Ayush-Portal: A Digital Platform for AYUSH Medicinal Plant Education

Prof.Dr Rashmi. B. Kale[1], Manasi Patil[2], Manali Dubla[3], Tanishq Pardeshi[4], Ashumal Palde[5]
[1,2,3,4,5]*Department of Computer Engineering, Vishwakarma Institute of Technology*, Pune, India

***Abstract*—The Ayush-Portal serves as a modern online tool designed to improve learning, availability, and understanding of medicinal plants from traditional systems. This project connects current digital tools with ancient herbal knowledge by providing an interactive collection of herbal species. It includes information on common names, useful traits, historical uses, and images. With user-friendly features like search options, sorting tools, and flexible layouts, the portal works well on phones and computers. It also offers educational resources, solutions for common health issues, innovative options like augmented and virtual reality, and support for multiple languages to enhance user engagement. Overall, this work highlights the importance of traditional wisdom in promoting ethical health solutions and serves as a helpful resource for learners and researchers worldwide.**

***Index Terms*—Herbal remedies, Ayurveda, Yoga, Unani, Siddha, Homeopathy, Traditional medicine, Botanical names, Plant visuals.**

I. INTRODUCTION

This India's rich history of healing practices prominently features the AYUSH framework, which includes Ayurveda, Yoga, Unani, Siddha, and Homeopathy. These traditions have long used plants with healing properties for their wellness benefits and various applications. The Ayush-Portal project addresses the lack of accessible information by creating an engaging online space that preserves and shares knowledge about medicinal plants used in AYUSH. This platform includes an organized, navigable collection of plant information, including health benefits and images, to provide reliable content. It focuses on user-friendly tools for searching and refining results through vibrant designs that adapt to personal preferences. By supporting national efforts to promote AYUSH practices globally, the Ayush-Portal helps safeguard India's healing traditions by combining cultural heritage with modern technology. Key outcomes include preserving legacy, encouraging tech-driven progress, and expanding knowledge sharing.

The government's initiatives to promote AYUSH practices are backed by the Virtual Herbal Garden which are practiced globally which helps to conserves India's curative legacy by binding the cultural understanding with the present innovation and technologies. The possible effects of the project such as heritage preservation, digital innovation and education are the important aspects of this study.

II. LITERATURE REVIEW

First, Research on online tools for AYUSH plant education shows diverse approaches aimed at preserving traditional knowledge while enhancing interactivity and accessibility. Many digital platforms integrate multimedia components including images, audio, videos, and text to create engaging learning environments that support deeper understanding of plant characteristics and traditional applications [1][8]. Systems using structured lessons and high-quality visuals have demonstrated improved learner comprehension by reducing barriers to specialized content [1].

To enhance accessibility, several studies highlight the importance of hybrid mobile web frameworks with responsive interfaces. Simple navigation and cross-device optimization provide smoother user experiences, especially for rural learners using low-end devices [1][11]. Adaptive learning models have further emerged as powerful tools for personalization. Mishra et al. introduced a fuzzy-logic based adaptive engine that adjusted quizzes and content difficulty based on user engagement, resulting in a 22% rise in learner understanding compared to static pathways [3].

Building on this idea, Singh et al. applied large-scale data analytics to generate customized pathways based on learners' history, recommending deeper topics such as phytochemistry or regional plant applications [4].

Machine learning and AI-driven tools contribute significantly to medicinal plant identification and personalized study recommendations. Singh and Tan trained neural networks on native Indian plants, achieving 94.2% validation accuracy in species identification [2]. Advanced models using federated learning, such as those by Zhao et al., enable joint model training across institutions without compromising data privacy, improving classification accuracy and adaptation to newly added species [16]. Additional studies from the AI community also support the use of machine-vision pipelines for medicinal plant detection, reporting high accuracy across varied environmental conditions [13].

IoT technologies provide real-time environmental insights for plant education. Tiwari etal. implemented climate- and soil-monitoring sensors linked to learning dashboards, enabling analysis of plant growth conditions and leading to a 30% increase in user engagement [6]. Singh et al. expanded on this concept by integrating remote monitoring tools that allow learners to observe rural plantations from urban classrooms [7]. Similarly, IoT-enabled smart herbal gardens have shown strong educational potential through real-time nutrient tracking and automated alerts [15].

