

AYUAIIRA: INTELLIGENCE AYUVEDIC MEDICINE SYSTEM FOR ARTHRITIS

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Final Individual Report

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Department of Information Technology

Sri Lanka Institute of Information Technology Sri
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DECLARATION

I declare that this is my own work, and this proposal does not incorporate without acknowledgement any material previously submitted for a degree or diploma in any other university or Institute of higher learning and to the best of my knowledge and belief, it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate is carrying out research for the undergraduate Dissertation under my supervision.

Signature of the supervisor

Date

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(Mr. Ravi Supunya)

Signature of the Co-supervisor

Date

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(Ms. P.K. Suriya Kumari)

ABSTRACT

Millions of individuals worldwide deal with the chronic and painful condition of arthritis. The traditional Indian medical system of Ayurveda provides a comprehensive approach to treating arthritis. According to Ayurveda, arthritis is a disorder brought on by an imbalance of the body's doshas, and its therapy entails bringing the doshas back into balance through dietary modifications, lifestyle changes, and natural therapies. Recent technological developments like artificial intelligence, machine learning, and big data analytics offer the chance to integrate Ayurvedic principles with modern technology to create individualized treatment recommendations for arthritis patients. This study intends to investigate how traditional Ayurvedic knowledge can be integrated with modern technology to provide patients with arthritis with individualized treatment recommendations. An in-depth review of the body of research on Ayurvedic medicine and arthritis will be done before the study gets started. Here, develops a model for individualized treatment recommendations for arthritis patients based on the literature review. The patient's age, sex, symptoms, overall health, and Ayurvedic medical principles will all be considered in the model. To examine patient data and find the best treatment alternatives, a model will be created utilizing big data analytics and machine learning techniques. A dataset of arthritis patients will be used to validate the model, and the findings will be compared to the current treatment recommendations. feasibility and acceptability of the model among arthritis patients and medical experts will also be evaluated as part of the study. The results of this study will help in the development of individualized treatment suggestions for arthritis patients using modern technology and traditional Ayurvedic knowledge. Thus, the overall discussion in this paper is to explore the analysis of diseases caused by the impact of lifestyle by using the best technologies in the Ayurveda field. Saving people time during the diagnosis and treatment processes while maintaining the fundamental principles of Ayurveda is one of the key objectives of integrating modern medical technologies with Ayurveda.

Keywords : Arthritis, Artificial intelligence, Machine learning, Ayurveda, Recommendations

ACKNOWLEDGEMENT

This is the Final Thesis report of the Research Project module. I would like to reserve this page of acknowledgment to be thankful to all the parties who joined to make this project a success.

Our project aimed to develop a personalized treatment recommendation system using machine learning and Ayurvedic medicine principles. This project consumed great effort of work, research, and dedication. Still, implementation would not have been possible if we did not have any support and guidance. Therefore, I would like to take this opportunity to extend our sincere gratitude to our supervisor, Mr. Ravi Supunya , and our co-supervisor, Ms. P.K.Suriya Kumari, Sri Lanka Institute of Information Technology, Malabe for the exemplary guidance, monitoring, and constant encouragement throughout the course of the project.

Additionally, we are grateful for the resources and patient data made available to us by the Ayurvedic General Hospital in Rajagiriya and the Gampaha Wickramarachchi Ayurveda Institute in Sri Lanka. We also appreciate colleagues and the healthcare industry for their helpful feedback and ideas that helped us develop and evaluate the machine learning model. Finally, we want to convey our gratitude to the patients who took part in the study and provided us with their insightful and useful feedback. We would like to extend heartfelt thanks to our friends and family for their unflagging support and encouragement during this effort.

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1 INTRODUCTION

1.1 Background

Arthritis is a common and chronic condition characterized by joint inflammation, pain, and stiffness. Millions of individuals all over the world suffer from arthritis. While there are traditional treatments available, some people use alternative treatments like Ayurvedic medicine. Ayurveda is a traditional medical system with Indian roots that focuses on comprehensive approaches to treatment like dietary habits, physical activity, and lifestyle modifications. People of any age are affected, but older people are more likely to experience it. Non-steroidal anti-inflammatory medications (NSAIDs), disease-modifying anti-rheumatic drugs (DMARDs), and biological treatments are all used in the traditional treatment of arthritis.

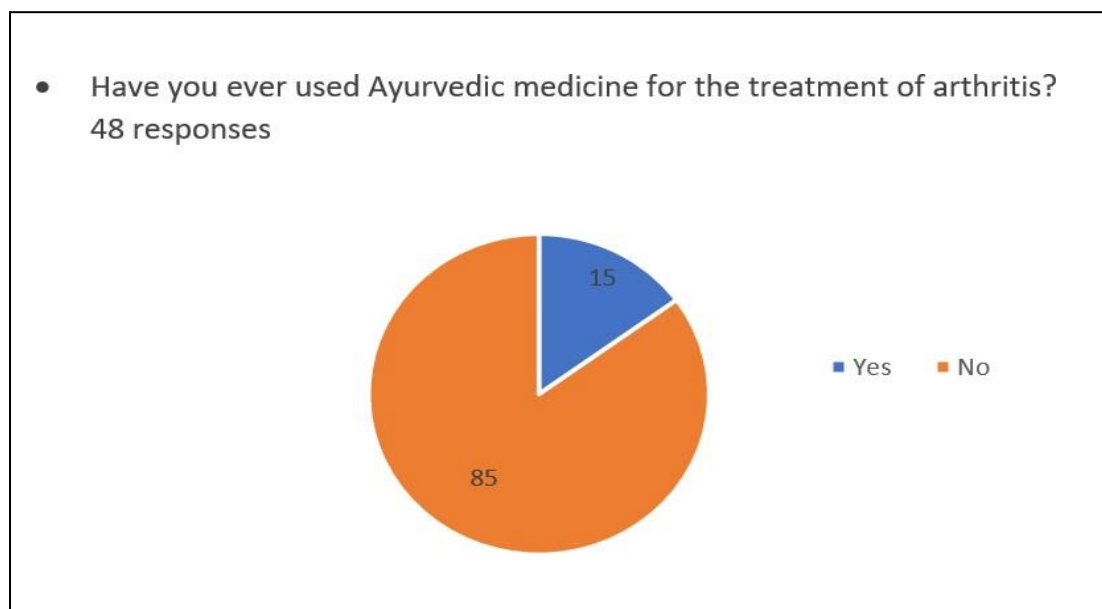


Figure 1.1's results show that 15% of respondents who answered the question about using Ayurvedic medicine for the treatment of arthritis have really done so, while 85% have not. This is shown by the pie chart. Ayurvedic medicine may not have been used personally by the majority of respondents, 85% of whom selected "No" as their response, suggesting that they had not used it for arthritis treatment.

