MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 2, 2026, Pages 2292-2295

REQUIREMENTS ENGINEERING FRAMEWORK WITH CONTEXTUALIZATION FOR INTELLIGENT AYURVEDA APPLICATIONS

Dr. Rasika Mallya
Associate Professor, MCA, DES's NMITD, Mumbai, India.
Email: rasika.mallya@despune.org

Abstract:
Ayurveda, an ancient Indian system of medicine, emphasizes personalized healthcare based on individual constitution and environmental factors. Traditional diagnostic methods primarily depend on contextual factors such as Prakriti, Dosha imbalance, lifestyle patterns, and seasonal changes. However, the integration of Ayurveda with modern intelligent systems remains limited. This paper proposes a **context-aware Requirements Engineering (RE) framework** for Ayurveda Intelligence Applications. The framework incorporates IoT-enabled context acquisition, context modelling, context processing and reasoning, decision making and adptation to deliver personalized healthcare recommendations. The proposed approach bridges traditional Ayurvedic knowledge with modern computational techniques, enabling scalable, adaptive, and context-aware healthcare systems.
Keywords: Adaptive Requirements Engineering, Ayurveda Intelligence, Context Management Lifecycle, Context-Aware Healthcare Systems, IoMT.

1. Introduction

Ayurveda, one of the world's oldest systems of medicine with roots in India dating back thousands of years, adopts a holistic approach that integrates the mind, body, and spirit in the healing process. As a holistic system of medicine that originated in ancient India, Ayurveda emphasizes the classical methods of diagnosis and treatment, namely *Roga Pariksha* (disease examination) and *Rogi Pariksha* (patient examination), which include *Nadi Pariksha* (pulse diagnosis). At its core, Ayurveda focuses on personalized, holistic healthcare tailored to an individual's unique constitution (*Prakriti*) and imbalances in the *Doshas*.

Traditional Ayurvedic practice places strong emphasis on the practitioner's direct observations, clinical expertise, and experiential knowledge in diagnosing and treating patients. Despite their value, these methods face challenges related to standardization and effective integration with modern diagnostic approaches.

The use of Artificial Intelligence (AI) in Ayurvedic diagnosis presents a promising way to overcome these challenges, combining data-driven insights with greater accuracy to deliver more personalized and effective healthcare.

The integration of AI techniques into Ayurveda has the potential to streamline and optimize various processes, leading to more accurate, personalized and effective treatments as well as prevention from diseases. Moreover, the incorporation of AI into Ayurveda is reshaping the way doctors diagnose, treat, and manage a wide range of health conditions. Evidence-based research using AI techniques can correlate herbs and health conditions, prediction of treatment efficacy, refining clinical trials enhancing the applicability of Ayurveda in modern healthcare [1] [2] [3] . Following are some of applications where AI is integrated in Ayurveda treatment:

1. **Ayurgenomics - Personalized Healthcare:** Ayurgenomics is an evidence-based technique which is preventive healthcare technique for personalized medicine based on traditional Ayurveda, modern genomics and molecular biology technique. This concept is applied based on unique constitution of a human being named *Prakriti.* Ayurgenomics provide a **personalized treatment plan** by combining genetic markers with Ayurvedic profiles to predict **disease risks, drug responses, and lifestyle compatibility** more accurately. [4]
2. **Diagnosis and Prognosis:** Ayurvedic diagnosis relies on assessing Doshas (Vata, Pitta, Kapha), Prakriti (constitution), and clinical examinations such as pulse (Nadi Pariksha), tongue (Jihva Pariksha), and eye (Netra Pariksha) analysis, along with patient history. AI can enhance this process by analyzing large volumes of historical data using machine learning and deep learning techniques. AI systems can identify subtle patterns in pulse diagnosis, monitor Dosha imbalances, assess Vikriti, and support disease prognosis, enabling timely and personalized interventions. [4]
3. **Preventive Care and Wellness Tracking:** AI can strengthen Ayurveda's preventive approach by continuously monitoring lifestyle patterns, environmental factors, and genetic predispositions through wearable and home-based health monitoring systems. By analyzing real-time health data and integrating it with Ayurvedic principles, AI can provide personalized recommendations on diet, exercise, stress management, Ayurvedic remedies, and lifestyle modifications, promoting well-being and reducing the risk of chronic diseases.
4. **Digital Consultation and Health Literacy:** AI-powered chatbots and virtual assistants can support both practitioners and patients by providing reliable information, addressing queries, and offering guidance on Ayurvedic practices. AI-powered platforms can provide initial consultations, answer patient queries and offer preliminary health advice based on Ayurvedic principles in remote and underserved areas. [4]

