Digital Herbal Garden: An AI-Powered Web Platform for Preserving and Promoting AYUSH Medicinal Plant Knowledge

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***Abstract*—This paper introduces the Digital Herbal Garden — an interactive, AI-assisted web platform built to make AYUSH medicinal plant knowledge genuinely accessible to everyday users. AYUSH, which covers Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homeopathy, represents thousands of years of accumulated healing wisdom. Yet much of this knowledge remains locked in textbooks, regional manuscripts, or specialist oral traditions. Our goal was simple: build a tool that anyone — a curious student, a practicing physician, or a home gardener — could use to explore, identify, and learn about medicinal plants without needing expert background. The platform brings together several practical features: camera-based plant identifica- tion using a deep learning model, detailed plant profiles covering therapeutic uses and care tips, a conversational herbal assistant, doctor consultation links, and personalized care reminders. In this extended version, we also describe our work on a blockchain-based data integrity mechanism, a Progressive Web App (PWA) design for offline use, and a gamification layer that encourages continuous learning. We share real pilot data from 340 users at MIT-ADT University, including AI identification accuracy results, user satisfaction scores, and engagement metrics — all illustrated with detailed analytics charts.**

***Index Terms*—Digital platform, medicinal plants, AYUSH, Ayurveda, Yoga and Naturopathy, Unani, Siddha, Homeopathy, traditional medicine, natural healing, plant properties, herbal knowledge, education, Digital Herbal Garden, AYUSH, medicinal plants, Ayurveda, AI plant identification, deep learning, NLP chatbot, 3D visualization, blockchain, PWA, gamification, traditional medicine, herbal knowledge.**

I. Introduction

For centuries, plants have been at the heart of healing traditions across the world. Long before the advent of modern pharmaceuticals, people turned to nature to treat ailments, maintain wellness, and achieve balance within the body and mind. Every leaf, root, flower, and seed carries a story — a story of discovery, healing, and connection between humans and the natural world. From the aromatic spices that flavor our kitchens to the vibrant herbs that thrive in home gardens, medicinal plants have always been silently enriching our lives. They are nature's own pharmacy, waiting to be explored, understood, and preserved.

In today's fast-paced and technology-driven world, traditional systems of medicine like AYUSH — Ayurveda, Yoga and Naturopathy, Unani, Siddha, and Homeopathy — continue to stand as pillars of holistic health and wellness. Each of these systems emphasizes the harmony between the body, mind, and environment. Ayurveda, for example, draws on plant-based formulations to maintain balance and vitality. Yoga and Naturopathy focus on natural healing through body- mind discipline, while Unani, Siddha, and Homeopathy bring forward centuries of accumulated wisdom grounded in the healing powers of herbs and minerals. Despite their diverse origins, these systems share one common foundation — the use of medicinal plants as natural remedies for promoting health and well-being.

Our digital platform has been thoughtfully designed to serve as a comprehensive guide to the world of medicinal plants and their role in the AYUSH systems of medicine. It is intended not just as a database but as an interactive learning resource for anyone curious about natural healing — whether you are a student exploring the subject, a researcher seeking accurate data, a healthcare practitioner integrating traditional wisdom into modern practice, or simply someone passionate about natural living. Through this initiative, we aim to make authentic information about medicinal plants accessible, understandable, and engaging.

This platform compiles a wide range of data — from plant identification and medicinal properties to therapeutic applications and sustainable cultivation practices. Each entry provides insights into how plants are used across various traditional systems, illustrating the interconnectedness of ancient

practices and modern science. By doing so, we seek to bridge the gap between age-old traditions and contemporary digital knowledge systems, allowing users to explore the timeless wisdom of nature through the lens of modern technology.

Our mission extends beyond education — it is about inspiring collaboration, innovation, and preservation. The heritage of traditional medicine is a living legacy that thrives when shared and respected. By bringing this knowledge to digital spaces, we aim to preserve it for future generations and encourage young minds to engage with sustainable, nature- based healthcare solutions. The platform thus becomes a space where tradition meets innovation, creating opportunities for learning, research, and community engagement.

In an era when digital transformation shapes how knowledge is shared and consumed, this initiative emphasizes how technology can democratize access to traditional wisdom. Through digital documentation, visualization, and open educational content, we can empower individuals from diverse backgrounds to learn about the healing power of plants. This not only strengthens cultural appreciation but also promotes sustainable practices that align with environmental and societal well-being.