Traditional Indian medicine, or Ayurveda, has been used for thousands of years to treat a wide range of diseases, including arthritis. The basis of Ayurveda is the idea of doshas, which are the three primary forces that direct bodily processes. The vata, pitta, and kapha dosha are said to be in charge of maintaining the physical and mental well-being of the body.

Ayurvedic treatment offers a comprehensive strategy for treating arthritis that entails modifications to diet, lifestyle changes, and herbal therapies. Ayurvedic treatments for arthritis include yoga, massage, and herbal medications.

The principles of Ayurvedic medicine can be integrated with modern technology to create individualized therapy recommendations for arthritis patients. Recent advances in technology like machine learning, artificial intelligence, and big data analytics provide this potential. Personalized medicine seeks to adjust medical care to each patient's unique features, such as age, sex, and symptoms, and general health.

The management of arthritis may be revolutionized by integrating Ayurvedic medicine with modern technology. Patients can receive more efficient and specific treatment alternatives that are catered to their needs by creating personalized therapy recommendations based on the principles of Ayurvedic medicine. This study will explore how traditional Ayurvedic knowledge can be combined with modern technology to provide patients with arthritis-specific treatment recommendations.

The American Rheumatism Association criteria were used in a particular study conducted at the Ayurvedic Trust in Coimbatore, India, to evaluate the effectiveness and safety of Ayurvedic treatment for rheumatoid arthritis. Here, the results showed that all measures improved statistically significantly from admission to discharge, and even individuals with major limitations in function showed improvement.

Several studies have investigated the potential benefits of Ayurvedic medicine for arthritis. For example, Chopra et al.'s (2013) randomized controlled trial revealed that Ayurvedic treatment, which included herbal drugs, changes in diet, and lifestyle interventions, was successful in reducing pain and inflammation in individuals with rheumatoid arthritis [08]. An Ayurvedic herbal composition has been shown to be

both safe and effective in enhancing joint function and reducing pain in osteoarthritis patients, according to Chandran et al.'s (2012) study [09].

But establishing standardized treatment plans for arthritis is difficult due to the personal approach of Ayurvedic medicine. This is where integrating modern technology, like machine learning, can be highly helpful. A number of studies have suggested using machine learning-based methods to generate individualized recommendations for treatment for arthritis patients. For instance, Ding et al.'s work from the year 2021 created a machine learning model that used demographic and clinical information to predict response to treatment in rheumatoid arthritis patients [10]. Jain et al. (2019) used a machine learning-based decision support system to select an appropriate Ayurvedic treatment plan based on the specific characteristics of each patient [11].

Despite all of these developments, an advanced and user-friendly Ayurvedic treatment recommendation system remains necessary which integrates the basic principles of Ayurvedic medicine with modern technology. This study aims to address this gap by developing a system for specific treatment recommendations that appeals to arthritis patients by combining the principles of Ayurvedic medicine with machine learning algorithms.

1.2 Literature survey

Arthritis is a chronic condition that affects millions of people worldwide. Ayurvedic medicine, a conventional Indian medical system, offers a comprehensive method of treating arthritis. The effectiveness of Ayurvedic medicine in the treatment of arthritis has been investigated in a number of studies.

In order to use technology and Ayurveda combined for real-world uses of diagnosis and therapy, Nair [1] provides a persuasive case for doing so. He claims that Ayurveda needs to be completely restructured to fit the evolving needs of a cyber society.

Ruchika Nandha [2] the author discusses the benefits of integrating allopathy with ayurveda. Although we have advanced instruments that are commonly used in modern medicine, the author shows that our traditional area has failed in the use of technology. The author demonstrates how modern society is experiencing an increase in a variety of lifestyle disorders, chronic diseases, and an increase of drug resistance; integration of Ayurveda with allopathy must be taken into consideration. The greatest approach to manage good health, prevent disease, and offer the most effective therapy is through the use of an innovative comprehensive system that was built by integrating rich traditional remedies with modern medicine.

In the study [3], the three doshas—vata, pitta, and kapha—were analyzed. Based on the questionnaires, data was gathered to build the ML model. In this investigation, ensemble learning was applied. Instead of employing just one machine learning method, ensemble learning is utilized to address complicated issues. The ensemble learning approach is comparable to asking a number of doctors before starting a medical procedure. Numerous ML algorithms, including ANN, NB classifiers, KNN, SVM, DT, Logistic Regression, Fuzzy Logic, and Genetic Algorithm, were utilized to train the model based on the data set gathered. The accuracy level of this model was 0.95. According to this study, one can estimate their doshas and examine any imbalances without seeing a doctor before undergoing therapy for any condition.

The effectiveness of Ayurvedic treatment in individuals with rheumatoid arthritis was studied in a study that was published in the Journal of Ayurveda and Integrative Medicine. The study discovered that rheumatoid arthritis symptoms such as joint pain, swelling, and stiffness might be effectively treated with ayurvedic medicine. The report proposed more research be done to examine how Ayurvedic medicine might be used to treat rheumatoid arthritis.