Intelligent Ayurveda Applications refer to the integration of traditional Ayurvedic knowledge with modern technologies like Artificial Intelligence (AI), Internet of Things (IoT), data analytics, and context-aware computing to enhance diagnosis, treatment, and preventive healthcare. Unlike conventional systems, Ayurveda diagnosis is highly context-dependent, making it suitable for integration with **context-aware computing and artificial intelligence**. However, there is a lack of structured frameworks that incorporate Ayurveda principles into modern software engineering practices.

This paper proposes a Requirements Engineering framework with contextualization to design Ayurveda-based intelligent applications. The LR focuses on concept of Internet of Medical Things(IoMT), Context Aware Healthcare System and necessity ofAdaptive Requirements Engineering Framework. Section III proposes Requirements Engineering framework with contextualization for Ayurveda Intelligent application. Section IV explores how Agentic AI can be used to implement proposed framework and section V concludes the research study.

2. Literature Review

2.1 Internet of Medical Things (IoMT): The **Internet of Medical Things (IoMT)** is an advanced extension of IoT specifically designed for healthcare. It refers to a connected ecosystem of **medical devices, applications, and healthcare systems** that communicate with each other over the internet to improve patient care, monitoring, and operational efficiency. IoMT is a network of **interconnected medical devices and software applications** that collect, analyze, and transmit health data in real time to healthcare providers. IoMT applications assure sustainable advancement in smart healthcare.

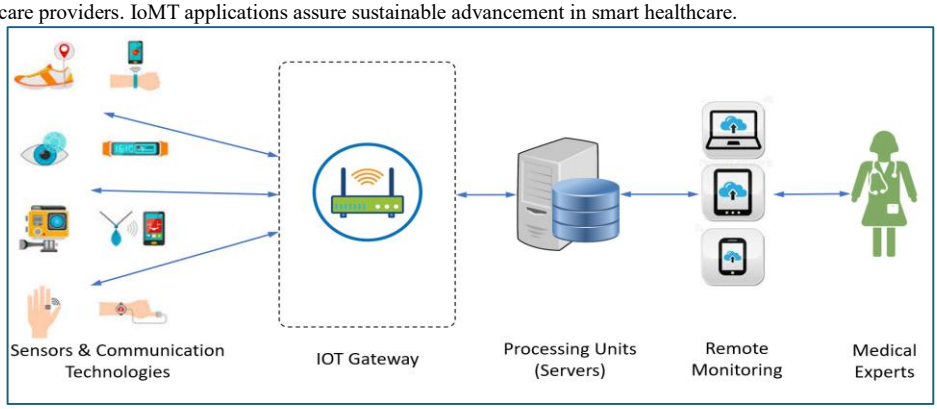

Figure 1: Architecture of IoMT System

As shown in figure1, Data acquisition occurs through sensors/wearables of the system. After preprocessing of data, data is sent to cloud storage through communication gateways. At cloud, data is used for further analysis and specific indicators are generated for the patient's health.

2.2 Context Aware Healthcare System: A **Context-Aware Healthcare System** is an intelligent healthcare framework that not only collects patient data but also **understands the situation (context)** in which the data is generated, and adapts its behavior accordingly to provide **personalized and timely healthcare services**. Context aware healthcare system is based on the concept on context aware computing where systems can sense, interpret, and respond to dynamic contextual information such as Patient condition, Location, Time, Activity and Environment.