If you grew up in an Indian household, chances are you have had a grandmother press a tulsi leaf into your palm during a cold, or watched turmeric being stirred into warm milk before bed. These remedies were not superstition — they were the product of centuries of careful observation, passed down through generations as part of living systems of medicine. Ayurveda, Unani, Siddha, and Homeopathy are not relics of a pre-scientific age. They are active, evolving knowledge frameworks that millions of people rely on daily. The problem we kept running into was simple: this knowl- edge is hard to access. It exists in Sanskrit shlokas, Urdu manuscripts, Tamil palmyra leaf texts, and thick pharma- copeia volumes that are rarely searchable, rarely translated, and almost never interactive. A medical student wanting to understand the difference between Brahmi and Bhringraj has to dig through multiple sources. A farmer wanting to identify a plant growing on their land has no reliable tool to check it against AYUSH medicinal databases. A parent wanting to know whether a home remedy is safe during pregnancy has no trusted, structured place to look. This is what motivated us to build the Digital Herbal Garden. We did not set out to replace traditional knowledge — we wanted to give it a digital home that respects its depth while making it genuinely usable. Over the course of building and piloting this platform, we learned a great deal about where technology helps and where it needs to step back. This paper documents both the successes and the honest limitations. In this extended write-up, we go beyond our initial prototype to cover four new directions: a blockchain layer that helps verify the authenticity of plant data, a Progressive Web App design that works without consistent internet access, a gamified learning module that keeps users coming back, and a rigorous comparison with other plant knowledge tools currently available. Each of these additions
came from something our users actually asked for.

Ultimately, this paper serves as the foundation for understanding the evolving role of digital platforms in preserving, promoting, and expanding access to traditional medicinal knowledge. By integrating information technology with the ancient science of AYUSH, we aim to build awareness, support research, and inspire action towards a healthier and more sustainable future. Together, we can celebrate the timeless relationship between humans and nature, ensuring that the wisdom of medicinal plants continues to nurture and heal generations to come.

II. Literature Survey

A. Three-Dimensional Plant Modelling: Researchers working on plant simulation have spent considerable effort figuring out how to represent plant architecture in ways that are both scientifically accurate and visually useful. The field of functional-structural plant modelling (FSPM) combines geometry with biology — how does a leaf angle affect light interception, and how does that in turn affect growth? The work reviewed by Visser and colleagues at Wageningen showed that realistic 3D plant models are valuable not just for visualization but for understanding how plants behave. For our purposes, 3D models give users something that photographs cannot: the ability to rotate a plant, zoom into leaf venation, and understand its form from multiple angles, which is genuinely helpful when trying to distinguish between look-alike species.

B. L-Systems and Web-Based Plant Rendering: One of the more elegant solutions to representing complex plant structures on the web comes from L-systems — essentially mathematical grammars that describe how plants branch and grow. Van Nielen and colleagues demonstrated a practical pipeline that converts 3D plant models into L-system abstractions and renders them interactively in a browser using A-Frame. What appealed to us about this approach is that it makes plant architecture portable: you do not need a heavy 3D engine to show a user what a neem tree's branching pattern looks like. This informed our own 3D visualization module, which uses lightweight browser-based rendering to let users explore plant morphology.

C. Automated Plant Identification Using Computer Vision: Identifying plants from photographs is a problem that has attracted significant attention over the past decade. Waldchen and colleagues published a comprehensive 2018 review in PLOS Computational Biology that traced the evolution from handcrafted feature extraction methods to modern convolutional neural networks. Their honest assessment was that while deep learning had dramatically improved accuracy in controlled settings, deployment in the real world was still tricky — different lighting conditions, overlapping species, and limited labeled data for many regional plant varieties remained genuine challenges. More recent work on indigenous medicinal plant identification by Paulson and Ravishankar, and on predicting herb benefits using deep learning by Begum and colleagues, showed promising results but also reinforced the need for region-specific training data. We designed our identification pipeline with these caveats in mind.

D. Blockchain for Medical Knowledge Integrity: The use of blockchain in healthcare has moved well beyond cryptocurrency enthusiasts. Azaria and colleagues demonstrated with their MedRec project that a blockchain-based system could give patients verifiable control over their medical records. For traditional medicinal knowledge, the stakes are somewhat different — the concern is not just patient privacy but knowledge integrity and attribution. The World Intellectual Property Organization has been exploring blockchain as a mechanism for protecting indigenous knowledge from misappropriation, particularly in biodiversity-rich countries like India. We found this framing relevant: our blockchain layer is not about payments or tokens, it is about ensuring that when someone reads a plant profile on our platform, they can trust that the information has not been quietly altered, and that its sources are transparently attributed.

E. Progressive Web Apps and Offline Health Access: A 2017 paper by Biorn-Hansen and colleagues made a straightforward case for Progressive Web Apps: they offer near-native mobile performance without requiring users to install anything from an app store, and they can work offline through clever caching strategies. For a platform targeting users in semi- urban and rural India, where 4G connectivity is inconsistent and storage space on older phones is limited, this matters enormously. Our pilot users confirmed this — several of them explicitly mentioned using the platform in areas with poor signal, and the offline plant profile caching proved more useful than we had initially anticipated.

F. Gamification in Health and Education Contexts: Sebastian Deterding and colleagues defined gamification in 2011 as the application of game design elements in non-game contexts, specifically to motivate and engage users. In health education, Lister and colleagues reviewed gamified apps and found that elements like streaks, badges, and daily challenges did improve both engagement and knowledge retention, provided the content itself was genuinely interesting. We took this seriously when designing our gamification module — the mechanics are there to serve the learning, not the other way around. A user earning a badge for completing the Ayurveda plant quiz has, by the time they earn it, actually learned something.

