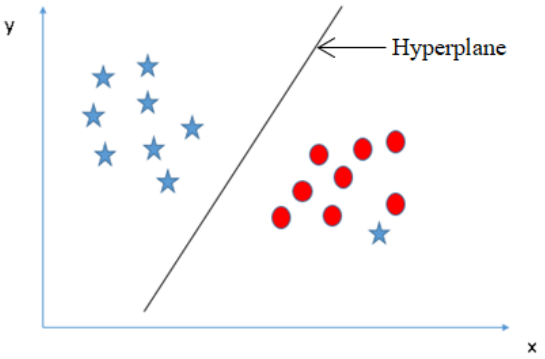

Figure 5. SVM illustration to identify hyperplane

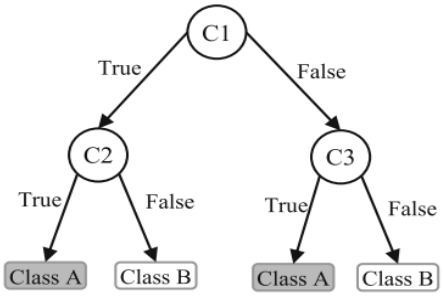

Figure 6. Illustration of DT with elements and rules

Decision Tree

Decision tree is among the supervised machine learning algorithms used in regression and classification problems. In DT, nodes represent the data and the leaves of a tree represent the final result. The decision tree is created by using training data during the training process. The DT manages both categorical and numerical data set. In DT no pre-processing of data is required. A few applications of decision tree are used in medical field to detect breast cancer, in which leaf nodes of the tree are split into two groups (Benign or Malignant). The DT tree has different levels with the nodes at each level is data and the first node represents the root node of a tree. The level of the DT varies depending on the prediction problem statement. DT is more efficient to infer, analyze and fast to analyze in the medical diagnostic protocol. An illustration of DT with its elements and rules is shown in Figure 6.

Random Forest

Random forest [35] is an ensemble classifier and consists of many decision trees similar to the way the forest is represented as a collection of many trees. The efficiency and performance of the Ensemble algorithm can be improved by building base learners from the various approaches.

Bagging

Bagging [36] is one of the most widely used ensemble-building techniques. Bootstrap sampling and model aggregation are two crucial steps in bagging. Bootstrap sampling selects N samples from the data set using sampling with replacement, ensuring the independence of the various sampling training sets. Furthermore, the major voting method is used, which accepts the classification results with the most occurrences as the final classification results if multiple base learners are used. Figure 8 depicts the algorithm [36] for bagging.

Boosting

The boosting algorithm constructs base classifiers in a sequential fashion. The basic idea behind sequence is that on the training set, a weak classifier is built first. If the sample is correctly classified, it will be assigned a small weight in the training set, otherwise it will be assigned a relatively large number of weights based on the classification result of the previous classifier. In order to achieve the best classification performance, this process will be repeated several times with several weak classifiers. The boosting algorithm produces a final model that is a linear combination of many base classifiers weighted by their own results. Freund and Schapire's AdaBoost is one of the most effective boosting algorithms. Figure 9 represents the AdaBoost algorithm.

Input: Dataset $S = \{(x_1, y_1), (x_2, y_2), \dots, (x_n, y_n)\}$;
Base learning algorithm $\mathcal{L}$;
Number of base learners m.
Process:
For $j - 1,2, \dots, m$:
$S_j = booststrap(S)$; % Generate a bootstrap sample from S
$h_j = \mathcal{L}(S_j)$ % Train a base learner h_j from the bootstrap sample
end.
Output: $H(x) = mode(h_1(x), \dots, h_m(x))$ % For classification studies