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 2, 2026, Pages 2292-2295

Context-Aware Computing is a paradigm in which computer systems can **sense, interpret, and respond to their environment and user situation automatically**, enabling intelligent and adaptive behavior. Context is any information that characterizes the situation of an entity (user, device, or environment). There are following types of contexts: [6]

1. User Context – covers preferences, health status, behavior
2. Location Context – GPS, indoor positioning
3. Temporal Context – time, date, schedule
4. Activity Context – walking, sleeping, working
5. Environmental Context – temperature, noise, light

The context management lifecycle plays a critical role in context-aware healthcare systems by enabling intelligent, adaptive, and patient-centric services through the integration of sensors and wearable devices. This lifecycle comprises four fundamental stages: context acquisition, context modeling, context reasoning, and context dissemination. As shown in figure 2, context acquisition involves the continuous collection of healthcare data from context sources such as physiological sensors, wearable devices, and environmental sensors, capturing parameters like location, activity, and vital signs. The acquired data is then transformed into structured representations during the context modeling phase using ontologies and models to ensure efficient data management . In the context reasoning stage, advanced techniques such as rule-based systems, machine learning, and context-aware inference mechanisms are applied to derive meaningful insights, detect anomalies, and predict potential health risks. Context interpretation identifies health conditions, risks and anomalies. Decision making and adaptation will generate personalized recommendations, alerts and implement automated actions. Recent studies highlight that IoT-enabled context-aware healthcare architectures significantly enhance real-time monitoring and automated decision support, particularly in chronic disease management and clinical environments . Furthermore, the integration of cognitive and context-aware decision-making systems has been shown to improve adaptability, accuracy, and scalability of healthcare solutions, while addressing challenges such as data heterogeneity and system interoperability . Additionally, research on wearable sensor-based context fusion demonstrates the effectiveness of continuous, real-time monitoring in improving patient outcomes and enabling proactive healthcare interventions . These advancements collectively reinforce the importance of the context lifecycle in ensuring accurate, real-time, and contextually relevant information, thereby facilitating automated monitoring of chronic conditions and enhancing clinical decision-making processes.

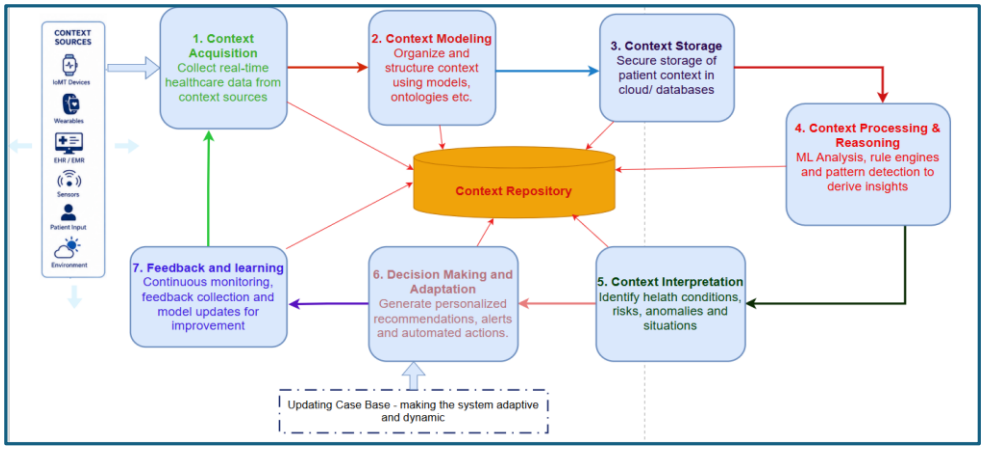

Figure 2: Context Aware Healthcare System

2.3 Need for Adaptive Requirements Engineering Framework:

Adaptive Requirements Engineering (Adaptive RE) extends conventional RE by enabling systems to modify requirements dynamically according to environmental and contextual changes. Adaptive RE supports runtime monitoring, reasoning, and evolution of requirements.

Research on self-adaptive systems has significantly contributed to adaptive RE concepts. Self-adaptive systems are designed to autonomously modify their behavior in response to environmental changes while maintaining system goals and quality attributes. [7]

According to studies in [8] and [9], adaptive RE is necessary in healthcare systems because of:

- Runtime uncertainty
- Dynamic patient conditions
- Continuous stakeholder involvement
- Real-time monitoring requirements
- Context-sensitive decision-making