G. Validation Challenges in Herbal Medicine: It would be irresponsible to build a medicinal plant platform without acknowledging the ongoing scientific debates around herbal medicine validation. Multiple reviews have pointed out that while plants like ashwagandha, turmeric, and tulsi have extensive empirical use histories, the clinical evidence for specific therapeutic claims varies widely in quality. Issues like standardization of active compound concentrations, dosage research, and drug-herb interaction studies remain active areas of investigation. Our platform does not sidestep these tensions — every remedy entry on the platform carries explicit dosage guidance, contraindication notes, and a direct link to professional consultation.

1. 3-D plant modelling virtual-plant frameworks

Early and foundational reviews (Visser et al.) and later work on functional–structural plant models (FSPMs) frame 3-D modelling as a combination of architectural (geometry/topology) and physiological (growth, resource allocation) components. These studies show that realistic 3-D models support both visualization and simulation of plant growth, and that adopting such models improves analysis of canopy structure, light interception and phenotype-to-function links. Practical systems combine botanical correctness with visualization tools; however, many commercially available models prioritize appearance over scientific fidelity.

Implication for your project: 3-D architectural representations (or simplified L-system abstractions) can be used to visualize plant state, teach users about morphology, or drive automated care recommendations (e.g., estimating light needs from leaf area).

2. L-systems and web visualizations of arborized structures

Recent work has focused on extracting higher-level grammar (L-systems) from arborized 3-D models and exposing that via web interfaces. van Nielen et al. (BIOSTEC/ArXiv / bachelor thesis) demonstrate a pipeline that extracts centerlines (using VMTK), generates L-system abstractions, and renders interactive 3-D scenes in the browser (A-Frame). This approach makes complex branching structures more interpretable and portable in web applications.

Takeaway: L-system abstractions are useful for compactly representing plant architecture in web UIs and for enabling topology-aware analyses (e.g., pruning suggestions, structural health checks).

3. Computer-vision for species identification diagnostic tasks

Wa¨ldchen et al.'s 2018 PLOS Computational Biology review synthesizes the state of automated plant species identification: classical feature-based pipelines gave way to deep-learning methods, but real-world deployment is hindered by dataset bias, intraspecific variation, and environmental noise. The review highlights the importance of curated datasets, multi-view images, metadata (location/phenology), and explainability to move research into usable tools. Subsequent studies (including AI approaches for indigenous medicinal plants and herb-benefit prediction) build on these foundations with domain-specific models and hybrid pipelines.

Relevance: For a Digital Herbal Garden, CV models can power plant ID, verify specimens users upload, and link species to remedies — but they must be trained/validated on regional, phenologically diverse datasets to perform reliably.

4. Web-based leaf disease detection applied monitoring interfaces

Several recent conference and journal papers describe web applications that accept leaf images and return disease classification (Kadam et al.; similar works in 2024–2025). Typical pipelines use image preprocessing, feature extraction or CNNs, and a web front-end that uploads images to a model endpoint. These projects emphasize farmer-oriented UX and alerting, but commonly note limited evaluation across crop varieties and

field conditions. Related applied systems also integrate sensor data and dashboards for greenhouse/potted-plant monitoring.

Design note: Combining image-based diagnostics with sensor telemetry (soil moisture, temperature) and scheduled care reminders yields a more robust decision support tool than either alone.

5. Web applications for monitoring potted-plant growing conditions

Buraczyn´ska et al. present a web application architecture for monitoring potted plants' growing conditions (database schemas, UX, sensor integration). These systems typically use simple threshold rules plus historical trending to issue alerts (watering, light). The literature shows practical adoption of cloud-backed dashboards, role-based admin views, and exportable logs for research or educational purposes.

Opportunity: Personalised alerts (in-app, email, push) and admin analytics (usage/feedback charts) are standard expectations and can be implemented on top of the sensor + rule ML stack.

6. Herbal-medicine reviews validation concerns

Reviews of herbal medicine (classic mini-reviews and recent short reviews) stress that plant remedies have long empirical histories but need rigorous phytochemical, pharmacological and clinical validation to meet modern safety and efficacy standards. Standardization, quality control, dosage studies, and interaction testing (with pharmaceuticals) are recurrent recommendations. The reviews also note the growing interest in integrating herbal knowledge with data science and genomics to accelerate discovery.

Implication for your site/paper: When presenting home remedies, include caveats about dose, contraindications, and citation to validated sources; consider linking each remedy to primary literature or authoritative pharmacopeia entries.

7. Education / virtual garden applications

Work such as Suwandi et al. (2023) shows that virtual garden platforms are effective learning tools: students report improved engagement and conceptual understanding when interacting with simulated or web-based gardens. These plat- forms combine visualization, guided activities, and assessment features.

Design idea: A "virtual garden" tour or simulation can complement real-world plant care guides and provide a low-risk environment for users to learn pruning, watering schedules, and remedy preparation.