Another study examined the anti-inflammatory effects of Ayurvedic herbs in the treatment of arthritis, and it was published in the Journal of Ethnopharmacology. The study discovered that Ayurvedic plants with anti-inflammatory properties, including *Boswellia serrata*, *Zingiber officinale*, and *Curcuma longa*, may be utilized to treat arthritis. The study recommends more research into the use of herbs from Ayurveda in the therapy of arthritis.

The principles of Ayurvedic medicine can be integrated with modern technology to create individualized therapy suggestions for arthritis patients. Recent technological advancements like machine learning, artificial intelligence, and big data analytics provide this potential. The use of decision support systems and machine learning in the treatment of arthritis has been examined in several research.

A study that was published in the Journal of Medical Systems suggested a machine learning-based strategy for individualized treatment suggestions for people with rheumatoid arthritis. Based on the patient's age, sex, length of the disease, and test results, the study used machine learning algorithms to analyze patient data and create individualized therapy recommendations. According to the study, rheumatoid arthritis symptoms were significantly reduced by the individualized therapy recommendations.

Another study examined the use of an Ayurvedic decision support system for osteoarthritis treatment in the Journal of Clinical Rheumatology. According to the study, the decision support system offered individualized therapy suggestions that successfully reduced osteoarthritis symptoms.

These results show the possibility of integrating Ayurvedic medicine with modern technology to provide arthritis sufferers with individualized therapy recommendations. To investigate the effectiveness and practicality of such a strategy, more study is necessary.

1.3 Research Gap

There is a research gap to develop a comprehensive and individualized treatment recommendation system that combines both traditional knowledge of Ayurvedic medicine and advanced technology, given the fact that many studies have investigated the use of Ayurvedic medicine and advanced technology in the treatment of arthritis. An integrated strategy is required because the majority of studies have been focused on either Ayurvedic medicine or technology. During the literature review, I found some research that have been done for this. The following table shows the comparison of the features of research that have been done so far and our proposed research.

In Table 1.2.1 shows the comparison of the gap between some existing research and our proposed system

Features	Research A	Research B	Research C	Research D	Proposed System (AyuAira)
Comprehensive and personalized treatment recommendation system that combines Ayurvedic medicine and advanced technology.	✗	✗	✗	✗	✓
Integrating traditional medicine and technology for the treatment of arthritis	✗	✓	✗	✗	✓
Personalized treatment recommendations for arthritis patients using machine learning.	✗	✗	✓	✗	✓
Decision support system for the Ayurvedic treatment of arthritis	✗	✗	✗	✓	✓

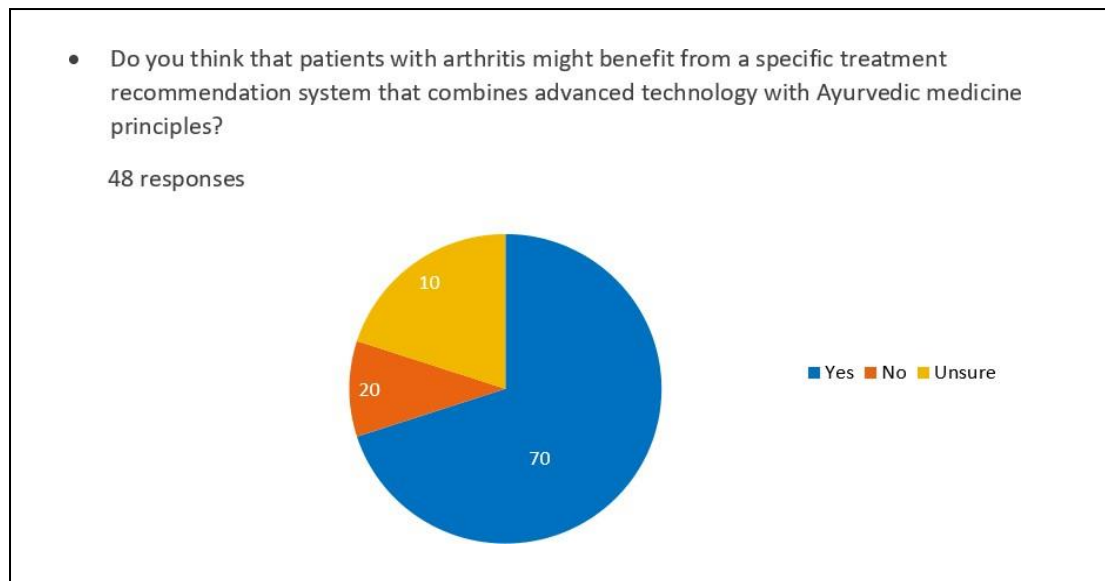
- **Research A:** Ayurvedic treatment of rheumatoid arthritis: a randomized double-blind placebo-controlled cross-over study.[04]
- **Research B:** Anti-inflammatory and anti-arthritic effects of thymoquinone in a rat model of arthritis.[05]
- **Research C:** Personalized treatment recommendations for rheumatoid arthritis patients using machine learning.[06]
- **Research D:** Decision support system for Ayurvedic treatment of osteoarthritis.[07]

There are no modern technology or individualized therapy recommendations in this research paper [04]; rather, it examines how Ayurvedic medicine is used to treat rheumatoid arthritis. In contrast, our proposed system (AyurAira) uses modern technology to integrate Ayurvedic medical principles with specific treatment recommendations for arthritis patients. This research paper [05] examines the anti-arthritic and anti-inflammatory properties of thymoquinone, a substance present in black seed oil, in a rat arthritis model. This study provides valuable insight into the potential benefits of thymoquinone in the treatment of arthritis but does not recommend a comprehensive and personalized treatment that combines both the traditional knowledge and modern technology of Ayurvedic medicine.

The research paper [06] suggests using machine learning to develop individualized treatment recommendations for people with rheumatoid arthritis. Although the goal of this study is to provide patients with arthritis individualized therapy recommendations, it does not include traditional Ayurvedic medical principles. In order to cure osteoarthritis, this research suggests an Ayurvedic medicine-based decision support system [07]. Although this system is in line with the goal of integrating traditional Ayurvedic medicine into treatment suggestions, it only addresses osteoarthritis and does not use modern technology or provide individualized advice.