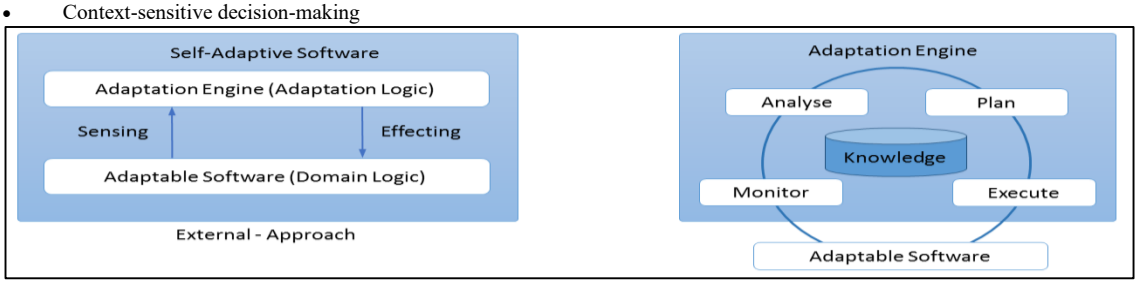

Figure 3. Self-adaptive software with Adaptation Engine

Self-adaptive software dynamically adapts its behavior or architecture at run-time and possesses capabilities such as self-healing, self-protection, self-optimization, and self-configuration to achieve higher-level goals. [11][12]. Such self adaptive systems can be used for ubiquitous, user centric intelligent applications. To handle changes in requirements or the environment, the system analysis phase is carried out continuously and in parallel, enabling ongoing adaptation. If the adaptation plans are implemented at runtime by the system, then it is dynamic adaptation. As shown in figure 3, The architecture of self-adaptive software consists of two main components: the adaptation engine, which executes the MAPE-K cycle to manage adaptation logic, and the adaptable software, which encapsulates domain knowledge and handles the functional aspects of the software system. [13].

Self-adaptive systems identified context-awareness as a core property of adaptive systems that enables systems to sustain operational goals despite environmental changes. [9] To make e-healthcare system context aware, context information can be gathered from

- Wearable sensors
- Mobile devices
- Electronic health records
- Environmental sensors
- User interactions

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 2, 2026, Pages 2292-2295

Goal-Oriented Requirements Engineering (GORE) and Model-Based Requirements Engineering (MBRE) are the requirements engineering framework suitable for adaptive systems but they have limitations for context aware healthcare system due to limited runtime adaptation support, inadequate context integration and weak uncertainty management.

Thus, there is a strong need for an Adaptive Requirements Engineering Framework specifically designed for context-aware healthcare systems. Such a framework should:

- Dynamically capture changing healthcare contexts
- Support runtime requirement evolution
- Manage uncertainty and variability

3. Proposed Framework Overview

The proposed framework integrates Requirements Engineering with a **context lifecycle approach** to support Ayurveda Intelligence Applications. The requirements engineering framework with **context lifecycle approach can consists of following components:**

1. Context Acquisition Layer
2. Context Repository
3. Context Modeling Engine
4. Reasoning Engine
5. Adaptation Manager
6. Requirement Management Module

Figure 4 describes Context Lifecycle Components with Requirements Engineering activities.

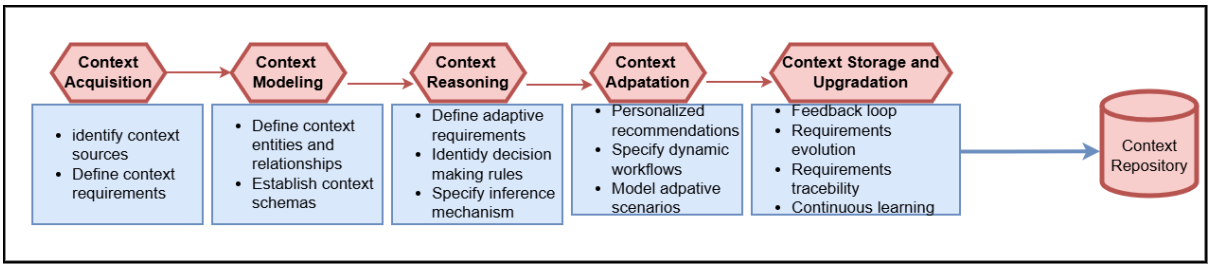

Figure 4: Context Lifecycle Components with Requirements Engineering activities

As shown in figure 4, Context Acquisition component collects contextual information from various sources such Ayurveda practitioners (Vaidyas), Patients and end users, Healthcare institutions, Wearable/IoT devices and Classical Ayurvedic literature etc. This contextual information defines context requirements. Requirements are gathered from multiple stakeholders:Context plays a critical role in Ayurveda-based decision-making. The **Context Modeling** component represents and structures context information using techniques such as Ontology-based modelling, Key-value models, graph-based representation or Semantic models. This helps to define context entities and relationships, establish context schemas and specify constraints and dependencies. Following contexts are useful for Ayurveda Intelligent application:

- **User Context:** Prakriti, age, gender, medical history
- **Environmental Context:** Climate, season, location
- **Behavioral Context:** Diet, sleep, activity, stress
- **Physiological Context:** Sensor-based health data

The **Context Reasoning component** interprets and analyzes contextual data to derive meaningful insights using rule-based reasoning, machine learning, fuzzy logic or knowledge graphs. This helps to define adaptive requirements and identify decision-making rules. It transforms raw contextual data into meaningful knowledge and actionable healthcare recommendations. In Ayurveda-based intelligent systems, reasoning helps interpret patient conditions according to Ayurvedic principles such as *Prakriti*, *Dosha imbalance*, *Agni*, lifestyle, and environmental influences.

The **Context Adaptation component allows** Dynamic modification of system behavior according to context changes. It helps to define adaptation policies, specify dynamic workflows and model adaptive scenarios. In Ayurveda intelligent apps, adaptation policies are defined based on *Prakriti* (body constitution), *Vikriti* (current imbalance), Seasonal changes (*Ritucharya*), Daily routine (*Dinacharya*) and Age, diet, and environmental conditions. Thus, context adaptation plays a central role in building intelligent Ayurveda systems capable of delivering personalized, adaptive and real-time healthcare support.

The **Context Storage and Evolution** component stores historical context data and allows continuous updating of requirements. This allows Feedback incorporation, Continuous learning, requirement traceability and requirement evolution. In Ayurveda intelligent apps, he Context Storage and Evolution component performs the following functions:

- Stores historical and real-time context information
- Maintains user health profiles
- Tracks changes in Dosha patterns and health conditions
- Supports continuous learning and personalization
- Enables adaptive requirement evolution
- Improves prediction and recommendation accuracy

The **Context Repository** is a central component of the Context Management Lifecycle in Ayurveda Intelligence Applications. It serves as a structured storage and management system for contextual information collected from users, sensors, healthcare records, environmental sources, and Ayurveda knowledge bases. [14]

When the requirements engineering framework integrated with context management life cycle for designing Ayurveda Intelligent application, the goal model is described in figure 5.

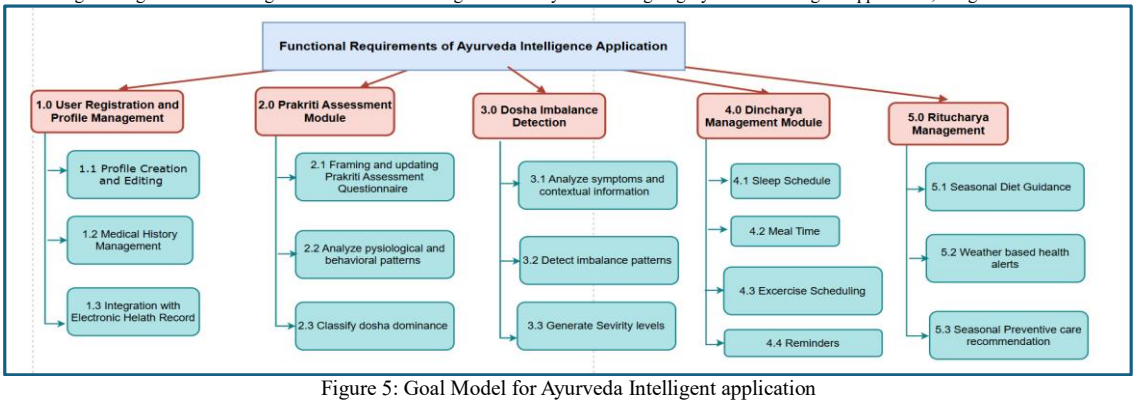

Figure 5: Goal Model for Ayurveda Intelligent application

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 2, 2026, Pages 2292-2295

Figure 5 described functional requirements in terms of goal model. These functional requirements can be mapped with actors, tasks and soft goals are described in figure 6.