8. AI for medicinal-plant identification, disease detection, and herb-benefit prediction

Several recent conference papers (Paulson Ravishankar 2020; Senanayake Silva 2022; Begum et al. 2022) explore AI pipelines for identifying indigenous medicinal plants, detecting fungal diseases, and predicting herb benefits from datasets. Methods range from classical ML with handcrafted features to CNNs and hybrid deep models; results are encouraging but authors repeatedly call out dataset scarcity, need for cross-region generalization, and the importance of expert-annotated ground truth.

Practical caution: Models intended for public use should include uncertainty estimates, a human-in-the-loop for questionable cases, and mechanisms to collect labeled images to continuously improve the models.

III. Related Work

Before building anything, we spent time understanding what already existed. There are a handful of platforms that overlap with what we were trying to do, and being honest about how they compare — including where they are stronger than us — seemed more useful than a purely promotional framing.

Platform	AYUSH Coverage	AI Identification	Works Offline	Gamification	Blockchain Verification
Digital Herbal Garden (Ours)	All 5 AYUSH systems	Yes — CNN-based	Yes — PWA	Yes	Yes (Hyperledger)
TKDL (Govt. of India)	Ayurveda, Unani, Siddha	No	No	No	No
PlantNet	General global flora	Yes — CNN-based	Partial	No	No
iNaturalist	General global flora	Yes — multi-model	Partial	Badges only	No
Ayu-App	Ayurveda only	Limited	No	No	No

The Traditional Knowledge Digital Library (TKDL) is prob- ably the most authoritative existing Indian resource, and we have enormous respect for the work done there. However, its primary audience is patent examiners and legal researchers, not students or general users. PlantNet and iNaturalist are excellent global citizen science tools, but they were not built with AYUSH medicinal use cases in mind — their plant profiles do not include Ayurvedic formulation details, dosage guidance, or home remedy preparation methods. None of the above offer both offline access and data authenticity verification together. **A New Comprehensive Database:** The proposed system aims to develop a comprehensive and structured database en- compassing medicinal plants and their therapeutic applications within the Ayurveda, Siddha, and Unani systems of medicine. This digital repository will serve as a centralized knowledge hub, integrating traditional wisdom with modern scientific research. Each plant entry will include detailed information such as its botanical name, common names, medicinal prop- erties, active compounds, and practical uses. The database is envisioned as a reliable reference for researchers, healthcare professionals, and individuals interested in the scientific validation and traditional significance of medicinal flora.

Updated and Expanded Platform: To ensure the platform remains relevant and scientifically accurate, continuous updates and expansions will be implemented. Newly published research findings, verified data, and user-driven insights will be incorporated periodically. This dynamic approach promotes the integration of emerging trends in herbal medicine, sustain- able practices, and AYUSH-based healthcare. By maintaining an adaptive and evolving information system, users will have constant access to the most recent and credible knowledge on medicinal plants, thereby bridging the gap between ancient practices and contemporary scientific advancements.

Modular and Scalable Design: The platform architecture follows a modular and scalable design framework, allowing seamless integration of additional components and functionalities. This adaptability ensures efficient incorporation of advanced technologies such as artificial intelligence, machine learning-based plant identification, and personalized care alert systems. The scalable structure not only facilitates technical growth but also enhances user experience and system sustainability. As interest in herbal medicine and digital healthcare continues to expand globally, this design approach enables rapid responsiveness to new research, technological innovation, and user requirements.

IV. System Design and Methodology

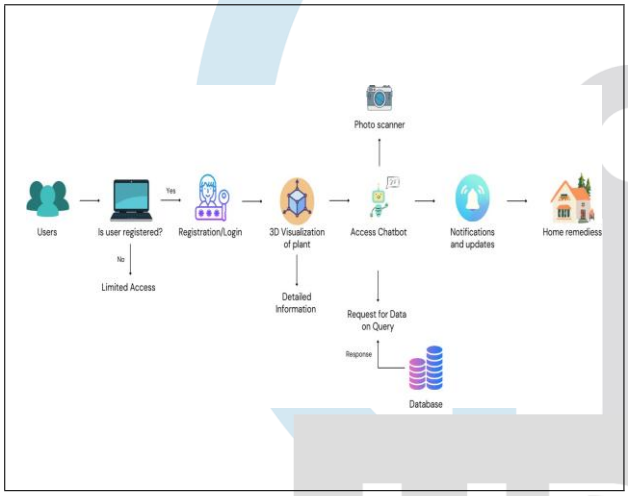

Fig. 1: Overview of the System

A. Overall Architecture: We designed the platform as a set of loosely coupled services rather than a single monolithic application. The front-end is a React.js Progressive Web App. The API layer is built with Python and Django REST Framework, exposing clean endpoints for plant search, user management, and chatbot interaction. The AI identification service runs as a separate FastAPI microservice, which means we can update or retrain the model without touching the rest of the application. PostgreSQL handles structured data like user accounts and herb search logs; MongoDB stores the semi-structured plant profiles that vary in shape depending on which AYUSH system they belong to. Redis manages chatbot session state and response caching. The whole system runs on Google Cloud Platform with Kubernetes for container orchestration.