1.4 Research Problem

The lack of a complete and specific treatment recommendation system for arthritis patients which integrates traditional Ayurvedic medical knowledge with modern technology is the research problem that this paper aims to address. While both modern medicine and Ayurveda have made tremendous progress in the treatment of arthritis, there is still a lack of current research on a system that combines the two approaches to offer specific recommendations based on specific factors that influence each patient.



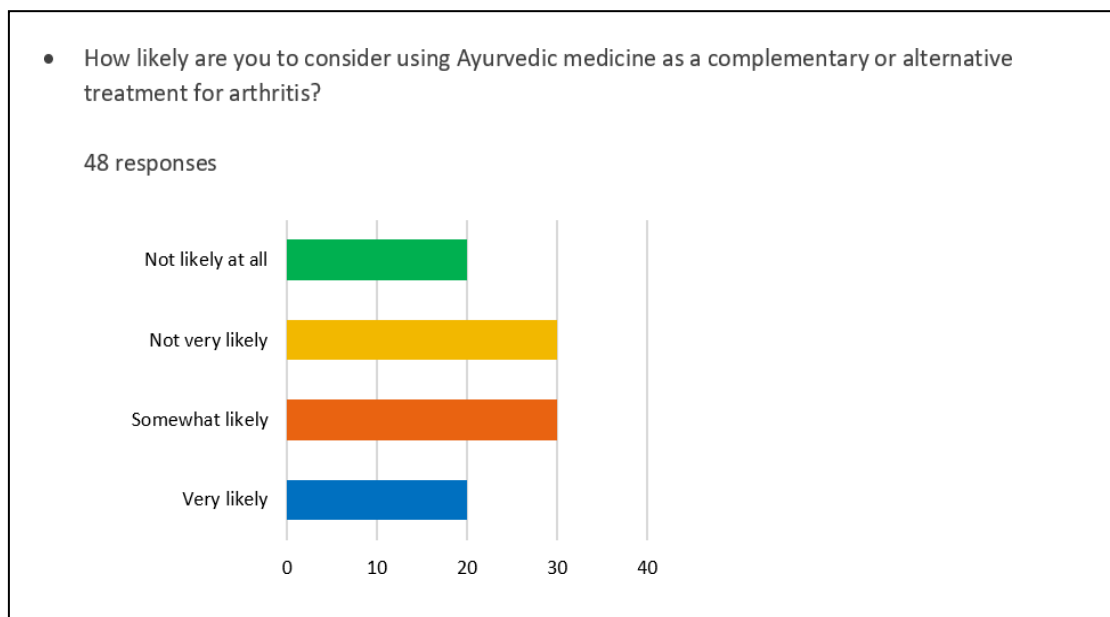
As Figure 1.2 shows 70% of the respondents answered yes, indicating that they believe such a system could be helpful. These respondents could expect advantages including patient-specific treatment strategies, increased efficacy, and enhanced general health outcomes.

10% of those surveyed gave a negative response, suggesting that they did not think such a system would be helpful. These responders may prefer more traditional medical treatments or are concerned about the efficacy or safety of Ayurvedic

medication. 20% of the respondents said they were uncertain, indicating that they require more data or evidence before making a decision. Overall, the majority of respondents thought that patients with arthritis would benefit from a personalized treatment recommendation system that integrates the principles of Ayurvedic medicine with modern technology. However, there are still specific problems and concerns that require further research and guidance.

Most of current medical techniques to treating arthritis rely on physiotherapy, surgery, or pharmacological treatments, all of which can have negative side effects and can frequently be costly. The integrated strategy provided by Ayurveda, on the other hand, treats arthritis while also taking into account the patient's general health and well-being. Ayurvedic treatments might also involve yoga, massage therapy, herbal cures, and dietary changes.

A comprehensive and individualized system that integrates the principles of Ayurvedic medicine with modern technology to offer patients with arthritis specific recommendations is yet to be developed, despite the growing interest in using Ayurveda as a complementary or alternative treatment method. Many current systems only use modern medical techniques, which may not be appropriate for many individuals, especially those looking for a more integrative and naturalistic approach.



As shown in Fig 1.3, Ayurvedic medicine is an alternative to medicine that 20% of respondents said they would be very interested in utilizing. These people might be looking for alternative and natural methods to their healthcare or they might have already tried conventional treatments without effectiveness. According to their limited interest in utilizing Ayurvedic medicine, 30% of respondents selected somewhat likely as their response. While having is concerned about the efficacy or safety of Ayurvedic medicine, many individuals may be receptive to the idea of using alternative treatments.

30% of those surveyed gave the response "not very likely," indicating that they are not particularly interested in using Ayurvedic medicine as a form of treatment. These people might favor traditional medicine or reject the efficacy of complementary therapies.

20% of those surveyed gave the response not at all likely, suggesting that they have no interest in utilizing Ayurvedic medicine as a form of therapy. These people might hold firm opinions or be very concerned about the efficacy or safety of other treatments. Overall, the results show that many respondents are receptive to the concept of implementing Ayurvedic medicine as a complementary or alternative form of treatment for arthritis.

Our research aims to expand knowledge of traditional medicine and its integration with modern technology, as well as to improve the quality of life for arthritis patients. A model for the integration of traditional medicine with modern medicine, the development of a personalized treatment recommendation system combining Ayurveda and modern technology may ultimately have wide-ranging applications outside the treatment of arthritis.

1.5 Research Objectives

1.5.1 Main Objective

The main objective of the research is to develop AyuAyira, a personalized treatment and idea system for arthritis patients using modern technology and Ayurvedic medical principles. This system works to provide patients with personalized treatment plans that take into account the patient's age, sex, symptoms, and overall health while taking into account the specific characteristics of Ayurvedic medicine.