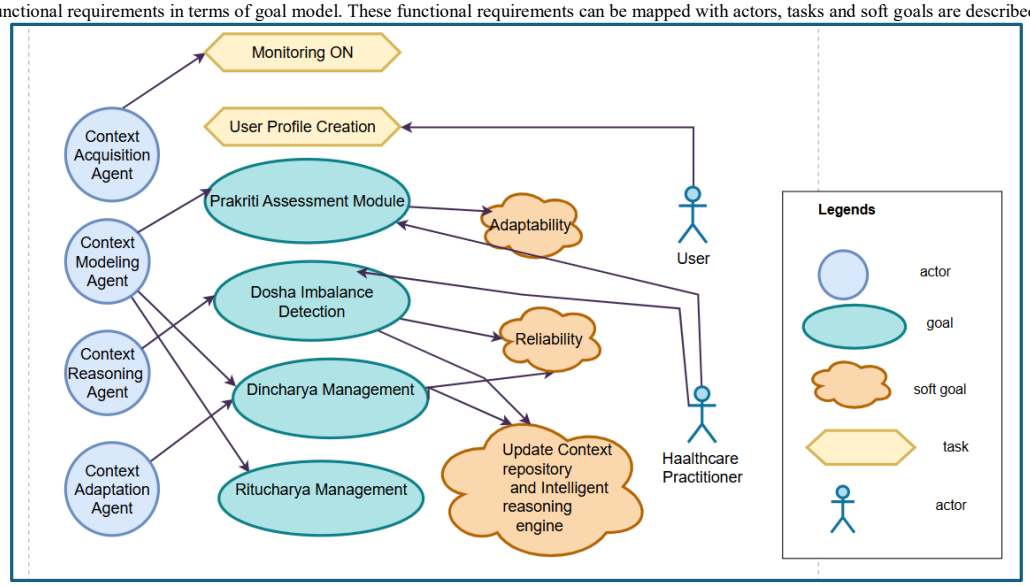

Figure 6: Actor Model for Ayurveda Intelligent application

Figure 6 represents the actor diagram for contextualized requirement engineering for Ayurveda Intelligence Application. The actor diagram consists of agents, tasks, hard goals and soft goals. As shown in diagram, there are hard goals are functional requirements which are clearly described and soft goals can be achieved at runtime. Reliability and adaptability are important soft goals for any intelligent application. Due to adaptable nature of software, the case base is updated dynamically based on new scenarios of Doshas or Prakritis. The actor diagram can be transformed into a class diagram and directly utilized for implementation and coding.

4. Implementation of Proposed Framework

Ayurveda Intelligence Applications require dynamic decision-making, personalization, contextual awareness, and adaptive healthcare recommendations. Traditional AI systems are often limited to static predictions and predefined workflows, making them less suitable for highly adaptive healthcare environments. To address these limitations, an Agentic AI Framework can be employed. Agentic AI systems comprise autonomous intelligent agents capable of perceiving contextual information, reasoning independently, making adaptive decisions, learning continuously, and collaborating with other agents.

Figure 5 illustrates the proposed multi-agent architecture for the system implementation. The framework can be developed using AI orchestration platforms such as CrewAI and AutoGen. Context modeling can be implemented using OWL-based ontologies, while contextual and healthcare data can be stored using databases such as MongoDB and Neo4j. Integration with wearable sensors and IoT devices can be achieved through MQTT and Node-RED. Secure and scalable cloud-based storage and processing services can be supported using Microsoft Azure and Google Cloud. [15][16]

5. Conclusion

This paper presents a **context-aware Requirements Engineering framework** for Ayurveda Intelligence Applications. By integrating contextual modeling, AI-based reasoning, and traditional Ayurvedic principles, the framework enables intelligent, adaptive, and personalized healthcare solutions. The paper describes goal model and actor model for proposed system. The proposed approach offers significant potential for advancing digital Ayurveda and smart healthcare systems. Overall, AI offers a transformative pathway for advancing personalized and preventive Ayurvedic medicine, fostering its global acceptance and integration with modern healthcare systems. The context can be defined in terms of ontologies for Ayurveda Intelligence applications and can be updated due proposed adaptive requirements engineering framework.