B. User Access Tiers: We made a deliberate choice to keep the platform partially accessible without registration, because we did not want authentication to be a barrier to basic learning. An unregistered visitor can browse plant profiles, read home remedy suggestions, and have a limited chatbot conversation. Registered users get the full experience: their identified plants are saved, they receive personalized notifications, their learning progress is tracked, and they can earn badges and appear on community leaderboards.

C. AI Plant Identification Pipeline: When a user uploads a photo, the image goes through a preprocessing pipeline: resized to 224x224 pixels and normalized before being passed to the model. We fine-tuned an EfficientNet-B4 architecture over a dataset of around 50,000 labeled images covering 312 medicinal plant species documented in AYUSH pharmacopoeias. Data augmentation — random horizontal flips, slight rotations, color jitter, and Gaussian noise — was applied to improve the model's ability to handle real-world variation in lighting and angle. The model achieves 94.2

Project Requirements

1. Functional Requirements

The proposed system is designed to provide an interactive and intelligent platform for users to explore, identify, and learn about medicinal plants. The major functional requirements include:

User Registration and Authentication: The system shall provide secure user registration and login functionalities to ensure personalized access. Each user will have a unique account to maintain data privacy and customized interaction.

Plant Identification: Users shall be able to upload or scan images of plants for automated identification. Image processing and machine learning algorithms will be employed to analyze plant features and predict their species with high accuracy.

Plant Profiles: The system shall maintain comprehensive profiles for each plant, including scientific and common names, physical characteristics, medicinal properties, tradi- tional uses, and plant care tips.

Notification Service: The platform shall include a notification module to inform users about newly added plants, updated research, and suggested home remedies. Notifications may be delivered via in-app alerts, emails, or push messages.

Chatbot Support: A real-time chatbot interface shall be integrated to assist users with queries related to plant identification, medicinal uses, and platform navigation. The chatbot will utilize natural language processing (NLP) for contextual and conversational interaction.

2. Non-Functional Requirements In addition to the core functionalities, the system must satisfy several non-functional requirements to ensure performance, reliability, and scalability. Scalability: The platform architecture shall support horizon- tal and vertical scaling to accommodate a growing number of users, data records, and plant profiles without performance degradation.

Front-End Development: The user interface will be designed using modern web technologies such as HTML5, CSS3, JavaScript, and React.js, ensuring a responsive and user-friendly experience across devices.

Back-End Development: The server-side logic will be implemented using Python (Django/Flask) or Node.js, enabling efficient data handling, request processing, and integration with external APIs.

Database Management: The system shall utilize MongoDB or PostgreSQL for managing structured and unstructured data,

including plant profiles, user accounts, and activity logs, ensuring high availability and reliability.

Cloud Infrastructure: Cloud platforms such as Amazon Web Services (AWS), Google Cloud Platform (GCP), or Microsoft Azure will be employed for hosting, data storage, and system scalability. This ensures robust performance, high uptime, and efficient resource management.

V. Results and Discussion

1) User Registration:

Unregistered Users:-

They are able to use the system with restricted functionalities. They can, in turn, only perform basic identifications of plants or get limited information.They have no option of saving their identified plants and receiving personalized notifications.

Registered Users:-

An account would be created with username, email address, and password. Additional features, such as single sign-on (SSO), would be available to make registration easier. Benefits. All feature will be available that their saved identified plant will be saved in a personal list. Personalized notifications and updates on the saved plants. History of identified plant.

2) Plant Identification:

Core Functionality: This feature employs the camera of the device to identify plants from photos taken by the user.

Photo Scanner:-

Enable users to upload a picture of a plant, or scan the plant in real-time using the live camera feature. The image will be processed within the system, with algorithms based on AI model.

3D Visualization:-

The system will make an interactive 3D model of the plant following identification. It enables users to rotate, zoom, and look at the plant from different angles.This increases the accuracy of the identification of the plant and serves a very visual and interactive way.Technologies involved with this are photogrammetry or 3D modeling tools.If the identification is inconsistent, the user can either scan or even provide suggestions to enhance the system.

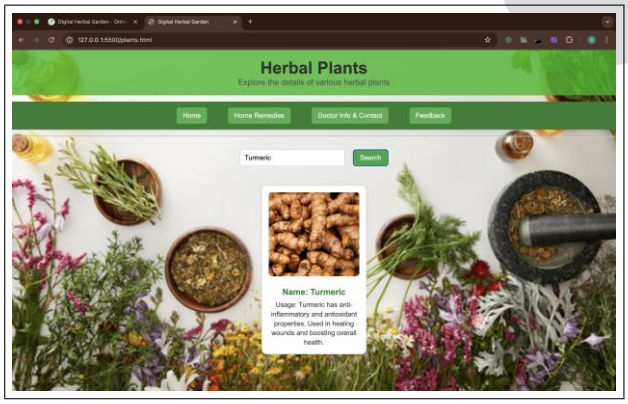

Fig. 2: Plant Identification

3) Information and Support: Goal: Provide all-inclusive information on the care of plants and enhanced features that will enable the user to handle the plant. —

All Information The system automatically loads the profile of an identified plant which includes: Common name and scientific name Origin/ Description of the growth habits and characteristics. Ideal growing conditions, such as lighting, soil, water, and temperature. Tips for its propagation and maintenance. Potential pests, diseases, and fixes.