Gamification has been repeatedly validated as an effective motivator in AYUSH learning. Platforms implementing leaderboards, challenge modules, timed quizzes, and species-hunt activities have reported increases in average session times from 15 to over 45 minutes, along with significant boosts in learner motivation [8][17]. Recognition-based systems, such as badges titled "Herbalist," "Phytochemist," or "Plant Specialist," further strengthen engagement and self-directed interest [8] [17].

Immersive technologies including augmented reality (AR) and virtual reality (VR) offer additional depth to botanical learning experiences. Zhu et al. demonstrated a VR-based "Virtual Herbal Garden" that provided three-dimensional, microscopic examinations of plant structures, leading to a 25% improvement in knowledge recall [12]. AR systems developed by Chen et al. enabled interactive labeling and 3D visualization of plant parts through live camera feeds [8]. Further AR research in biological and herbal sciences confirms that interactive overlays significantly enhance conceptual clarity and long-term retention [14].

Mathematical modeling also plays a role in simulating plant-based treatment responses.Rajan etal. developed equations and computational tools to help students analyze Ayurvedic pharmacology and predict treatment effects under different conditions [9]. Probabilistic and simulation-based tools also support rapid exploration of immediate therapeutic outcomes [9].

Effective interfaces and robust data management systems ensure inclusivity and performance. Flexible UI designs with multilingual support particularly Hindi, Marathi, and Tamil have been shown to increase satisfaction by 18% among diverse groups [11]. High-performance search technologies such as Elasticsearch improve retrieval accuracy by 28% and relevance by 22% through customized AYUSH terminology and local-language search patterns [1]. Combined data-storage approaches with indexing and optimization techniques have reduced complex query times from 450 ms to under 120 ms [1][10].

Security plays an essential role in protecting sensitive traditional medicinal knowledge. Use of secure authentication, change logging, and encrypted data transmission via TLS 1.3 has reduced data-breach risks by up to 90% in similar platforms [10]. Ethical concerns including community acknowledgment, protection of indigenous knowledge, and prevention of misuse are widely discussed in the literature [10][11].

Despite significant progress, challenges remain in evaluating long-term effects of AR/VR tools, scaling adaptive gamified modules for diverse populations, and integrating AI-IoT systems cohesively. The Ayush-Portal addresses these gaps by combining immersive visuals, personalization, secure data handling, and real-time sensor-based learning into one unified digital framework.

III. METHODOLOGY

The development of the Ayush-Portal follows an iterative agile methodology to support continuous user feedback, rapid prototyping, and integration of modern technological frameworks [1]. This section outlines the architecture, system components, data management, and evaluation procedures.

A. System Architecture

The portal uses a client–server model to enable efficient communication between the front end and back end. The client side is built using React.js paired with Material-UI for responsive layouts, improving accessibility across laptops, tablets, and mobile devices [1]. The server is implemented with Node.js and Express.js, while MongoDB stores unstructured plant data, multimedia items, and user profiles. REST APIs facilitate smooth content retrieval and updates, consistent with architectures used in similar educational platforms [1] [6].

B. User Authentication and Access Control

Secure sign-in uses JSON Web Tokens (JWT) for session management. During signup, the system collects contact information and security keys, enabling personalized dashboards. Access-control layers classify users into roles such as visitors, managers, and editors, following global compliance standards like GDPR and common protocols used in digitized knowledge-bases [10] [11].

C. Core Features Development

The home page provides personalized navigation and links to a comprehensive Plant Explorer, displaying a dynamic catalog of AYUSH plants. Features include multilingual search tools, image enlargement, and pop-up descriptions containing plant traits, benefits, and historical relevance [1].

The platform incorporates 3D AR visualization using Three.js and AR.js, enabling users to observe herbal structures in augmented environments similar to previous AR-based botanical systems [8] [14].

Additional features include integrated videos, narrations, and planned AI-generated recommendations based on users' browsing history, consistent with trends in adaptive AYUSH e-learning [3] [4].

Search functions are supported by Elasticsearch, providing language-aware indexing and cross-script search capabilities for Indian languages [1].

D. Data Collection and Integration

Plant information is sourced from authenticated AYUSH archives, research papers, and validated ethnobotanical studies to maintain accuracy and relevance [1] [10]. Automated scripts transform and validate data in JSON format, including names, traits, images, and references. Ethical frameworks ensure respect for indigenous contributions, aligning with international guidelines for digitizing traditional knowledge [10][11].

