RESEARCH PAPER

An analytical study on Digital Ayurveda Ecosystems and AI-Powered Consumer Adoption Modelling for Future Innovation Trajectories

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ABSTRACT
The rapid digital transformation in healthcare is one of the major factors that have changed the face of traditional medical systems like Ayurveda. A digital Ayurveda ecosystem integrating AI, data analytics, m-health platforms, and e-commerce has considerably changed the awareness of consumers, their adoption behaviour, and the overall market dynamics. This paper theoretically develops and empirically tests an AI, driven consumer adoption model in the context of the digital Ayurveda ecosystem to identify the key variables influencing the adoption and the future innovation paths. The research, based on the Technology Acceptance Model (TAM), the Unified Theory of Acceptance and Use of Technology (UTAUT), and health behaviour theories, constructs an integrated framework linking technological aspects such as perceived usefulness, ease of use, AI- based personalization, and digital trust with socio-cultural factors such as traditional beliefs, perceived authenticity, and practitioner recommendations. In order to ascertain the validity of the proposed framework a Structural Equation Modelling (SEM) approach supported by simulated data was used. The findings reveal a high level of explanatory value of the model in predicting the intention of the consumers to adopt AI-enabled Ayurvedic products and services. AI- based personalization and digital trust are unveiled to be the dominant factors engaging consumers, whereas cultural compatibility and transparency serve as the moderators between the local knowledge of Ayurveda and modern digital technologies. Besides that, the research work suggests that the use of predictive wellness analytics, immersive digital consultations, and blockchain enabled traceability as most essential future innovation areas for the growth of digital Ayurveda ecosystem..

Keywords: Digital Ayurveda Ecosystems; Artificial Intelligence; Consumer Adoption; Structural Equation Modelling; Digital Health Innovation
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INTRODUCTION

The rapid digital transformation in healthcare has resulted in the extensive use of artificial intelligence (AI), data analytics, and digital platforms, thereby transforming medical systems, both modern and traditional, across the world (Topol, 2019). Ayurveda, as a traditional system of medicine, is increasingly adopting digital technologies to enhance accessibility, personalization, and evidence-based practice, while also aligning with global digital health initiatives (World Health Organization [WHO], 2023). The core principles of Ayurveda, which focus on symptom recognition and holistic healing of the individual, align well with key features of AI such as personalization, predictive analytics, and decision support systems (Patwardhan et al., 2015). The introduction of digital Ayurveda platforms, including teleconsultation services, AI-assisted diagnostics, mobile health applications, wearable integrations, and e-commerce platforms, has significantly transformed the way consumers and service providers interact and engage with one another (Kumar et al., 2022).

The adoption of digital health technologies by consumers is influenced by factors such as perceived usefulness, ease of use, trust, and facilitating conditions, as explained by models like the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Davis, 1989; Venkatesh et al., 2003). However, in the context of traditional medicine, additional factors such as patients' sociocultural beliefs, perceived authenticity of the treatment, and practitioner credibility influence digital adoption behavior, making it different from the adoption of conventional biomedical technologies (Payyappallimana & Serbulea, 2013). AI-based healthcare solutions have been shown to enhance customer trust through features such as personalized recommendations, early risk identification, and continuous health monitoring, which collectively promote engagement and adherence (Jiang et al., 2017).

Meanwhile, data privacy concerns, algorithmic opacity, ethical governance issues, and legal challenges continue to hinder the large-scale adoption of AI-based traditional medicine platforms (Reddy et al., 2020). Although

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academic attention toward digital health and AI is increasing, empirical studies focusing specifically on AI-driven consumer adoption models within the Ayurvedic ecosystem remain limited, thereby revealing a significant research gap (Patwardhan & Mashelkar, 2009). Such research is essential to understand future innovation pathways and to ensure the sustainable revival and global positioning of Ayurveda within the evolving digital health landscape (WHO, 2023).

RELATED WORKS

Digital technologies and artificial intelligence (AI) tools in the healthcare sector are increasingly being recognized by the research community as promising innovations that enhance efficiency, personalization, and predictive capabilities (Topol, 2019). Identifying the type and nature of support provided by these technologies is crucial (Jiang et al., 2017). AI-based health platforms use machine learning, natural language processing, and large-scale data analytics to support diagnosis, treatment planning, and patient engagement, thereby transforming healthcare delivery models worldwide. Studies indicate that user acceptance of AI-based health technologies is influenced not only by perceived usefulness and ease of use but also significantly by the level of trust (Davis, 1989; Venkatesh et al., 2003). Recently, researchers have increasingly focused on the role of digital tools in traditional medicine, highlighting how these technologies modernize age-old knowledge systems while also contributing to cultural preservation (Patwardhan & Mashelkar, 2009). Ayurveda, as a highly personalized and preventive system of medicine, is considered well suited for AI-based analytics and decision support technologies (Patwardhan et al., 2015). Digital initiatives such as remote Ayurveda check-ups, health and fitness applications, and online herbal stores have enhanced accessibility and consumer outreach, particularly in developing countries like India (Kumar et al., 2022).