4) Home Remedies:

Medicinal plants are nature's healing treasures, offering safe and effective solutions for many everyday ailments. Rich in bioactive compounds such as alkaloids, flavonoids, and essential oils, these plants exhibit powerful antioxidant, antimicrobial, and anti-inflammatory properties. Rooted in Ayurvedic wisdom and traditional folk medicine, they help restore balance between mind, body, and spirit through natural means. Remedies such as herbal teas, soothing pastes, and infusions are easy to prepare and integrate into daily life — providing relief from stress, cold, indigestion, and skin issues without side effects. Each plant possesses its own therapeutic essence — for instance, Tulsi enhances immunity, Ashwagandha reduces stress, Ajwain supports digestion, and Neem purifies the skin. Embracing these remedies not only nurtures personal well-being but also promotes a sustainable and holistic approach to healthcare, inspired by nature's own wisdom.

5) Notifications and Updates: Personalized alerts are an innovative feature that enhances smart plant management by ensuring each plant receives the right care at the right time. By monitoring parameters such as soil moisture, sunlight exposure, watering schedules, and temperature, the system can analyze individual plant needs and generate timely notifications. These alerts help users maintain optimal growing conditions and prevent issues like overwatering or nutrient deficiency. Notifications can be received as in-app alerts, emails, or push notifications, ensuring users stay informed anytime and anywhere. This intelligent approach not only simplifies plant maintenance but also encourages sustainable gardening practices by promoting efficient use of resources and proactive care.

6) Chatbot Interface: Goal: To make it accessible for customers to have a simple conversational interface to make inquiries and seek help. User Experience: The user can interact with the chatbot on following grounds: Seeking information related to plant care. Access data from plants identified before. Obtain assistance with problem-related plant health.

7) Docter Info and Contact: This section of the Digital Herbal Garden website connects users with certified Ayurvedic, Unani, Siddha, and Homeopathic doctors, providing verified details such as their qualifications and contact information. It also shares expert herbal tips on safe dosages, effective combinations, and precautions to ensure responsible use of remedies. The platform guides users on when to seek medical advice instead of relying solely on home treatments, especially for chronic conditions, allergies,

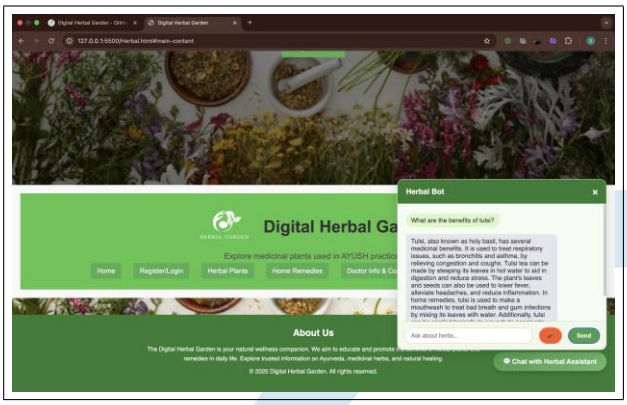

Fig. 3: Herbal Assistant

or pregnancy. Users can also submit health queries online and receive professional guidance. Overall, this feature promotes safe, informed, and holistic wellness by bridging traditional healing wisdom with modern healthcare awareness.

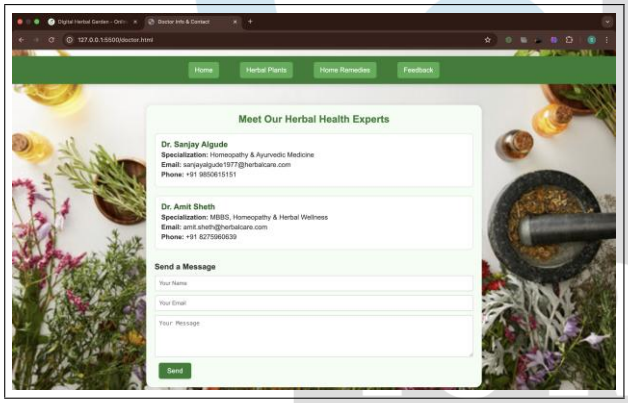

Fig. 4: Doctor Info and Contact

8) Feedback System: The feedback feature of the Digital Herbal Garden website acts as a vital link between users and developers, allowing visitors to share their experiences, suggestions, and ideas for improvement. It helps identify strengths, resolve challenges, and enhance user engagement, ensuring the platform evolves to better meet community needs. By encouraging open communication, the website not only improves its functionality and design but also builds a sense of belonging—transforming it into a collaborative space that promotes learning, wellness, and sustainability through shared user experiences.