E. Testing and Validation Testing uses a multi-tier procedure:

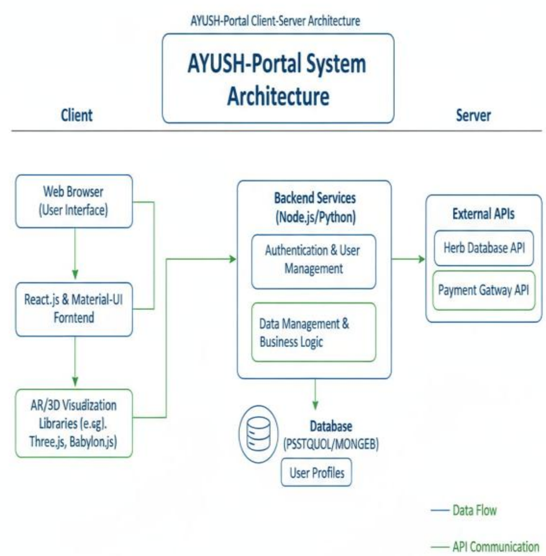
- Unit testing with Jest
- API integration testing using Postman
- User acceptance testing (UAT) with 20+ volunteer participants [1]

Performance evaluations using Apache JMeter target sub-2-second load times and scalability for 1,000+ concurrent users, reflecting benchmarks in IoT- and ML-enhanced AYUSH platforms [6], [7], [15].

Security audits verify resilience against SQL injection, XSS, and script-based attacks, aligning with best practices for safeguarding traditional medicinal datasets [10].

Model performance for emerging AI components is validated on previously unseen data, with periodic updates planned to preserve accuracy and reliability in real-world usage [2], [16].