Ayurvedic medicine has grown in popularity as a supplementary or alternative treatment for chronic diseases like arthritis because of its all-natural, integrated approach. There isn't much research on the efficiency and safety of Ayurvedic medicine, and there aren't many possibilities for individualized care.

By using modern technology like machine learning and natural language processing to evaluate patient data and produce specific treatment recommendations based on Ayurvedic principles, AyuAyira aims to close this gap. To provide a thorough and personalized treatment plan, the system will also take the patient's medical history, lifestyle choices, and personal needs into account.

AyuAyira might contribute to improved treatment outcomes, a decrease in dependence on traditional drugs, and a more patient-focused approach to healthcare. The system could also throw insight into the efficacy of Ayurvedic medication and help in reducing the gap between Conventional and modern healthcare.

1.5.2 Specific Objective

To reach the main objectives, the specific objectives that need to be attained are as follows.

1. Develop an extensive database of Ayurvedic arthritis treatments:

A wide variety of efficient alternative treatments to manage arthritis symptoms is needed to build an effective recommendation system. This database will serve as the foundation for the system, containing information on various types of Ayurvedic arthritis treatments.

2. Identify key elements for treatment recommendations:

To generate an effective recommendation system, it is important to identify the key elements that affect how well Ayurvedic arthritis treatments work. These variables could be the patient's age, sex, symptoms, and general health.

3. Design a predictive model:

A predictive model will be developed with machine learning algorithms to determine the effectiveness of Ayurvedic arthritis treatments based on variables specific to each patient. To determine the most effective course of action for each patient, the model will take into consideration a variety of characteristics.

4. Evaluate the model's accuracy:

The model needs to be evaluated using appropriate evaluation measures in order to ensure its accuracy and dependability. The results of this test will be used to assess how well the model predicts the efficacy of Ayurvedic arthritis treatments.

5. Optimize the model:

The model has to be developed when its accuracy is evaluated in order to provide specific treatment recommendations that are both accurate and effective. This can involve modifying the parameters of the machine learning algorithms or using an entirely other methodology.

6. Develop a user-friendly interface:

A user-friendly interface that provides specific treatment recommendations based on the patient's specific symptoms and health requirements will be developed. Patients will be able to obtain the recommendations simply due to the interface's clarity and simplicity.

7. Test the system with patients:

To evaluate the Ayurvedic treatment recommendation system's effectiveness and usability, it will be tested with a group of arthritis patients. Their feedback will help refine the system and improve its accuracy.

8. Continuously update the database:

The Ayurvedic treatment recommendation system must be continually updated with new knowledge regarding Ayurvedic arthritis treatments in order to maintain current and effective recommendations. This process will involve ongoing research and the addition of new treatment options as they become available

2. METHODOLOGY

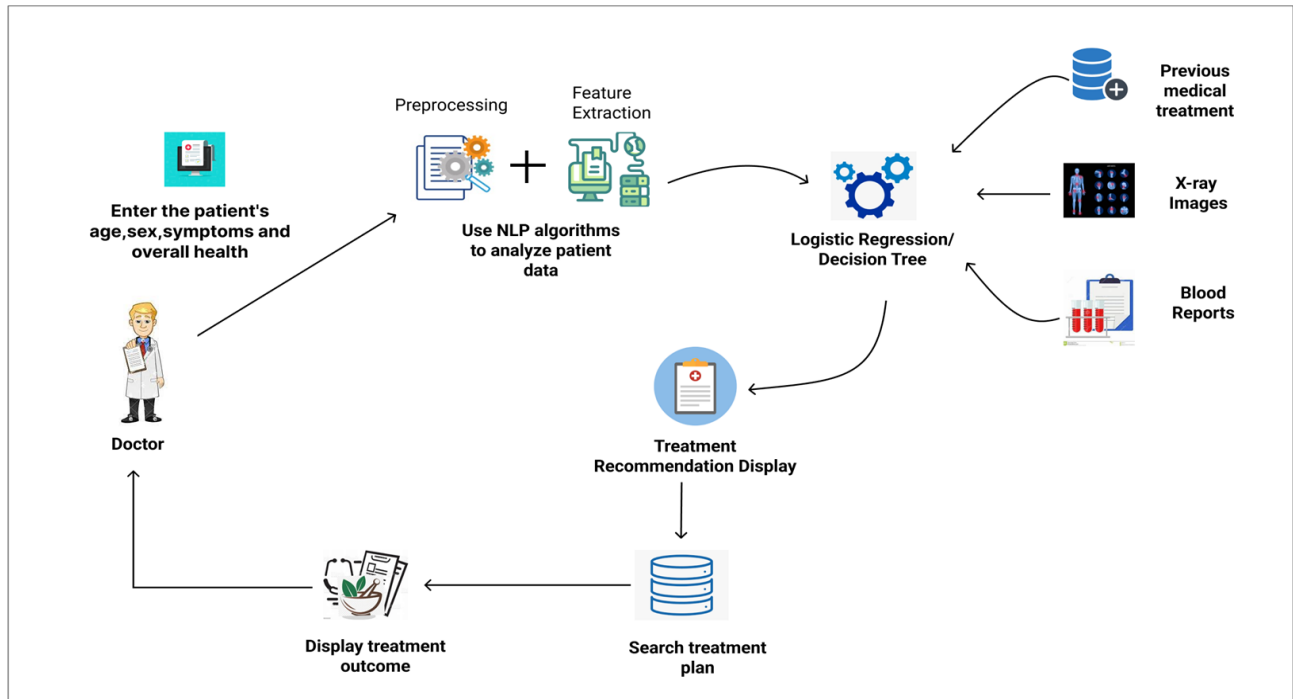
The process of developing a machine learning-based system that recommends personalized Ayurvedic treatments includes many stages. First, we will gather patient information from doctors and hospitals, such as age, sex, symptoms, and overall health. Following that, the dataset will be organized and processed to remove any unnecessary or redundant values that could compromise the model's accuracy.