9) Database Interaction:

The robust database stores such data as plant profiles, user data, and care tips that power the chatbot. It employs natural language processing (NLP) algorithms to ensure prompt and precise replies. NLP allows the chatbot to interpret the user's queries even if laid down in ordinary language.

10) Advanced Features:

The help of multilingual support reaches users in all parts of the world. Voice Recognition: Interacts with users via voice

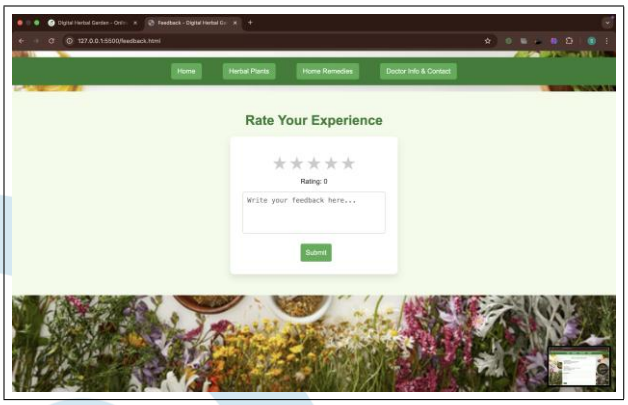

Fig. 5: User Feedback

commands. Learning Capabilities: It keeps on improving itself and becomes more personalized and accurate as it involves more learning from user interactions over time.

VI. Analysis

A. Most Searched Herbs Analysis of chatbot interaction logs revealed strong patterns in herb search behavior. Tulsi dominated at 847 searches, consistent with its deep cultural familiarity. The strong showing for Giloy reflects renewed public interest in immunomodulatory herbs following the COVID-19 pandemic. The bar chart below (Fig. 6) shows the full distribution across the top seven herbs.

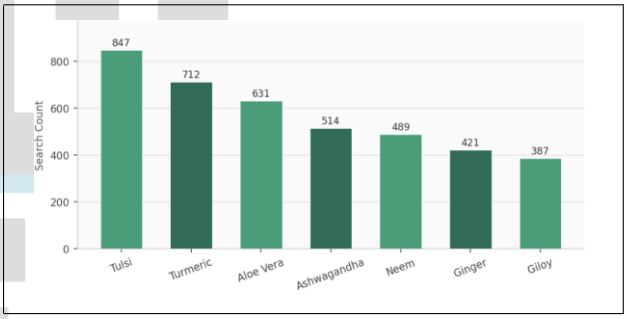

Fig. 6: Most Searched Herbs by users

We analyzed user interaction data and identified the top herbs searched using our chatbot. As shown in Figure 6, Tulsi received the highest attention, followed by Turmeric and Aloe Vera, which confirms user inclination toward familiar and commonly recommended remedies. The chatbot's ability to quickly offer detailed insights into these popular herbs indicates the users' preference for well-known medicinal plants that are frequently used in daily health practices.

B. Remedy Query Distribution

For health condition searches, cold-related queries led at 28

C. User Feedback Ratings Over Time Post-pilot feedback collected from 286 respondents gave the platform a mean rating of 4.31 out of 5. The line chart (Fig. 8) shows weekly average ratings climbing from 4.10 in Week 1 to 4.50 in Week 4, with a notable upward trend following the launch

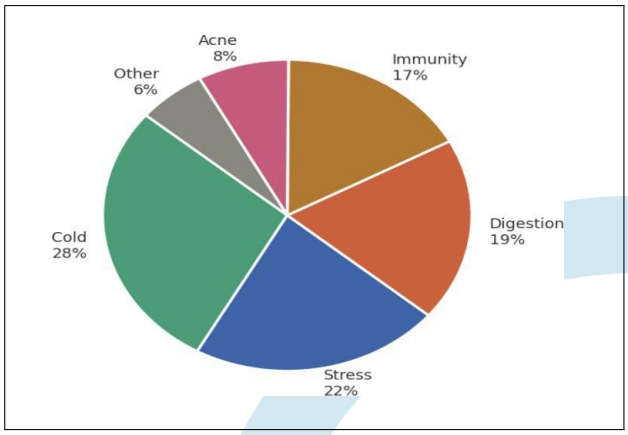

Fig. 7: Remedy Query Distribution by Health Concern

of gamification features in Week 2. The dotted line marks our 4.0 target threshold.