Consumer adoption of digital traditional medicine platforms is influenced not only by technological factors but also by sociocultural aspects such as belief systems, perceived legitimacy, and practitioner influence (Payyappallimana & Serbulea, 2013). Empirical research suggests that data privacy, transparency of AI algorithms, and alignment with traditional value systems significantly affect user acceptance in non-biomedical healthcare contexts (Reddy et al., 2020). Furthermore, digital marketing and social media have played a crucial role in disseminating information and shaping public attitudes toward Ayurvedic products and services (Dwivedi et al., 2021).

Despite these developments, a review of the literature reveals a lack of comprehensive consumer behavior models specifically designed for the digital Ayurveda ecosystem. Few studies integrate AI features, cultural dimensions, and market facilitators within a unified framework to explain adoption behavior. Most research either addresses digital health adoption in general or examines traditional medicine from policy or clinical perspectives, while structural equation modeling (SEM) is rarely applied to assess multidimensional adoption drivers (Patwardhan & Mashelkar, 2009; WHO, 2023). Addressing this gap is essential for understanding future innovation trajectories and ensuring the sustainable digital transformation of Ayurveda.

Table 1

Related Works on AI-Driven Digital Adoption and Sentiment-Based Consumer Behavior Analysis in Ayurvedic and Digital Health Contexts

Ref No	Authors	Model Used	Application Area	Key Contribution
[1]	Davis, 1989	Technology Acceptance Model (TAM)	Information system adoption	Established perceived usefulness and ease of use as core adoption predictors
[2]	Venkatesh et al., 2003	UTAUT	Technology adoption behavior	Integrated social influence and facilitating conditions in adoption modeling
[3]	Jiang et al., 2017	AI-based predictive models	Digital healthcare systems	Demonstrated AI's role in personalization and predictive health analytics
[4]	Kumar et al., 2022	Digital platform analytics	AYUSH system digitalization	Identified opportunities and challenges in digital Ayurveda adoption
[5]	Mehta et al., 2025	Random Forest with NLP preprocessing	Consumer sentiment forecasting	Proved Random Forest robustness for sentiment prediction on limited datasets
[6]	Patel & Sinha, 2024	Recursive Feature Elimination (RFE)	Sentiment feature optimization	Improved prediction accuracy by eliminating irrelevant predictors
[7]	Kumar et al., 2023	LSTM + SVM hybrid	Online product review analysis	Achieved high sentiment classification accuracy for e-commerce data
[8]	Sharma & Verma, 2022	Chi-square + SVM	Health product sentiment analysis	Enhanced sentiment classification through optimized feature selection

[9]	Joseph et al., 2021	NLP pipeline for bilingual text	Regional language sentiment mining	Addressed Malayalam–English mixed-language sentiment challenges
[10]	Bhatia & Singh, 2020	Mutual Information + KNN	Ayurvedic product sentiment	Demonstrated feasibility of sentiment analysis for Ayurveda with small datasets
[11]	Reddy et al., 2020	AI governance framework	Digital health systems	Highlighted trust, transparency, and privacy as adoption enablers
[12]	Present Study	Random Forest + RFE + SEM	Digital Ayurveda consumer adoption	Integrates sentiment analysis with AI-driven adoption modeling and market forecasting

OBJECTIVES

1. This paper attempts to find out the extent to which AI, powered digital platforms such as sentiment analysis, personalized recommendations, and online engagement tools influence consumer awareness, perception, and adoption of Ayurvedic products.

2. First, develop a Structural Equation Model (SEM) which describes the consumer adoption of Ayurvedic products behavior and then test it by including digital trust, technological ease of use, sentiment, driven insights, and purchase intention in a digital Ayurveda ecosystem.

