



AI-Based Stress and Anxiety Detection System Using Ayurvedic Parameters and Machine Learning Techniques

Dr. Bhawna Garg

bhawnagarg2702@gmail.com

Abstract

Stress and anxiety disorders have emerged as major global health concerns due to increasing work pressure, lifestyle imbalance, emotional instability, and digital dependency. Traditional diagnostic systems primarily rely on psychological evaluation and clinical observations, often overlooking personalized and holistic health indicators. Ayurveda, the ancient Indian system of medicine, emphasizes the relationship between mental wellness, lifestyle, diet, sleep, and the balance of Tridoshas (Vata, Pitta, and Kapha). This research proposes an Artificial Intelligence (AI)-based stress and anxiety detection framework integrating Ayurvedic principles with machine learning techniques for early diagnosis and personalized wellness recommendations. The proposed system utilizes questionnaire-based data collection including behavioral, psychological, and Ayurvedic parameters. Multiple machine learning algorithms such as Random Forest, Support Vector Machine (SVM), Decision Tree, Logistic Regression, and XGBoost are analyzed for predictive performance. The study highlights literature review, methodology, system architecture, dataset preparation, model training, evaluation metrics, advantages, limitations, ethical considerations, and future scope. The proposed framework demonstrates the potential of combining AI and Ayurveda to create explainable, preventive, and personalized mental healthcare systems.

Keywords: Artificial Intelligence, Ayurveda, Stress Detection, Anxiety Prediction, Machine Learning, Mental Health, Explainable AI, Dosha Analysis, Personalized Healthcare

1. Introduction

Mental health disorders such as stress and anxiety are increasing rapidly due to modern lifestyle changes, work-related pressure, academic burden, financial instability, social isolation, and excessive digital engagement. According to global healthcare reports, millions of individuals suffer from stress-induced disorders that affect emotional, physical, and psychological well-being. Early diagnosis and intervention are essential to prevent severe mental and physical complications.

Conventional mental health assessment methods generally involve clinical interviews, psychological questionnaires, and behavioral observations. Although these approaches are effective, they may not fully capture individualized health patterns or preventive indicators. Moreover, accessibility to mental healthcare remains limited in many regions. Artificial Intelligence (AI) has transformed healthcare by enabling automated diagnosis, predictive analytics, and personalized treatment recommendations. Machine learning algorithms can identify patterns in healthcare data and predict diseases with high



accuracy. In mental healthcare, AI-based systems are increasingly used for emotion recognition, stress analysis, and behavioral monitoring.

Ayurveda provides a holistic approach to healthcare by emphasizing the balance between body, mind, and spirit. According to Ayurveda, mental imbalance occurs due to disturbances in Tridoshas:

- **Vata** – associated with movement, nervousness, fear, and anxiety
- **Pitta** – associated with aggression, anger, and emotional intensity
- **Kapha** – associated with calmness, stability, and emotional attachment

Ayurvedic assessment includes factors such as sleep quality, digestion, food habits, emotional stability, daily routine, energy levels, and lifestyle practices. Integrating Ayurvedic principles with AI can create a personalized and preventive mental healthcare framework.

This research presents a comprehensive study on an AI-based stress and anxiety detection system using Ayurvedic parameters and machine learning techniques.

2. Research Objectives

The major objectives of this research are:

1. To study the role of Ayurveda in stress and anxiety assessment.
2. To identify Ayurvedic and psychological indicators related to mental wellness.
3. To design a questionnaire-based dataset for stress prediction.
4. To develop machine learning models for stress and anxiety classification.
5. To compare the performance of different AI algorithms.
6. To provide personalized Ayurvedic wellness recommendations.
7. To develop an explainable and preventive healthcare framework.

3. Literature Survey

3.1 Artificial Intelligence in Mental Healthcare

Recent advancements in Artificial Intelligence have significantly improved healthcare diagnostics and predictive systems. AI techniques such as machine learning, deep learning, and natural language processing are widely used in mental health analysis.

Researchers have developed stress detection systems using:

- Physiological sensors
- Speech analysis
- Facial expression recognition
- Wearable devices
- Behavioral data analysis



- Questionnaire-based datasets

Machine learning algorithms such as SVM, Random Forest, Neural Networks, and XGBoost have demonstrated promising accuracy in detecting emotional disorders.

Key Findings from Existing Studies

Study Area	Technique Used	Outcome
Stress prediction using wearable sensors	Random Forest	High accuracy in physiological monitoring
Anxiety detection using facial analysis	CNN	Effective emotion recognition
Mental health chatbot systems	NLP	Improved accessibility to support
Depression prediction using social media	Deep Learning	Early symptom detection

Although these systems provide technological advancements, most of them rely solely on physiological or psychological data and ignore holistic healthcare approaches.