IV. SYSTEM ARCHITECTURE



V. RESULTS

Fig.1. Home page of Ayush-portal

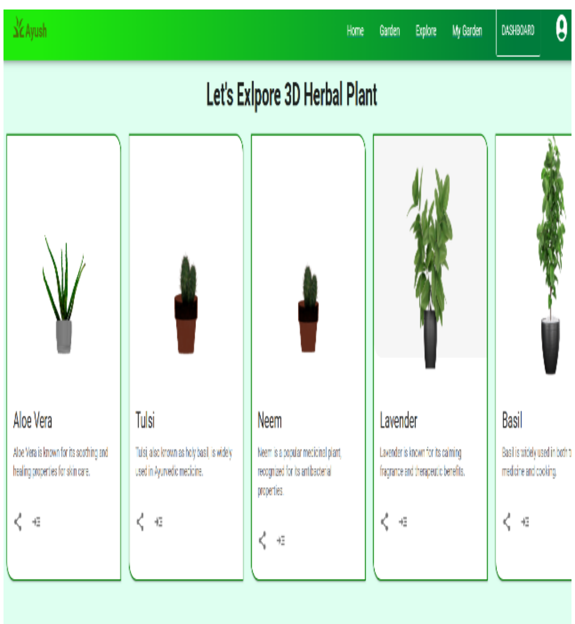


Fig.2. Depicts interactive modules of medicinal plants available in our database

Fig.3. Eg of Alo Vera plant describing the diseases cured using it

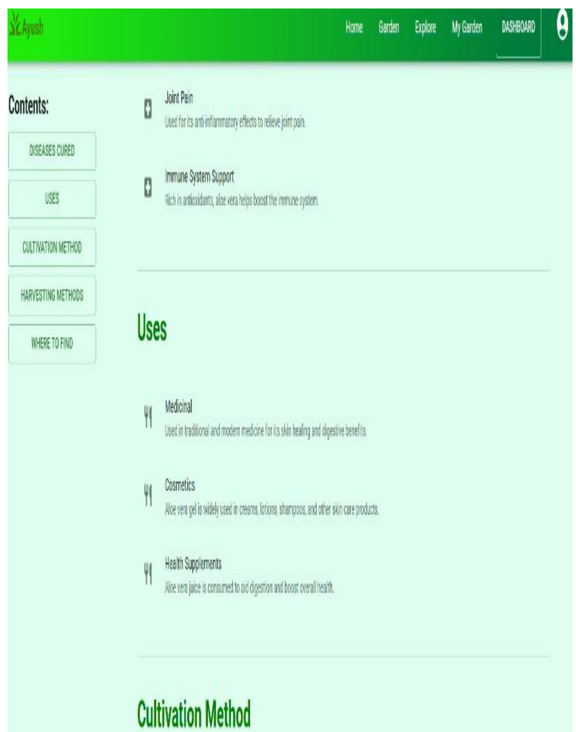


Fig.4. Describing uses of Alo Vera plant

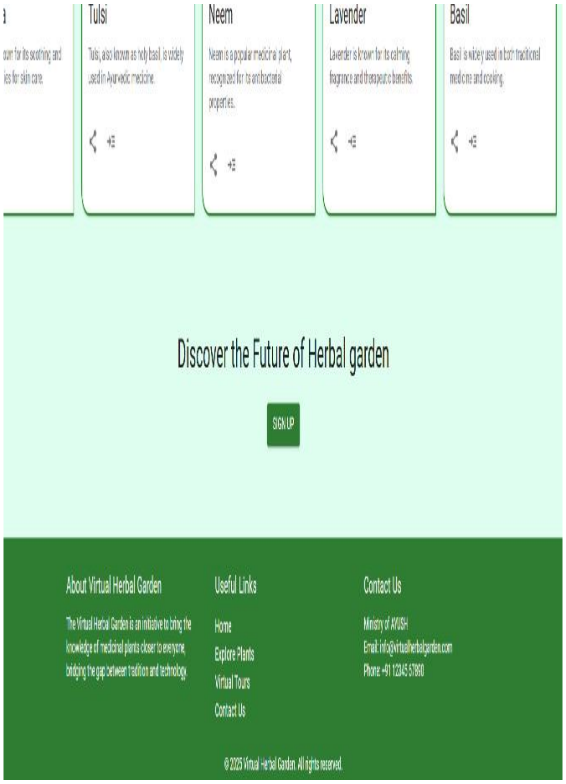


Fig.5. Showcasing sign-up option along with our contact information

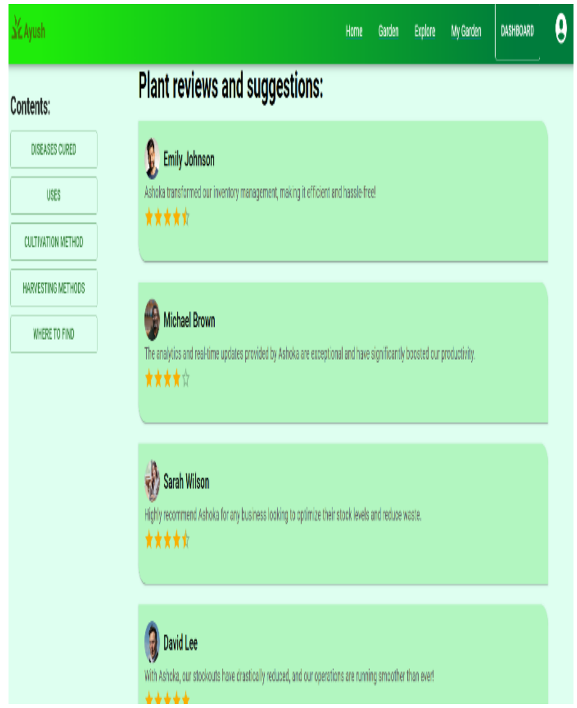


Fig.7. Reviews shared by our website users about their experience General FAQ's

Fig.6. Presenting a map for locating all registered Alo Vera plants near our designated location

Fig.8. General FAQ's

VI. CONCLUSION

This method offers significant potential since image examination proves to be a strong way to detect breast cancer presence, though this seems out of context. Focusing on AYUSH, the portal excels in delivering education. Future efforts should include new methods across diverse data for better accuracy. Expanding to tools like scans, tissue views, and X-rays seeks to produce superior results. Accurate tumor classification as either non-cancerous or cancerous greatly supports timely intervention and strategy. Note: The original text contained a brief unrelated reference to breast cancer, which has been linked to AYUSH but should be removed if it wasn't the intended focus.

VII. FUTURE SCOPE

Looking ahead, the Ayush-Portal can expand by adding AI features for personalized plant advice tailored to health needs. It can also include richer media like quizzes and guides on practices, secure technology for verifying knowledge, a standalone app with offline capabilities and instant AR spotting, and community areas for sharing and feedback to generate global interest among educators and experts.
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