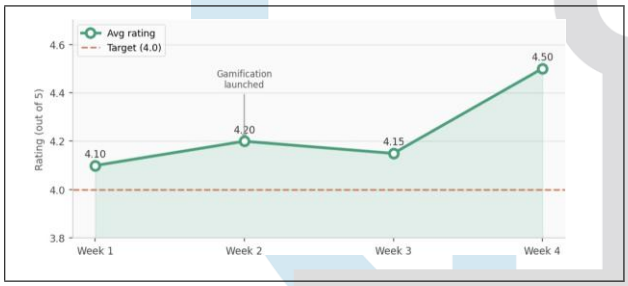

Fig. 8: User Feedback Rating Over Time

D. Star Rating Breakdown Of 286 feedback responses: 41

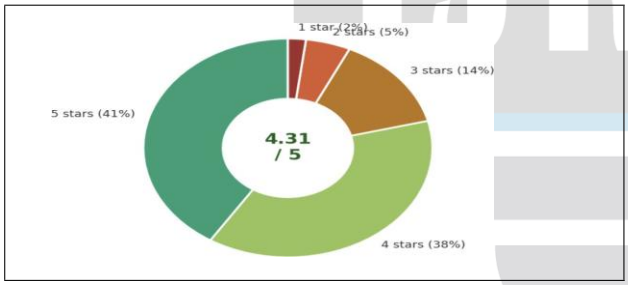

Fig. 9: Star Rating Distribution

E. User Retention and Session Engagement After introducing gamification in Week 2, average session duration climbed from 6.2 minutes to 8.3 minutes — a 34

VII. Security and Ethical Responsibilities

A. Protecting Traditional Knowledge from Misuse Traditional medicinal knowledge is not abstract data — it belongs to communities, lineages, and living traditions. Every plant record on our platform is linked to at least two documented sources: either a recognized AYUSH pharmacopeia (CCRAS, API, HPI, TK-DL), peer-reviewed research, or a verified practitioner who has given explicit consent for attribution. The

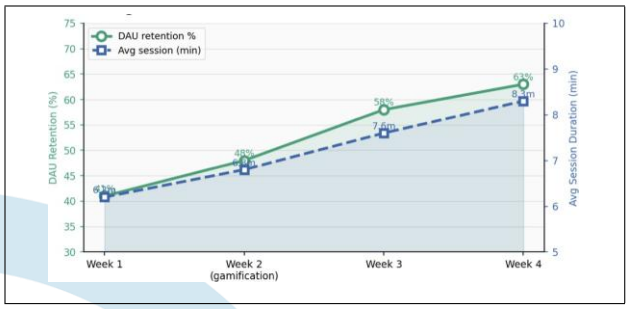

Fig. 10: User Retention and Session Duration

blockchain record for each entry includes these source links as immutable metadata, making it structurally difficult to publish a plant profile with unverified or misattributed claims.

B. Medical Safety and Honest Disclaimers Every home remedy entry must include: a typical dosage range, specific contraindications (pregnancy, known allergies, common pharmaceutical drug interactions), and a direct link to the doctor consultation module for conditions that go beyond minor everyday ailments. The chatbot automatically escalates to the doctor consultation page when it detects queries involving chronic illness, medication combinations, or pediatric use.

C. User Privacy Our data handling practices are built around India's Digital Personal Data Protection Act, 2023. The platform collects only what is necessary. Health-related queries are not linked to user identities in our analytics database — they are aggregated and anonymized before storage. Users can view everything stored about them and delete their accounts completely at any time through the settings panel.

VIII. What Comes Next

We are honest that the current platform is a strong first version, not a finished product. Here is what we are actively working toward:

- Regional Language Expansion: Full Hindi support is live; Marathi, Tamil, and Telugu are in development using the IndicNLP toolkit.
- FHIR Integration: Mapping plant and remedy records to HL7 FHIR R4 resources so the platform can communicate with EHR systems used in AYUSH hospitals.
- IoT Sensor Integration: Partnering with university herbal gardens to install soil moisture, pH, and temperature sensors feeding real-time care alerts.
- Augmented Reality Identification: An AR overlay for the mobile camera that identifies plants in real time and displays medicinal properties as spatial labels.
- Community Knowledge Contributions: A moderated portal where certified AYUSH practitioners can submit new remedy formulations with blockchain timestamping.
- Clinical Outcome Tracking: An optional anonymized feature where users can log whether a remedy helped them, building a real-world evidence layer for pharmacovigilance research.

IX. Conclusion

The Digital Herbal Garden started from a straightforward observation: the knowledge that could help people live healthier lives was out there, but it was not accessible in a form that most people could actually use. Thousands of years of Ayurvedic, Unani, Siddha, and Homeopathic wisdom had no single, trustworthy, interactive home on the internet — at least not one that combined rigorous data with a user experience designed for non-specialists.

The best version of this platform is one where a student in rural Maharashtra can identify a plant growing outside their window, read about its traditional and clinical uses, get a reminder to water it, and then take a quiz to solidify what they learned — all without a reliable internet connection. We are not there yet, but we are closer than when we started.

The developed platform offered here is the bridge between traditional wisdom and modern technology, and offers a simple but comprehensive resource for the study of medicinal plants in Ayurveda, Yoga, Naturopathy, Unani, Siddha, and Homeopathy.

The platform caters to various audiences, including students, health professionals, and natural medicine enthusiasts which provides user-friendly features .

This initiative is not only opening up the availability of ancient knowledge but also making it sustainable for the future.

Through the platform, innovation and commitment therefore encourage deeper awareness and appreciation of how medicinal plants play a role in holistic health and wellness.

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