3.2 Ayurveda and Mental Health

Ayurveda considers mental wellness as an essential component of overall health. Ancient Ayurvedic texts describe mental imbalance through concepts such as:

- Manasika Doshas
- Satva, Rajas, and Tamas
- Tridosha imbalance
- Lifestyle disturbances
- Improper dietary habits

According to Ayurveda:

- Increased Vata causes fear, restlessness, anxiety, and overthinking.
- Increased Pitta may lead to anger, irritability, and frustration.
- Imbalanced Kapha may cause emotional heaviness and lethargy.

Ayurvedic therapies for stress management include:

- Meditation
- Yoga
- Herbal remedies
- Panchakarma
- Sleep regulation
- Dietary modifications



Modern healthcare research has shown positive outcomes of Ayurvedic interventions in reducing stress and improving emotional stability.

3.3 Research Gap

Despite significant progress in AI-based healthcare systems, several limitations remain:

1. Existing systems mostly use modern clinical data only.
2. Very limited research integrates Ayurveda with AI.
3. Personalized mental wellness systems are still underdeveloped.
4. Explainable AI approaches in mental healthcare remain insufficient.
5. Preventive and holistic frameworks are rarely considered.

This research addresses these gaps by integrating Ayurvedic principles with machine learning for stress and anxiety detection.

4. Proposed System

4.1 Overview

The proposed system combines Ayurvedic assessment and machine learning algorithms to predict stress and anxiety levels.

The framework includes:

1. Data Collection
2. Data Preprocessing
3. Feature Engineering
4. Model Training
5. Prediction and Classification
6. Recommendation System

4.2 System Architecture

Input Layer

The system collects data using questionnaires including:

- Sleep quality
- Digestion pattern
- Emotional behavior
- Lifestyle habits
- Food preferences
- Physical activity



- Anxiety symptoms
- Stress indicators
- Prakriti analysis

Processing Layer

The collected data undergoes:

- Cleaning
- Normalization
- Feature extraction
- Encoding
- Missing value handling

Machine Learning Layer

Algorithms used:

- Random Forest
- Decision Tree
- Logistic Regression
- Support Vector Machine
- XGBoost

Output Layer

The system predicts:

- Low stress
- Moderate stress
- High stress

Additionally, Ayurvedic wellness recommendations are generated.

5. Dataset Preparation

5.1 Data Collection Method

The dataset can be collected using:

- Google Forms
- Hospital surveys
- Ayurveda clinic assessments
- Mental wellness questionnaires

Participants provide responses related to:



- Physical health
- Emotional stability
- Sleep
- Lifestyle
- Dietary patterns
- Mental stress indicators

5.2 Sample Dataset Structure

Attribute	Description
Age	Age of participant
Gender	Male/Female/Other
Sleep Quality	Good/Average/Poor
Appetite	Normal/Low/High
Anxiety Level	Scale-based response
Emotional Stability	Behavioral analysis
Work Pressure	Stress indicator
Screen Time	Daily device usage
Meditation Practice	Yes/No
Vata Score	Ayurvedic parameter
Pitta Score	Ayurvedic parameter
Kapha Score	Ayurvedic parameter
Stress Level	Target variable

6. Methodology

6.1 Data Preprocessing

The collected data is preprocessed using:

- Removal of missing values
- Data normalization
- Label encoding
- Feature scaling
- Outlier detection

Preprocessing improves model efficiency and prediction accuracy.



6.2 Feature Selection

Important features influencing stress prediction are identified using:

- Correlation analysis
- Information gain
- Recursive feature elimination
- Feature importance ranking

Potential significant features include:

- Sleep quality
- Anxiety score
- Emotional imbalance
- Vata dominance
- Work pressure
- Meditation frequency

6.3 Machine Learning Algorithms

6.3.1 Random Forest

Random Forest combines multiple decision trees to improve prediction accuracy and reduce overfitting.

Advantages

- High accuracy
- Handles large datasets
- Robust against overfitting

6.3.2 Support Vector Machine (SVM)

SVM identifies optimal boundaries between stress categories.

Advantages

- Effective for classification
- Works well with high-dimensional data
- Strong generalization capability

6.3.3 Logistic Regression

Used for binary and multiclass classification problems.

Advantages

- Simple implementation



- Fast training
- Easy interpretability

6.3.4 Decision Tree

Creates tree-like decision structures for prediction.

Advantages

- Easy visualization
- Explainable predictions
- Minimal preprocessing

6.3.5 XGBoost

Advanced boosting algorithm providing high predictive performance.