Figure 8. Bagging Algorithm

Input: Dataset $D = \{(x_1, y_1), (x_2, y_2), \dots, (x_m, y_m)\}$;
A weight of each sample in the training set constitutes a weight vector Z_t;
Base learning algorithm $\mathcal{L}$;
Number of learning rounds T.
Process:
$D_1(i) = 1/m$ % Initialize the weight distribution
For $t = 1,2, \dots, T$:
$h_t = \mathcal{L}(D, D_t)$; % Train a base learner h_t from D using distribution D_t
$\varepsilon_t = \Pr_{i \sim D_t}[h_t(x_i \neq y_i)]$; % Measure the error of h_t
$\alpha_t = \frac{1}{2} ln \frac{1-\varepsilon_t}{\varepsilon_t}$; % Determine the weight of h_t
$D_{t+1}(i) = \frac{D_t(i)}{sum(Z_t)} \times \begin{cases} \exp(-\alpha_t) & if\ h_t(x_i) = y_i \\ \exp(\alpha_t) & if\ h_t(x_i) \neq y_i \end{cases}$
% Update the distribution, where Z_t is a normalization factor with enables D_{t+1} to be a distribution
end.
Output: $F(x) = sign \sum_{t=1}^{T} \alpha_t h_t(x)$

Figure 9. AdaBoost Algorithm

XGBoost (eXtreme Gradient Boosting)

Chen and Guestrin [37] proposed XGboost in 2016. It is a more advanced version of the boosting algorithms, and it has been recognised as an advanced estimator with extremely high performance in classification and regression. The XGboost expression is given below to prevent overfitting during analysis.

$$\mathcal{L}_K = \sum_{j=1}^{T}\left[\left(\sum_{i\in I_j} g_i\right)\omega_j + \frac{1}{2}\left(\sum_{i\in I_j} h_i + \lambda\right)\omega_j^2\right] + \gamma T.$$

To deal with overfitting issues, XGBoost employs the learning rate, boosting number, maximum tree depth, and subsampling.

Machine Learning algorithms is becoming most popular in the field of the Medical sector in wide research areas such as analysis and prediction of diseases using supervised classification [22], cancer prediction with risk valuation after the surgery [23], frequent disease data mining by applying Apriori algorithm [24], predicting breast cancer survivability [25], prediction of drug dosage [27 – 29]. In the healthcare sector unsupervised learning algorithms are used in different areas such as extraction of medical-related rules in the medical database [30], to analyze the diseases using clustering and K means clustering techniques.

Data Collection

The proposed model integrates the best features of both Ayurvedic and Modern Medicine and is analyzed using the machine learning algorithms. The dataset related to chronic diseases is collected from Ayurvedic Vaidya's, PubMed, Google Scholar, Scopus, and Science Direct. The dataset and information on the medicine and diagnosis method are extracted using the keywords such as Ayurvedic Diagnosis, Modern Medicine Diagnosis, and Diagnostic tools. Figure 11 explains the integrated method analysis of different diseases using AI model. The detailed description of the proposed model is explained in Figure 12. Data is collected from both the diagnosis methods of Ayurveda and Modern Medicine from different resources as mentioned earlier. The same is shown in Figure 12.