Next, we'll split the dataset into training and testing sets, with training sets using 80% of the data and testing sets using 20%. Once we have found patterns and correlations in the patient data, we will use machine learning methods like random forests, and decision trees or neural networks to create a prediction model.

Ayurvedic medical principles will be integrated into the model to generate individualized treatment recommendations that are consistent with traditional understanding and procedures. Utilizing real-world data and input from patients and healthcare professionals, the system's precision and efficacy will be examined and confirmed. Additionally, in order to select the best machine-learning algorithm for our system, we will compare and contrast various machine-learning techniques.



2.1 System Overview



2.1.1 Data Collection

Data Collection: The Ayurvedic General Hospital in Rajagiriya and the Gampaha Wickramarachchi Ayurveda Institute in Sri Lanka will provide the data for this research's recommendation of Ayurvedic treatments. As part of the data collection, patients' ages, genders, symptoms, and overall health will be collected through interviews and questionnaires. For their ideas and suggestions, qualified Ayurvedic Vaidyas and those who learned Ayurvedic practices from their ancestors will also be contacted. The data gathered from various sources will be used to generate the questionnaires. The gathered information will be saved in a structured form, like a.csv file, so that it may be input into different machine learning algorithms.

AyurAyira: The AyurAyira system will be built to generate an appropriate configuration of the AyuAira architecture's components, including the data source, data staging, data storage, and information delivery. Along with structured data, the

data source component will also contain unstructured data, such as text, images, and multimedia files. Data from various data sources will be moved to data staging during the process of data gathering. The data staging component will carry out the Extract, Transform, and Load activities to prepare data from multiple sources for storage and analysis. In order to develop a personalized treatment suggestion system based on Ayurvedic principles, machine learning algorithms will be utilized to analyze the data gathered and detect connections and patterns. The system's accuracy and efficacy will be evaluated using data from the actual world and input from patients and healthcare professionals.

2.1.2 Data Pre-Processing

Data preparation is an essential stage in the development of an Ayurvedic treatment recommendation system to ensure that raw data is appropriate for machine learning algorithms. This procedure involves managing anomalies to avoid distortion, dealing with differences by standardizing formats and handling missing values using data replacement. Data processing is used to enhance feature patterns or interactions with the target variable, and data normalization is done to normalize features to a common range. By completing these tasks, the data is made more suitable for machine learning algorithms, improving performance and resulting in more precise predictions.

2.1.3 Feature Selection

In an Ayurvedic treatment recommendation system, feature selection involves identifying the most important factors determining the efficacy of treatments for particular diseases, such as arthritis. These variables include information personal to the patient, such as age, sex, symptoms, and overall health, as well as variables related to the progress of the treatment, such as individualized treatment, adherence to traditional Ayurvedic principles, and how long is the treatment. The machine learning algorithm can better capture data patterns by selecting the most pertinent attributes, which results in more precise recommendations for treatment and better patient outcome

2.1.4 Data splitting

Data splitting is an essential step in an Ayurvedic treatment recommendation system to ensure that the machine-learning model is strong and generalizable. The procedure involves splitting the information into separate sets for training, validation, and testing purposes. The dataset may contain variables like patient age, sex, symptoms, and general health. This division enables the model to improve its performance based on the validation results, learn patterns from the training data, and assess its efficacy on recently discovered test data. The recommendation system can offer accurate and reliable treatment recommendations for patients with particular illnesses, like arthritis, by dividing the data in this way.

2.1.5 Model development

Selecting and training a machine learning algorithm, such as decision trees, support vector machines, or neural networks, to predict the efficacy of Ayurvedic treatments based on the characteristics selected defines model development in an Ayurvedic treatment recommendation system. This phase involves evaluating many algorithms, selecting the best one, and then training the model with the training dataset. The algorithm selected will rely on the quantity and complexity of the dataset as well as the nature of the problem being solved. The best algorithm can be selected to generate accurate treatment recommendations and enhance patient outcomes by comparing the performance of several algorithms.

2.1.6 Model Evolution

An essential phase in an Ayurvedic treatment recommendation system is model evaluation, which measures how well the generated model executed on the validation set using metrics like accuracy, precision, recall, and F1-score. This phase verifies the model's ability to predict treatment outcomes and makes sure it generalizes well to current, untested data. Comparing the effectiveness of several models using different evaluation criteria can assist in determining the best model for the particular issue, ultimately resulting in accurate and reliable therapy recommendations for patients with diseases like arthritis.

2.1.7 Model Optimization

An Ayurvedic treatment recommendation system's model optimization process involves improving the model based on the evaluation results by changing its parameters, adding new characteristics, or trying with different machine-learning techniques. Hyperparameter tuning, which determines the ideal set of parameters to improve the results of the learning process dev. to, might be a part of this procedure. To further improve the model's prediction capabilities, feature engineering can be used to develop new features or modify current ones. The recommendation system can perform more effectively and offer more precise treatment recommendations for individuals with particular diseases, like arthritis, by utilizing these optimization techniques.

2.1.8 Decision Tree Algorithm

An Ayurvedic treatment recommendation system can use the decision tree algorithm to generate specific treatment recommendations based on patient-specific data. Due to their capacity to handle a large amount of providing responses that are easy to understand, and accepting a variety of input properties, decision trees are frequently utilized for medical decision-making tasks.

The decision tree algorithm would be trained on a dataset containing patient information, symptoms, and relevant Ayurvedic treatments in the context of an Ayurveda treatment recommendation system. The algorithm generates a recommended Ayurvedic treatment after training to make decisions based on input parameters including patient age, gender, medical history, and symptoms. A leaf node that corresponds to a treatment recommendation is situated at the end of the decision tree structure, which is made up of nodes representing features and branches indicating decisions.

The comprehensibility of decision trees, in this case, is a benefit since it enables medical professionals to understand the reasoning behind the particular treatment recommendation. Decision trees also make it simple to update and maintain them as new knowledge about Ayurvedic treatments and patient results comes out, ensuring that the recommendations are accurate and current.