Advantages

- High speed
- Better accuracy
- Handles missing values efficiently

7. Evaluation Metrics

The performance of models can be evaluated using:

Metric	Description
Accuracy	Overall prediction correctness
Precision	Positive prediction reliability
Recall	Detection capability
F1-Score	Balance between precision and recall
ROC-AUC	Classification performance

8. Ayurvedic Recommendation System

The proposed system provides personalized wellness suggestions based on stress levels and dosha imbalance.

Example Recommendations

For Vata Imbalance

- Warm food intake
- Meditation
- Oil massage therapy
- Regular sleep schedule

For Pitta Imbalance



- Cooling diet
- Relaxation practices
- Reduced screen exposure
- Breathing exercises

For Kapha Imbalance

- Physical exercise
- Active routine
- Light diet
- Motivational activities

9. Benefits of the Proposed System

9.1 Early Detection

AI can identify stress symptoms before severe mental disorders develop.

9.2 Personalized Healthcare

Ayurvedic analysis allows individualized recommendations.

9.3 Cost-Effective Solution

Questionnaire-based systems reduce dependence on expensive equipment.

9.4 Explainable Predictions

Decision-making becomes more transparent using explainable AI models.

9.5 Preventive Healthcare

The system focuses on prevention rather than only treatment.

9.6 Holistic Wellness

Combines physical, emotional, and lifestyle factors.

10. Advantages Over Traditional Systems

Traditional System	Proposed AI-Ayurveda System
Clinical-only assessment	Holistic analysis
Limited personalization	Personalized wellness
Reactive treatment	Preventive healthcare
Time-consuming	Automated predictions
Limited accessibility	Scalable digital system

11. Challenges and Limitations

Despite its advantages, the proposed system faces several challenges:

1. Dataset collection complexity
2. Subjective questionnaire responses
3. Limited availability of Ayurvedic datasets



4. Ethical concerns in mental health prediction
5. Requirement of expert validation
6. Cultural variations in Ayurvedic interpretation

Future studies should address these limitations using larger datasets and multimodal analysis.

12. Ethical Considerations

AI-based mental healthcare systems must ensure:

- Data privacy
- User consent
- Bias reduction
- Transparency
- Responsible recommendations

Sensitive healthcare information should be protected using secure data handling mechanisms.

14. Future Scope

Future enhancements may include:

1. Wearable device integration
2. Real-time stress monitoring
3. Mobile application development
4. AI chatbot for mental wellness
5. Deep learning-based emotional analysis
6. Voice and facial expression analysis
7. Integration with telemedicine platforms
8. Personalized Ayurvedic therapy planning

The integration of AI and Ayurveda has strong potential for next-generation healthcare systems.

15. Conclusion

Stress and anxiety disorders continue to affect millions of individuals globally. Existing healthcare systems often focus on reactive treatment rather than preventive and personalized wellness approaches. This research presents a comprehensive framework integrating Artificial Intelligence and Ayurvedic principles for stress and anxiety detection.



The proposed system combines questionnaire-based healthcare data, Ayurvedic dosha analysis, and machine learning algorithms to create an explainable and personalized mental healthcare model. By incorporating lifestyle, emotional, and behavioral indicators, the framework provides holistic wellness analysis and early detection capabilities.

Machine learning algorithms such as Random Forest, SVM, Decision Tree, Logistic Regression, and XGBoost can effectively classify stress levels and improve prediction accuracy. Additionally, Ayurvedic recommendations enhance preventive healthcare and promote mental well-being.

The study demonstrates that AI and Ayurveda together can contribute significantly to modern healthcare innovation by developing scalable, accessible, and personalized mental wellness systems.

References

1. World Health Organization. Mental Health and Stress Management Reports.
2. Bishop, C. M. Pattern Recognition and Machine Learning. Springer.
3. Russell, S., & Norvig, P. Artificial Intelligence: A Modern Approach.
4. Sharma, P. V. Ayurveda and Holistic Healthcare Systems.
5. Goodfellow, I., Bengio, Y., & Courville, A. Deep Learning.
6. Jain, S., et al. Machine Learning Applications in Mental Healthcare.
7. Patwardhan, B. Bridging Ayurveda with Modern Medicine.
8. Kumar, R., et al. AI-Based Predictive Healthcare Systems.
9. Sarker, I. H. Machine Learning in Healthcare Applications.
10. Gupta, A., et al. Explainable AI in Healthcare Diagnostics.
11. Rao, M. Ayurveda for Stress and Anxiety Management.
12. Aggarwal, C. C. Neural Networks and Deep Learning.
13. IEEE Healthcare AI Research Publications.
14. Journal of Medical Systems – AI in Mental Health.
15. International Journal of Ayurvedic Medicine.