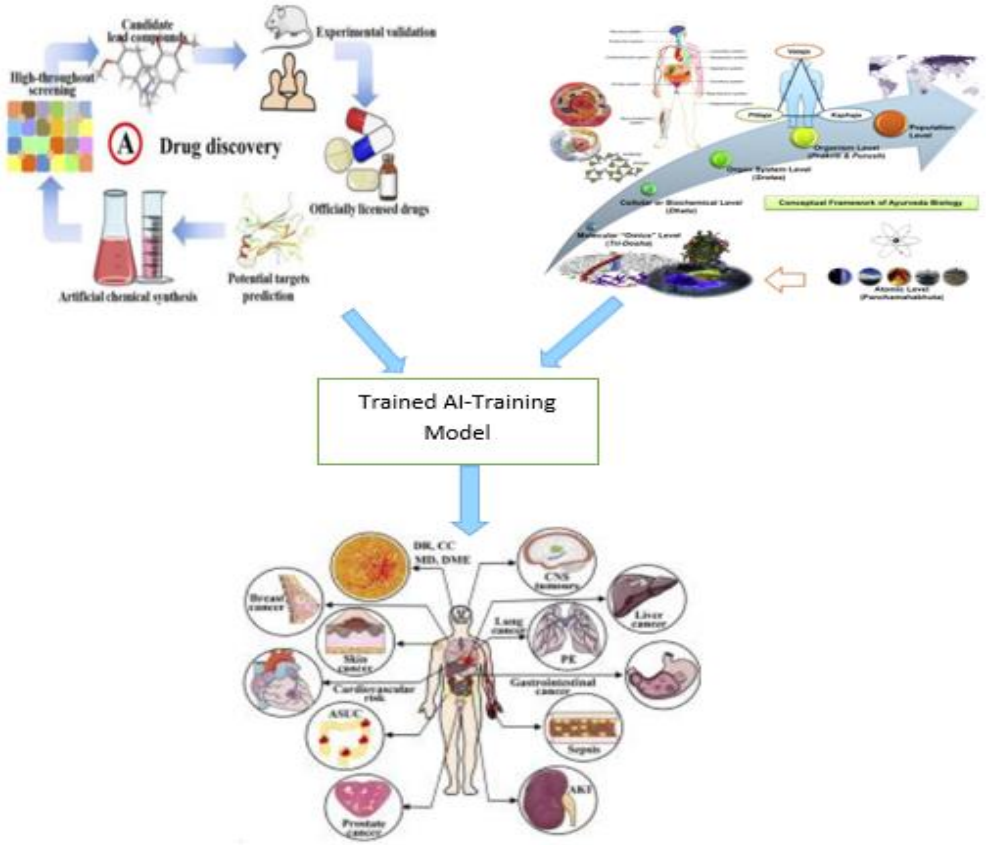

Figure 11. Integrated Diagnosis process of Disease using AI-Trained Model

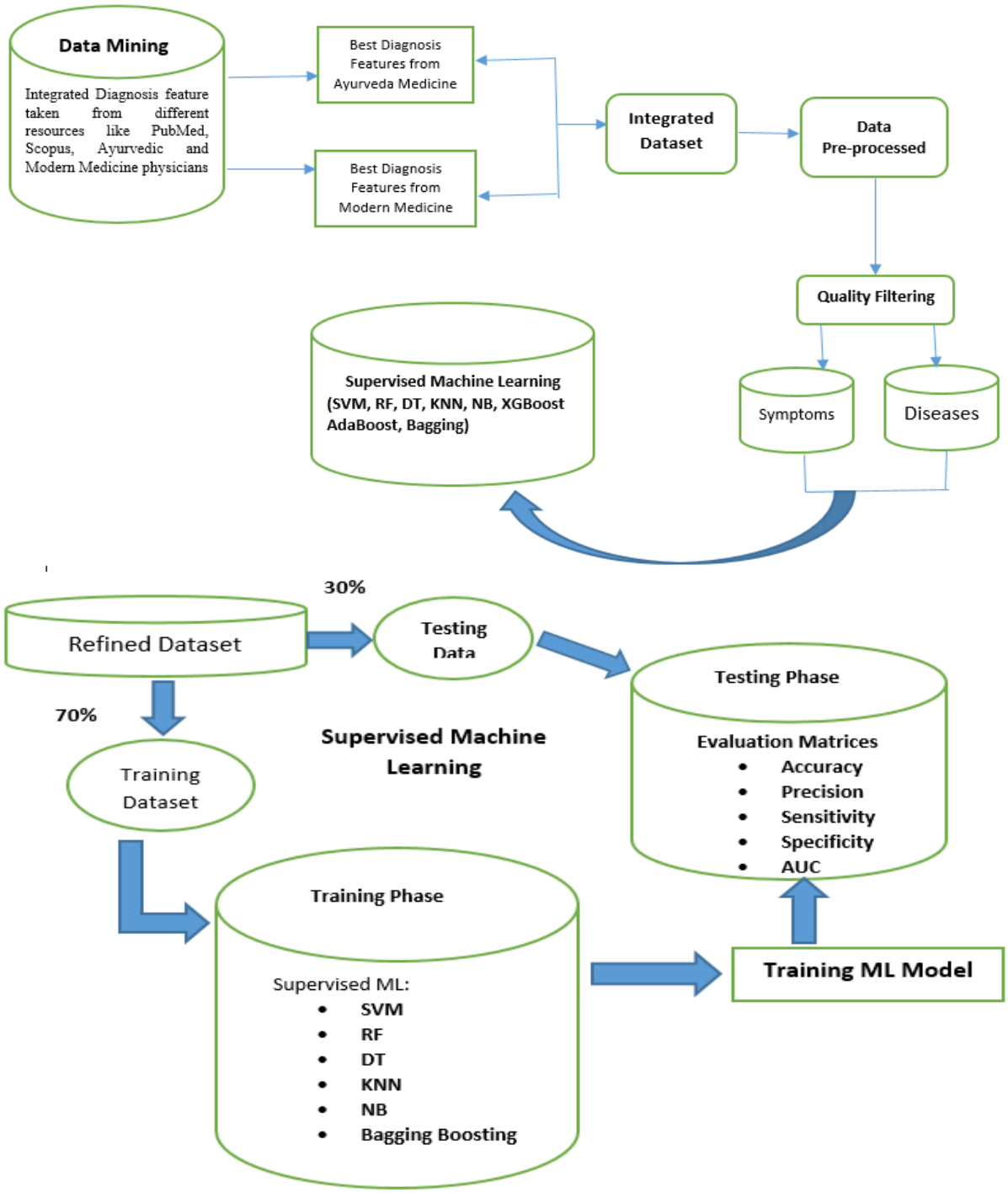

Figure 12. Block Diagram of Proposed Model for analysis of diseases using AI and ML techniques in the integrated medicine approach

Preprocessing of Data and Data Refinement

Preprocessing the data and Data refinement is carried out to select most discriminative variables. The variables with the unique values, irrelevant variables with label are filtered, and only data pertinent to model training