2.1.9 Support Vector Machines

Support Vector Machine (SVM) algorithms can be used to classify patient-specific data with precision and dependability for specific treatment recommendations in Ayurvedic treatment recommendation systems. Specifically intended for classification problems, SVM is a supervised machine learning method that performs well on large datasets.

The SVM algorithm would be trained on a dataset including patient data, symptoms, and relevant Ayurvedic treatments in the context of an Ayurvedic treatment recommendation system. Developing a hyperplane in space with N dimensions that clearly classifies the data points is the goal of the SVM method. The margin, or the distance between the hyperplane and the nearest data points for each class, is what the method seeks to maximize.

Once trained, the SVM model can be used to categorize new patient data and provide specific Ayurvedic recommendations for treatment based on the input features. The higher efficiency and improved accuracy with fewer samples are two benefits of using SVM in this case. This enables it for systems that recommend Ayurvedic treatments where the dataset size may be limited to a few thousand samples.

2.1.10 Neural Network

By identifying complex patterns and connections in patient data, neural networks can be used to develop accurate and personalized treatment recommendations for Ayurvedic treatments. Neural networks are a particular type of machine learning model that may represent non-linear connections between input data and output classes, making them appropriate for use in medical applications where more traditional algorithms might come up short.

A neural network would be trained on a dataset containing patient information, symptoms, and related Ayurvedic remedies in the context of an Ayurvedic treatment recommendation system. The neural network adjusts its parameters and weights through an iterative process to learn to map input variables (such as patient age, gender, medical history, and symptoms) to appropriate treatment recommendations.

After being trained, the neural network may be utilized to categorize new patient data and offer personalized treatment recommendations based on the input features. Neural networks are stable for medical applications because they can endure noise and mistakes in the training data and are especially helpful when dealing with uncertainty. For the purpose of training precise and reliable neural network models, it is essential that high-quality data be made available in sufficient amounts.

2.1.11 Model Testing

The evaluation of the finalized model's performance on the testing dataset is an essential phase in an Ayurvedic treatment recommendation system to verify the accuracy and generalizability of new, unreported data. During this procedure, predictions are made using the trained model on the testing dataset, and the effectiveness of the model is evaluated using appropriate evaluation metrics, such as accuracy, precision, recall, and F1-score. We can identify whether the model is over or underfitting and make the appropriate corrections to improve performance by evaluating the model's performance on the testing dataset. In order to confirm that the model is reliable and precise in real-life situations and can make useful treatment recommendations for patients with diseases like arthritis, testing it on current, previously explored data is also crucial.

2.1.12 Deployment and User Interface

The development of an Ayurvedic treatment recommendation system's deployment and user interface is an important phase. After development and validation, the machine learning model must be integrated into a user-friendly interface that enables patients or healthcare professionals to input patient-specific data and obtain individualized treatment recommendations. A REST API, which provides a standardized interface for communication between the machine learning model and the user interface, is one method of achieving this. The system can be easily accessed by patients or medical professionals thanks to the integration of this API with a web or mobile application.

Even for individuals who might not be used to Ayurvedic treatment, the user interface should be developed in a straightforward and simple-to-use way. It should allow the input of relevant patient information by the user, such as age, sex, symptoms, and medical background, and ought to then offer specific treatment recommendations based on the predictions of the machine learning model.

Additionally, the recommended treatments should be thoroughly explained in the interface, along with any possible adverse effects or limitations. By doing this, it will be made sure that both patients and healthcare professionals can decide on the best course of treatment for every patient. Deployment and user interface development are essential phases in making sure that the developed Ayurvedic treatment recommendation system is easy to use, accessible, and successful at offering patients personalized treatment recommendations.

2.1.13 Continuous updates and maintenance

This procedure requires gathering new patient data, integrating it into the database that already exists, updating the model's parameters or retraining it using the new data, and testing the performance of the updated model to verify the accuracy and reliability of application science. In order to improve the system's functionality and usability, it is also important to regularly assess its performance, identify any problems, and make the necessary modifications. The recommendation system will continue to be a beneficial tool for individuals and healthcare professionals looking for individualized Ayurvedic therapy options for ailments like arthritis by constantly being updated and maintained.

2.2 Commercialization

The commercialization plan for AyuAira involves several steps to bring the personalized treatment recommendation system to the market. Firstly, we plan to conduct clinical trials to gather more data on the effectiveness and accuracy of the system and to ensure that it meets regulatory requirements. We will also seek partnerships with Ayurvedic hospitals and clinics to integrate AyuAira into their treatment protocols. Secondly, we plan to develop a user-friendly interface for patients and healthcare providers to easily access and utilize the system. This will involve hiring a team of developers to create an intuitive and efficient platform that can be easily accessed from a computer or mobile device.

Thirdly, we will focus on marketing and outreach to increase awareness of AyuAira and its benefits. This will involve creating a comprehensive marketing strategy that includes social media, targeted advertising, and partnerships with relevant organizations in the healthcare and Ayurvedic medicine sectors.

Finally, we'll examine ways to generate income through collaborations with healthcare organizations, patient billing arrangements, and pharmaceutical company license deals. Our ultimate objective is to significantly improve the quality of life for arthritis patients worldwide by making AyuAira broadly accessible to them.

2.4 Testing and Implementation

Test Case ID	001
Test Case Description	Testing for a patient with only joint pain
Pre-condition	The patient has joint pain as the only symptom.
Test Procedure	<ol style="list-style-type: none">1. Input patient information2. Click “Recommend Treatment”3. Check the recommended treatment.
Test Input	Age :45 Sex: Female Symptoms: Join pain
Expected Output	Personalized Ayurvedic treatment recommendation for joint pain.
Actual Output	Ayurvedic treatments for joint pain are recommended.