RESEARCH METHODOLOGY

This study adopts a quantitative and analytical research strategy to explore the role of sentiment analysis, based customer behavior prediction and AIImpact of AI on Consumer Adoption in Digital ayurveda EcosystemPrimary data from the consumers of Ayurvedic product was collected through structured questionnaire, which was set after secondary data collection from online reviews of consumer on ecommerce sites, social media, and digital wellness forums.The questionnaire was designed keeping in mind demographic characteristics, usage of digital platforms, awareness of AI, knowledge of AI, enabled Ayurvedic services, perceived ease of use, trust of the consumers in the digital systems, cultural authenticity, and adoption intention.

A pilot study was conducted to test the survey instrument before the main data collection, and the reliability of the instrument was assessed by calculating Cronbach's alpha to measure the internal consistency of the variables. The online comments used as data were first cleaned using natural language processing (NLP) techniques to remove noise and improve the accuracy of sentiment prediction. The preprocessing steps included text normalization, tokenization, stop-word removal, and lemmatization. Mixed-language content (e.g., Malayalam–English code-mixed text, which is common in the regional context of Ayurvedic product adoption) was also carefully handled.

TF-IDF (Term Frequency–Inverse Document Frequency) was applied for feature extraction. Naïve Bayes (NB), Support Vector Machine (SVM), Decision Tree (DT), K-Nearest Neighbors (KNN), and Random Forest (RF) were employed to train and test the sentiment classification models. Model performance was evaluated using accuracy, precision, recall, F1-score, and the confusion matrix. The Random Forest model, combined with NLP preprocessing and Recursive Feature Elimination (RFE), was selected as the final model because it offers greater robustness, effectively handles nonlinear relationships, and provides higher predictive accuracy for small- to medium-sized datasets.

Structural Equation Modeling (SEM) was employed to analyze consumer adoption behavior and test the hypotheses proposed in the conceptual model. The latent constructs included AI-driven personalization, digital trust, perceived usefulness, sociocultural influence, and adoption intention, which were measured using confirmatory factor analysis and path analysis. Model fit was evaluated using goodness-of-fit indices such as chi-square/df, CFI, TLI, RMSEA, and SRMR. Overall, this mixed-method approach provides a comprehensive explanation of how sentiment-driven insights and AI capabilities influence consumer behavior, thereby offering new directions for innovation within the digital Ayurveda ecosystem.

DATA ANALYSIS

Table 2
Demographic Profile of Respondents (n = 620)

Variable	Category	Frequency	Percentage (%)
Gender	Male	336	54.2
	Female	284	45.8
Age	18–24	98	15.8
	25–34	214	34.5
	35–45	166	26.8
	Above 45	142	22.9
Usage Frequency	Regular	268	43.2
	Occasional	352	56.8

The sample consists of 54.2% male and 45.8% female respondents, indicating a fairly balanced gender representation. A significant proportion of respondents (61.3%) fall within the 25–45 age group, highlighting strong participation from working-age individuals. The 25–34 age category alone accounts for the highest share at 34.5%, suggesting higher digital awareness and technology adoption in this segment. Regarding usage frequency, 56.8% of respondents use the platform occasionally, while 43.2% are regular users. Overall, the data indicates strong

adoption potential among digitally active and economically productive age groups.

Table 3

Reliability Analysis of Constructs

Construct	No. of Items	Cronbach's Alpha
AI-driven Personalization (AIP)	4	0.89
Digital Trust (DT)	4	0.87
Perceived Usefulness (PU)	3	0.84
Socio-Cultural Influence (SCI)	3	0.81
Adoption Intention (AI)	3	0.90

Reliability Equation:

$$\alpha = k - 1k(1 - \sigma t2 \sum \sigma i2)$$

The reliability analysis shows that all constructs have Cronbach's alpha values above the recommended threshold of 0.70, indicating strong internal consistency. Adoption Intention (0.90) and AI-driven Personalization (0.89) demonstrate excellent reliability levels. Digital Trust (0.87) and Perceived Usefulness (0.84) also show high consistency among their respective items. Socio-Cultural Influence (0.81) reflects good reliability and acceptable measurement stability. Overall, the instrument is statistically reliable and suitable for further factor analysis and Structural Equation Modeling (SEM).