is retained. The data set is divided into training data set and testing data set whoch are used to train the model and evaluate the performance respectively. 80% of the samples are taken as training data set and 20% of the samples are taken as testing data set. Diagnosis ability and performance of different algorithms are determined by evaluation matrices such as confusion matrix and Receiver Operating Characteristics (ROC).

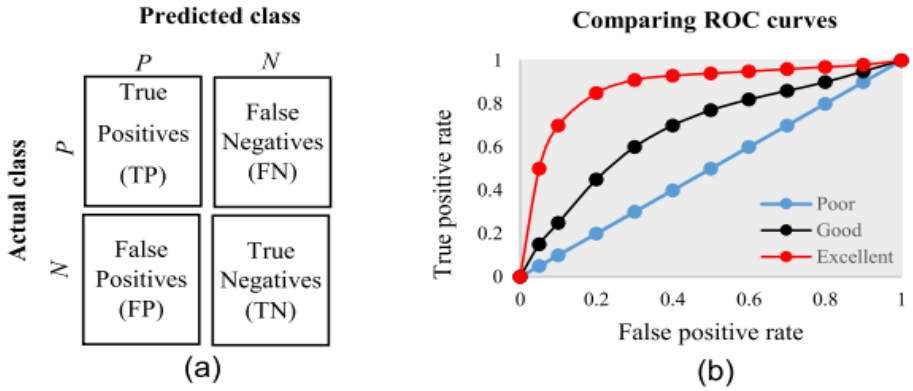

Figure 12. [a] The basic Framework of confusion matrix [b] Presentation of ROC Curve