Test Case ID	002
Test Case Description	Testing for a patient with multiple symptoms
Pre-condition	The patient has joint pain, inflammation, and stiffness.
Test Procedure	<ol style="list-style-type: none">1. Input patient information2. Click “Recommend Treatment”3. Check the recommended treatment.
Test Input	Age :60 Sex: Male Symptoms: Joint pain, inflammation, stiffness
Expected Output	Ayurvedic treatment recommendation for joint pain, inflammation, and stiffness
Actual Output	Personalized Ayurvedic treatment recommendation for multiple symptoms.

Test Case ID	003
Test Case Description	Testing for a patient with a history of heart disease
Pre-condition	The patient has a history of heart disease.
Test Procedure	<ol style="list-style-type: none"> 1. Input patient information 2. Click “Recommend Treatment” 3. Check the recommended treatment.
Test Input	Age: 55 Sex: Male Symptoms: Joint pain Medical History: Heart disease
Expected Output	Ayurvedic treatment recommendation for joint pain (without contraindications for heart disease)
Actual Output	Personalized Ayurvedic treatment recommendation for a patient with a history of heart disease.

Implementation

The development of a backend and frontend system are both essential to the implementation of an Ayurvedic treatment recommendation system. The machine learning model, which is a component of the backend system, is responsible of processing patient-specific data and generating specific treatment suggestions based on the basic principles of Ayurvedic medicine. The front-end system is in responsible for providing a user interface that allows patients or healthcare professionals to input patient-specific data and generate customized treatment recommendations.

Python is used to develop the backend system; it is an established programming language for data science and machine learning applications. Scikit-learn, an accepted machine learning toolkit for Python, is used for developing the machine learning model. A collection of patient data, including age, sex, symptoms, and overall health, as well as the related Ayurvedic treatments that have worked before for patients with similar diseases, is used to train the model.

Web-based programming languages like HTML, CSS, and JavaScript are used to develop the frontend system, along with web framework such as Flask or Django. Patients or healthcare professionals can input patient-specific data, such as age, sex, symptoms, and overall health, into the frontend system's user interface to receive specific treatment recommendations based on the results of the machine learning model.

A REST API is developed for integrating the backend and frontend services. The backend system can obtain specific Ayurvedic treatment recommendations from the machine learning model and receive patient-specific data from the frontend system via the REST API. The user is then shown the output on the frontend system.

In conclusion, the development of a backend and frontend system connected by a REST API is required to implement an Ayurvedic treatment recommendation system. This user-friendly interface allows patients or healthcare professionals to input patient-specific data and receive specific Ayurvedic treatment recommendations.

3 RESULTS AND DISCUSSION

3.1 Results

This section describes the results of the study with the deployment of the final product of responsive web application and the respective performances and accuracies of the trained machine learning models.

3.2 Research and Findings

The research findings of this study indicate that the integration of traditional Ayurvedic knowledge with advanced technology holds promise in providing personalized treatment recommendations for arthritis patients. The model developed effectively provides personalized treatment recommendations based on the principles of Ayurvedic medicine by considering elements like the patient's age, sex, symptoms, and general health. The validation of the model using a dataset of arthritis patients demonstrates its effectiveness in identifying the most suitable treatment options. The comparison of the model's recommendations with existing treatment guidelines reveals the potential of Ayurvedic interventions to complement conventional approaches and improve patient outcomes.

Furthermore, the study finds that the acceptance and feasibility of personalized treatment recommendations among arthritis patients and healthcare professionals are encouraging. The integration of technology in personalized medicine allows for enhanced patient engagement and empowerment, as well as more efficient decision-making processes.

These research results highlight the importance of applying Ayurvedic medicine to the field of treating arthritis. By leveraging advanced technology, healthcare practitioners can harness the vast knowledge of Ayurveda to provide tailored interventions that address the unique needs and characteristics of each patient. This personalized approach has the potential to enhance treatment outcomes, minimize side effects, and improve the overall quality of life for arthritis patients.

The research findings underscore the importance of further exploration and implementation of integrative approaches that bridge traditional medicine and advanced technology. This interdisciplinary approach has the potential to revolutionize the field of arthritis treatment and pave the way for more holistic and patient-centered healthcare practices.

3.3 Discussion

3.4 Requirement Analysis

A software system's development process must include requirement analysis. It involves understanding and documenting the requirements and desires of the users of the system and users, as well as changing those requirements into precise specifications that the system must satisfy. The following are the essential requirements for an Ayurveda treatment recommendation system for arthritis patients.

1. System Requirements

Patient-specific data, including characteristics, symptoms, medical histories, and treatment tastes, must be able to be gathered and stored by the system. Additionally, it should be able to identify relevant medical data in Ayurvedic literature and other sources.

2. Functional Requirements

To identify relevant elements that contribute to the diagnosis and management of arthritis, the system should be able to handle data preprocessing and feature selection. Additionally, based on the principles of Ayurvedic medicine, it should be able to use machine learning algorithms on the data to generate individualized treatment recommendations.

3. Non-Functional Requirements

The system must be dependable, flexible, and secure. Large amounts of patient data should be manageable, and it should be able to provide accurate and rapid treatment recommendations. Additionally, the system requires to be user-friendly and accessible to patients and healthcare providers with a variety of technical specializations.

4 CONCLUSION

The development of a mobile-based application is the purpose of this research. Here, the development of AyuAira, a machine learning-based individual treatment recommendation system that integrates modern technology and Ayurvedic medical principles, has the potential to completely change how arthritis sufferers receive healthcare. The system may provide specific treatment recommendations that are consistent with traditional Ayurvedic knowledge and practices by effectively evaluating and interpreting patient data. The accuracy and effectiveness of the recommendations are improved by integrating machine learning with the principles of Ayurvedic medicine, which benefits patients. Testing and real-world feedback have confirmed the system's efficacy and its commercialization plan offers promise for more acceptance and use. Overall, the development of the AyuAira system is a significant step toward the integration of traditional medicine and modern technology and has an opportunity to greatly improve the quality of life for arthritis patients.

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APPENDIX

i. Summary of Plagiarism Report