References

1. Avvinish Narine, Fatemeh Moazzamipeiro, Gopesh Mangal, Mehdi Moazzamipeiro, *"Transforming Ayurveda Research through the Synergy of AI Technology and Traditional Wisdom"*, Annals of Ayurvedic Medicine Vol-14 Issue-2 Apr.-Jun., 2025
2. Dr. Rachana Tiwari, Dr. Brijendra Kumar Godara, Dr. Sachin Kumar, Dr. Shri Ram Saini, Dr. Pankaj Rathore, "Scopes and Uses of Artificial Intelligence in the Field of Ayurveda: A Review Study", *Afr. J. Biomed. Res. Vol. 27(3s) (October 2024); 3597-3603, Research Article*
3. Parth Sorathiya, Dr. Remesh Chandran T. S., "Ayurveda and AI: Advancing Diagnostic Medical Devices", DOI: 10.5281/zenodo.16933189
4. Sanjay Gupta, Narasimha V, Vijaya Lakshmi A, *"ARTIFICIAL INTELLIGENCE (AI) IN AYURVEDA: ITS APPLICATION AND RELEVANCE"*, Ayushdhara, An International Journal of Research in AYUSH and Allied Systems, ISSN: 2393-9583 (P)/ 2393-9591 (O)
5. Peng Heabc, Dingying Huangabc, Dapeng Wuabc, Haiyang Heabc, Yinlai Weiabc, Yaping Cui,Ruyan Wangabc, Lei Pengd, "A survey of internet of medical things: technology, application and future directions", Digital Communications and Networks, S2352-8648(24)00159-7, DOI: https://doi.org/10.1016/j.dcan.2024.11.013 , Reference: DCAN 825
6. Mahalakshmi, V.; Karthikeyan, B. Edge Computing in Context Awareness: A Comprehensive Study. Eng. Proc. 2024, 62, 17. https://doi.org/10.3390/engproc2024062017 Academic Editors: Geetha Ganesan, Xiaochun Cheng and Valentina Emilia Balas
Published: 15 March 2024
7. Terence Wong a, Markus Wagner a, Christoph Treude, "Self-adaptive systems: A systematic literature review across categories and domains" , Elsevier-Information and Software Technology, Volume 148, August 2022, 106934
8. Rashid, T.A., Hassan, B.A., Alsadoon, A. et al. Awareness requirement and performance management for adaptive systems: a survey. J Supercomput 79, 9692–9714 (2023). https://doi.org/10.1007/s11227-022-05021-1
9. Terence Wong, Markus Wagner, Christoph Treude, "Self-adaptive systems: A systematic literature review across categories and domains", Information and Software Technology, Volume 148, 2022, 106934, ISSN 0950-5849, https://doi.org/10.1016/j.infsof.2022.106934 "
10. Zhongpei Zhao, Zhengshu Zhou, " A systematic literature review on model-based requirements engineering", Journal of Systems and Software, Volume 237, 2026, 112836, ISSN 0164-1212, https://doi.org/10.1016/j.jss.2026.112836.
11. Thomas Vogel, Holger Giese, "Model-Driven Engineering of Adaptation Engines for Self-Adaptive Software: Executable Runtime Megamodels", HPI. 2013.
12. Jeffrey O. Kephart, David M. Chess, The Vision of Autonomic Computing, 0018-9162/03/$17.00 © 2003 IEEE, 2003.
13. Gerald Tesauro, David M. Chess, William E. Walsh, Rajarshi Das, Alla Segal, Ian Whalley, Jeffrey O. Kephart and Steve R. White, "A Multi-Agent Systems Approach to Autonomic Computing".
14. Kirti Vijayvargia, Preeti Saxena, D. S. Bhilare, "Context Management Life Cycle for Internet of Things: Tools, Techniques, and Open Issues", ***Engineering, Technology & Applied Science Research Vol. 15, No. 1, 2025, 19449-19459*** **19449**
15. Prakash, C., Lind, M., & Sisodia, A. , "*Agentic AI Governance and Lifecycle Management in Healthcare.*"
16. Vatsal, S., Dubey, H., & Singh, A., "*Agentic AI in Healthcare & Medicine: A Seven-Dimensional Taxonomy for Empirical Evaluation of LLM-based Agents.*"