In ML technique, the evaution matrix called Confusion Matrix is used for anaysing the performance of the algorithms. In this, True-Positive (TP) are actual results correctly identified by different algorithms. Similarly, True-Negative (TN) are undesirable cases correctly identified by different algorithms. False-Positive (FP) are undesirable cases where the algorithms classify erroneously as positive. False Negative (FN) are positive cases where different algorithms false classification as negative. The perfomance measures based on the confusion matrix are analyzed for different machine learning algorithms in this proposed model are given by

a. Accuracy: The accuracy measure is applied to recognize correctly predicted values among all the other values in a data set. Accuracy from the confusion matrix is evaluated as:

$$Accuracy = \frac{TP + TN}{\mathrm{TP} + \mathrm{TN} + \mathrm{FP} + \mathrm{FN}}$$

b. F1 Score: Is taken as the harmonic mean of precision and sensitivity. In F1 score True Negative values are not considered.

$$F1\ score = \frac{2\ \mathrm{X\ TP}}{2\ X\ TP + FN + FP}$$

c. Precision: This predicts the true diseased patient from the total number of data set taken for analysis.

$$\mathrm{Precision} = \frac{\mathrm{TP}}{\mathrm{TP} + \mathrm{FP}}$$

d. Sensitivity: is used for categorizing the patients who are having disease from patient dataset.

$$\mathrm{Sensitivity} = \mathrm{Recall} = True\ positive\ rate = \frac{\mathrm{TP}}{\mathrm{TP+FN}}$$

Specificity : Is used for predicting the patients who are not having the disease from the patient dataset.

$$Specificity = \frac{\mathrm{TN}}{\mathrm{TN} + \mathrm{FP}}$$

$$False\ positive\ rate = \frac{FP}{\mathrm{FP} + \mathrm{TN}}$$

The ROC curve is created by plotting the true positive rate against the false positive rate at various threshold settings [38]. It is one of the fundamental tools used in diagnostic test evaluation. The area under the ROC curve can also be used to assess the predictability of various machine learning classifiers.

Result Analysis

The main objective is to study is to analyze the comparitive performance evaluation among different supervised machine learning algorithm such as SVM, Decision Tree, Ensembled Algorithm Random Forest with Bagging and Boosting, KNN, Naive Bayes, Logistic Regression. The comparison is analysed based on the evaluation matrix namely, accuracy, precision, F1, Sensitivity and specificity. Experimental results predicts that the ensemble learing algorithmgives best performance compared to other algorithms. May be because the proposed model with other algorithms is overfitting the trainaing data.

Conclusion

The purpose of this study is to analyze the performance of different machine learning algorithms used in the integrated diagnosis method of Ayurvedic and Mosern Medicine.The best analysis and common features from both the diagnosis methology i.e. from Ayurvedic and Modern Medicine is extracted fron the existing medical health record. This integrated dioagnosis model using best Machine Learning algorithm is proven to serve the fast diagnosis process for may choronic diseases with cost effective treatment. Thus with the use of AI-ML techniques will invent new therepeutic methods by integrating diagnosis model with fast and most accurate disease prediction and treatment.

Again integration is not the blind fold acceptance. Integration must be done with the best treatment both from Ayurvedic and Modern Medicine. So AI-ML techniques can play very important role in the decision making during diagnosis.

References

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.

Wikipedia Data: https://en.wikipedia.org/wiki/Data

World Economic Forum: Desjardins, Jeff. "How much data is generated each day." In *World economic forum*, vol. 17. 2019.

https://www.lowyinstitute.org/publications/big-data-and-national-security-guide-australian-policymakers

Fayyad, Usama, Gregory Piatetsky-Shapiro, and Padhraic Smyth. "From data mining to knowledge discovery in databases." *AI magazine* 17, no. 3 (1996): 37-37.

Kumar, Shailendra, and Sanghamitra Choudhury. "Ancient Vedic Literature and Human Rights: Resonances and Dissonances." *Cogent Social Sciences* 7(1) (2021): 1858562.

Khwaja, Ayub Zickriya. "Significance of Ancient Ayurveda in Soul-Body Relationship." *Annals of Ayurvedic Medicine,* 9, 4(2020): 313-319.

V.J. Thakar, "Diagnostic Methods In Ayurved", *Ancient Science of Life,* Vol No. I No.3 January 1982, Pages 139 – 145.