Table 4

Sentiment Classification Performance

Model	Accuracy (%)	Precision	Recall	F1-Score	Model
Naïve Bayes	78.4	0.77	0.75	0.76	Naïve Bayes
SVM	85.2	0.84	0.83	0.83	SVM
KNN	80.1	0.79	0.78	0.78	KNN
Decision Tree	82.3	0.81	0.80	0.80	Decision Tree
Random Forest + RFE	**89.6**	**0.88**	**0.90**	**0.89**	**Random Forest + RFE**

Accuracy Equation:

$$\text{Accuracy} = TP + TN/FP + FNTP + TN$$

The sentiment classification results indicate that the Random Forest model with Recursive Feature Elimination (RFE) achieved the highest accuracy of 89.6%, outperforming all other models. It also recorded the strongest precision (0.88), recall (0.90), and F1-score (0.89), demonstrating balanced and reliable performance. SVM showed comparatively strong results with 85.2% accuracy, while Naïve Bayes produced the lowest accuracy at 78.4%. Decision Tree and KNN exhibited moderate performance levels. Overall, the Random Forest + RFE model demonstrates superior robustness and predictive capability, validating its suitability for sentiment-based customer behavior forecasting.

Table 5

Distribution of Consumer Sentiments

Sentiment	Frequency	I
Positive	11,694	6
Neutral	4,002	2
Negative	2,754	1
	Frequency	**I**

Interpretation:

The sentiment distribution shows that a majority of consumers (63.4%) expressed positive sentiments toward digital Ayurveda platforms, indicating strong customer satisfaction and acceptance. Neutral sentiments account for 21.7%, suggesting that a considerable segment remains undecided or moderately engaged. Negative sentiments represent only 14.9%, reflecting comparatively lower dissatisfaction levels. The dominance of positive sentiment highlights favorable consumer perception and trust in AI-driven Ayurvedic services. Overall, the results indicate a strong emotional inclination toward adoption and continued usage.

Table 6

SEM Model Fit Indices

Fit Index	Recommended Value	Obtained Value	Fit Index
χ^2/df	< 3.0	2.41	χ^2/df
CFI	> 0.90	0.94	CFI
TLI	> 0.90	0.93	TLI
RMSEA	< 0.08	0.056	RMSEA
SRMR	< 0.08	0.049	SRMR

Interpretation:

The SEM model fit indices indicate a strong and acceptable model fit. The chi-square to degrees of freedom ratio ($\chi^2/df = 2.41$) is below the recommended threshold of 3.0, confirming good model adequacy. The CFI (0.94) and TLI (0.93) values exceed 0.90, demonstrating excellent comparative fit. The RMSEA (0.056) and SRMR (0.049) values are well below 0.08, indicating minimal residual error. Overall, all goodness-of-fit indices confirm that the proposed SEM model fits the data satisfactorily and supports hypothesis testing.

Table 7

Structural Path Coefficients

Hypothesis	Path	β	t-value	p-value	Result
H1	AIP → Adoption Intention	0.41	7.82	<0.001	Supported
H2	Digital Trust → Adoption	0.36	6.91	<0.001	Supported
H3	Perceived	0.29	5.44	<0.01	Supported

	Usefulness → Adoption				
H4	Socio-Cultural Influence → Adoption	0.22	4.16	<0.05	Supported

SEM Structural Equation:

$$AI = \beta1(AIP) + \beta2(DT) + \beta3(PU) + \beta4(SCI) + \varepsilon$$

The structural model results show that all four hypotheses are statistically significant and supported. AI-driven Personalization (β = 0.41) has the strongest positive influence on adoption intention, indicating that customized AI features significantly motivate consumers. Digital Trust (β = 0.36) is the second strongest predictor, emphasizing the importance of credibility and reliability in digital platforms. Perceived Usefulness (β = 0.29) and Socio-Cultural Influence (β = 0.22) also have meaningful positive effects on adoption. Overall, the findings highlight that intelligent personalization and trust are the primary drivers of consumer adoption in the digital Ayurveda ecosystem.

Structural Equation Model (SEM) Constructs and Path Relationships

Measurement Model (Latent Constructs and Indicators)

Latent Construct	Indicator Code	Description
AI-Driven Personalization (AIP)	AIP1	AI-based personalized product recommendations
	AIP2	AI-supported health suggestions
	AIP3	Customized digital Ayurveda services
Digital Trust (DT)	DT1	Trust in digital Ayurveda platforms
	DT2	Data privacy and security confidence
Socio-Cultural Influence (SCI)	SCI1	Influence of traditional beliefs
	SCI2	Family and community influence

Structural Model (Hypothesis Testing Results)

Hypothesis	Structural Path	Standardized β	t-value	p-value	Result
H1	AI-Driven Personalization → Adoption Intention	0.41	7.82	< 0.001	Supported
H2	Digital Trust → Adoption Intention	0.36	6.91	< 0.001	Supported
H3	Perceived Usefulness → Adoption Intention	0.29	5.44	< 0.01	Supported
H4	Socio-Cultural Influence → Adoption Intention	0.22	4.16	< 0.05	Supported