Vrinda Kurande, Anders Ellern Bilgrau,Rasmus Waagepetersen,Egon Toft, and Ramjee Prasad "Interrater Reliability of Diagnostic Methods in Traditional Indian Ayurvedic Medicine", Volume 2013 |Article ID 658275. https://doi.org/10.1155/2013/658275 Evidence-Based Complementary and Alternative Medicine / 2013 / Article

https://www.jeevana.in/benefits-ayurveda-allopathy

Kurande, Vrinda, Rasmus Waagepetersen, Egon Toft, and Ramjee Prasad. "Intrarater and interrater reliability of pulse examination in traditional Indian Ayurvedic medicine." *Integrative medicine research* 2(3) (2013): 89-98.

Marques, Oge. "Integrating contemporary technologies with Ayurveda: Examples, challenges, and opportunities." In *2015 International Conference on Advances in Computing, Communications and Informatics (ICACCI)*, 1399-1407. IEEE, 2015.

Wallace, Robert Keith. "Ayurgenomics and modern medicine." *Medicina* 56, no. 12 (2020): 661.

Sharma, Rohit, and Pradeep Kumar Prajapati. "Predictive, preventive and personalized medicine: Leads from Ayurvedic concept of Prakriti (human constitution)." *Current Pharmacology Reports* 6, no. 6 (2020): 441-450.

Nandha, Ruchika, and Harpal Singh. "Amalgamation of ayurveda with allopathy: A synergistic approach for healthy society." *International Journal of Green Pharmacy (IJGP),* 7(3): (2013).

Nisula, Tapio. "In the presence of biomedicine: Ayurveda, medical integration and health seeking in Mysore, South India." *Anthropology & Medicine,* 13(3) (2006): 207-224.

Kataria, Sushila, Pooja Sharma, Jai Prakash Ram, Vikas Deswal, Manish Singh, Rakesh Rana, Richa Singhal, Arunabh Tripathi, Kuldeep Kumar, and Naresh Trehan. "A pilot clinical study of an add-on Ayurvedic formulation containing Tinospora cordifolia and Piper longum in mild to moderate COVID-19." *Journal of Ayurveda and Integrative Medicine* 13, no. 2 (2022): 100454.

Seetharaman, Mahadevan, Geetha Krishnan, and Robert H. Schneider. "The Future of Medicine: Frontiers in Integrative Health and Medicine." *Medicina* 57, no. 12 (2021): 1303.

Kshirsagar, Suhas G., and Rammohan V. Rao. "Antiviral and immunomodulation effects of Artemisia." *Medicina* 57, no. 3 (2021): 217.

Megas, Ioannis-Fivos, Dascha Sophie Tolzmann, Jacqueline Bastiaanse, Paul Christian Fuchs, Bong-Sung Kim, Matthias Kröz, Friedemann Schad, Harald Matthes, and Gerrit Grieb. "Integrative Medicine and Plastic Surgery: A Synergy—Not an Antonym." *Medicina* 57, no. 4 (2021): 326.

Shaq, Abid, Saima Sadiq, Muhammad Umer, Saleem Ullah, Seyedali Mirjalili, Vaibhav Rupapara, and Michele Nappi. "Improving the prediction of heart failure patients' survival using SMOTE and effective data mining techniques." *IEEE access* 9 (2021): 39707-39716.

W. Dai, T.S. Brisimi, W.G. Adams, T. Mela, V. Saligrama and I.C. Paschalidis. "Prediction of hospitalization due to heart diseases by supervised learning methods,"*International Journal of Medical Informatics, Elsevier,*vol.84, no.3, pp.189 – 197, Mar 2015.

T. Oliveira, E. Barbosa, S. Martins, A. Goulart, J. Neves and P. Novais,"A Prognosis System for Colorectal Cancer", *Proceedings of 26th International symposium on Computer based Medical systems*, Jun 2013, Porto, Portugal, IEEE, 481-484.

M. Ilayaraja and T. Meyyappan. "Mining medical data to identify frequent diseases using Apriori algorithm," *Proceedings of International Conference on Pattern Recognition, Informatics and Medical Engineering (PRIME)*, Feb 2013, Salem, India, IEEE, pp. 1-6.

D. Delen, G. Walker and A. Kadam. "Predicting breast cancer survivability: a comparison of three data mining methods," *Artificial intelligence in medicine*, 34(2), 113–127, Jun 2005.

P.J. Hu, T.H. Cheng, C.P. Wei, C.H. Yu, L.F. Chan, and H. Y.Wang. "Managing clinical use of high-alert drugs: A supervised learning approach to pharmacokinetic data analysis," *Systems Man and Cybernetics, Part A: Systems and Humans IEEE Transactions,* vol. 37, no. 4, pp. 481–492, Aug 2007.

Y.H. Hu, F. Wu, CL. Lo and C.T. Tai. "Predicting warfarin dosage fromclinical data: A supervised learning approach," *Artificial Intelligence in Medicine,* vol.56, no.1, pp.27–34, Sep 2012.

Y. Wenqi, N. Widmer and G.D. Micheli, "Example-based support vector machine for drug concentration analysis," *Proceedings of thirty third Annual Conference Engineering in Medicine and Biology Society,* EMBC, Aug-Sep 2011, Boston, USA, IEEE 2011, 153–157.

R. Shirwaikar, N. Mago, D. Acharya, K. Makkithaya, G. Hegde. L. Lewis and Shivakumar "Partition and Hierarchical Based Clustering Techniques for Analysis of Neonatal Data," *Proceedings of International Conference on Cognition and Recognition*, D. Guru, T. Vasudev, H. Chethan. Y. Kumar Eds. Lecture Notes in Networks and Systems, Singapore, 14 Springer, 2018.

R. Paul and H. Latiful Abu, "Clustering medical data to predict the likelihood of diseases," *Proceedings of 5th International Conference on Digital Information Management,* ICDIM, Jul

2010, Lakehead University, Thunder Bay, Canada, IEEE, 44-49.

Wang, S., Hou, Y., Li, X., Meng, X., Zhang, Y., & Wang, X. (2021). Practical Implementation of Artificial Intelligence-Based Deep Learning and Cloud Computing on the Application of Traditional Medicine and Western Medicine in the Diagnosis and Treatment of Rheumatoid Arthritis. *Frontiers in pharmacology, 12,* 765435-765435.

Aggarwal, Bharat B., Haruyo Ichikawa, Prachi Garodia, Priya Weerasinghe, Gautam Sethi, Indra D. Bhatt, Manoj K. Pandey, Shishir Shishodia, and Muraleedharan G. Nair. "From traditional Ayurvedic medicine to modern medicine: identification of therapeutic targets for suppression of inflammation and cancer." *Expert opinion on therapeutic targets,* 10(1) (2006): 87-118.

Sen, Saikat, and Raja Chakraborty. "Revival, modernization and integration of Indian traditional herbal medicine in clinical practice: Importance, challenges and future." *Journal of traditional and complementary medicine,* 7(2) (2017): 234-244.

Uddin, Shahadat, Arif Khan, Md Ekramul Hossain, and Mohammad Ali Moni. "Comparing different supervised machine learning algorithms for disease prediction." *BMC medical informatics and decision making,* 19(1) (2019): 1-16.

Denisko, Danielle, and Michael M. Hoffman. "Classification and interaction in random forests." *Proceedings of the National Academy of Sciences,* 115, no. 8 (2018): 1690-1692.

Breiman, Leo. "Bagging predictors." *Machine learning,* 24(2) (1996): 123-140.

Chen, T.; Guestrin, C. Xgboost: A scalable tree boosting system. *In Proceedings of the 22nd ACM SIGKDD International Conference on Knowledge Discovery and Data Mining, San Francisco, CA, USA,* 13–17 August 2016; 785–794.

Fawcett, Tom. "An introduction to ROC analysis." *Pattern recognition letters,* 27(8): (2006): 861-874.