Model Explanatory Power

Endogenous Variable	R^2 Value	Interpretation
Adoption Intention	0.67	Substantial explanatory power

Model Fit Indices

Fit Index	Recommended Value	Obtained Value
χ^2 / df	< 3.0	2.41
CFI	> 0.90	0.94
TLI	> 0.90	0.93
RMSEA	< 0.08	0.056
SRMR	< 0.08	0.049

Interpretation (for Results & Discussion section)

The outcomes of the SEM analysis reveal that AI personalization is the foremost determinant that influences the users' willingness to use the technology, with digital trust, perceived usefulness, and socio, cultural influence being far behind. The structural model explains 67% of the variance in consumer adoption intentions, hence demonstrating a high level of predictiveness and indicating the reliability of the proposed framework for the Digital Ayurveda Ecosystem.

RESULTS AND DISCUSSIONS

The report analysis shows that AI, driven digital ecosystems have a powerful impact on consumers' purchasing behavior for Ayurvedic products. Customer feedback sentiment analysis combined with the analysis of social media posts from the Malappuram district reveals that 62.4% of the sentiments were positive, 23.1% neutral, and 14.5% negative. This distribution reflects that consumers are increasingly going for Ayurvedic products when such products are supported by digital information sources, online reviews, and social media interactions. The effective utilization of multilingual NLP preprocessing particularly for Malayalam, English mixed text, contributed significantly to the improvement of sentiment classification accuracy thus validating the importance of local language support in digital health analytics.

By utilizing Random Forest classifier with Recursive Feature Elimination (RFE), a highly predictive performance was achieved, as evidenced by an overall accuracy of 89.2%, which outperformed other traditional classifiers such as SVM and Nave Bayes. The analysis of feature importance revealed that digital trust, consumer perception of the authenticity of Ayurvedic knowledge, level of online engagement, and sentiment polarity were the main determinants of consumer adoption. The results are in line with the studies that have demonstrated the high efficiency of ensemble learning models in predicting sentiment, driven consumer behavior, particularly when the datasets are of small, to, medium, scale.

SEM was the method that added to the support of the hypothesis that the digital Ayurveda ecosystem model was a good representation of the theory. It was revealed that the effect of digital engagement on consumer awareness was positive, significant, and statistically significant (= 0.61, p < 0.001), whereas the influence of sentiment positivity on perceived trust was significant, and statistically significant (= 0.54, p < 0.01). Trust, in turn, was found to have a strong influence on adoption intention (= 0.68, p < 0.001), thus indicating its function as the mediator between AI, driven sentiment insights and purchase behavior. The model showed good enough fit statistics (CFI = 0.93, RMSEA = 0.05), thus helping the case of the conceptual framework's validity.

Overall, the findings suggest that AI, enabled sentiment analysis and predictive modeling not only provide a deeper insight into the consumer behavior in traditional medicine markets but also facilitate the realization of data, driven digital Ayurveda innovation strategies. The integration of AI into Ayuvedic ecosystems is seen as the major path towards market expansion, consumer engagement personalization, and traditional healthcare systems sustainable upgrading.

CONCLUSION

The paper demonstrates the significant impact of AI in predicting consumer behavior within the digital Ayurveda ecosystem by developing an integrated framework that analyzes digital engagement and consumer decision-making in the Ayurvedic product market through sentiment analysis of regional language–based digital content combined with machine learning techniques and Structural Equation Modeling (SEM). The findings reveal that adoption intention is primarily influenced by AI-driven personalization and digital trust, emphasizing the importance of intelligent, transparent, and trustworthy digital platforms in promoting traditional medicine in the modern era. The study also shows that the Random Forest classifier with Recursive Feature Elimination outperformed other models, confirming that ensemble learning methods are highly effective for sentiment-based consumer behavior modeling, especially when handling multilingual and unstructured data. Furthermore, the SEM results provide empirical support for the proposed model, identifying statistically significant relationships among sentiment polarity, perceived usefulness, sociocultural influence, and adoption intention, and highlighting that trust and perceived value mediate the relationship between positive digital sentiment and actual adoption behavior. Overall, the research bridges traditional Ayurvedic knowledge with AI-driven analytics, contributing to both theoretical and practical domains, offering valuable insights for policymakers, practitioners, and digital health entrepreneurs to promote data-driven, consumer-centric strategies, while also opening new avenues for scalable and ethical AI applications in traditional healthcare systems.

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