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Article

Website-Based Medicinal Plant Information System Design for Universitas Pahlawan Botanical Garden Using the Prototype Method

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A B S T R A C T

The Medicinal Plant Collection Garden of the Universitas Pahlawan (UP) Botanical Garden manages 60 medicinal plant species; however, public dissemination remains limited, and the on-site QR codes still direct visitors to the general Wikipedia platform. This study designs and builds a Medicinal Plant Information System website integrated with an independent QR code system based on validated local data. Validation of botanical data and medical warnings was approved by the Person in Charge of the UP Botanical Garden (a healthcare expert) and synchronized with ethnobotanical literature. The system was developed using the Prototype using Laravel 10 and a MySQL database through Role-Based Access Control for Visitors, Administrators, and the Person in Charge. Key features include a QR-code-enabled botanical catalog, an activity gallery, news articles, public reviews, and a PDF report printing module. Testing was conducted through Black Box Testing across 28 functional scenarios and 5 non-functional tests, covering input validation and access security. Evaluation of User Acceptance Testing (UAT) involved 5 respondents (3 Visitors, 1 Administrator, and 1 Person in Charge) using a task-based instrument, achieving a 100% pass rate across 12 test scenarios. The system operates reliably and has the potential to facilitate improvements in digital botanical literacy while supporting conservation governance at the UP Botanical Garden.

1. Introduction

The use of medicinal plants by communities in Indonesia has been practiced for generations, through processing the stems, roots, leaves, or bark to relieve pain and maintain health (Ambarwati et al., 2024; Andriani et al., 2022; Kumontoy et al., 2023).

Communities living around forest areas have used medicinal plants from generation to generation based on the knowledge, traditions, and customs passed down from their ancestors (Kameswari, 2023; Purwanto & Sumardi, 2022). The medicinal plants selected are often not based on accurate medical knowledge, but rather rely solely on experience inherited from previous generations (Ahmad & Salim, 2025).

Therefore, the public requires structured and verifiable information regarding botanical taxonomy, empirical benefits, and medical safety warnings to prevent misidentification, improper usage, and the neglect of local medicinal flora (Kumontoy et al., 2023). Delivering this knowledge necessitates an institutional and validated digital platform to ensure that public botanical education remains scientifically sound, reliable, and practically actionable (Kumontoy et al., 2023).

As part of its effort to preserve the environment, particularly regarding the diversity of medicinal plant species, Universitas Pahlawan Tuanku Tambusai established the Universitas Pahlawan Botanical Garden (hereinafter referred to as the UP Botanical Garden). Botanical gardens serve an important function as centers for conservation, education, and research on biodiversity (D. Rahmawati et al., 2026). In terms of its physical condition, the UP Botanical Garden has varied terrain, ranging from gently sloping valley areas to hilly regions with steep gradients. This conservation area is divided into two main sections, namely Block A covering 27 hectares and Block B covering an area of 125 hectares (Bachry et al., 2024).



Figure 1. Medicinal Plant Collection Garden

Within the UP Botanical Garden area, medicinal plant management takes place in the Medicinal Plant Collection Garden, which covers an area of approximately 1 hectare. At present, the garden manages roughly 60 species of medicinal plant collections, a number that will continue to grow as the garden is further developed. Based on interviews with the Head of the UP Botanical Garden, this Medicinal Plant Collection Garden is not yet widely known to the public because the information currently available is still limited to banners and social media. As a result, its information outreach is not yet optimal and can only be accessed by certain groups.



Figure 2. Plant QR Code

Every medicinal plant in the Medicinal Plant Collection Garden of the UP Botanical Garden has been fitted with a QR code (Figure 2) that directs visitors to the Wikipedia platform. Field evaluation of this old QR code system showed that physical scanning using various visitors' smartphone cameras worked well and responsively. However, this marker system has limitations because it fails to present relevant information when local botanical data records are not available on that platform. This results in information that is less specific to the medicinal plant collection at the UP Botanical Garden, not yet validated by local health experts, and vulnerable to content changes by external parties whose scientific validity is difficult to verify.

As a solution to this problem, a medium needs to be designed and built that can connect visitors, in this case the public, with all information related to the Medicinal Plant Collection Garden at the UP Botanical Garden.

One information medium that can be accessed by anyone from anywhere is a website

The medicinal plant information system website was developed using the Laravel 10 framework and a MySQL database. This study applies the prototype development method because it allows for continuous interaction. This is essential to ensure that the data presented for the 60 medicinal plant species is accurate and that the features developed meet the needs of the Medicinal Plant Collection Garden. Through this prototype method, functional errors can be detected and corrected early based on direct user feedback, using the black box (User Acceptance Test) method.

This website is designed as a digital information platform that replaces the use of a general reference (Wikipedia) with local data from the Medicinal Plant Collection Garden of the UP Botanical Garden. As a result, all information about the medicinal plant species found in the Medicinal Plant Collection Garden of the UP Botanical Garden can be made available and accessed by the public. This ease of access to information can optimize the function of the Medicinal Plant Collection Garden in preserving medicinal plants, providing a means for education and research, and improving public literacy and understanding of medicinal plants within the UP Botanical Garden.

2. Literature Riview

2.1 System Design and Development

System design and development is a systematic process that includes the stages of planning, sketching, and organizing various separate elements into a unified functional whole (Lubis et al., 2025). In its development, the design of botanical and family medicinal plant information systems has been widely studied using various software architecture approaches. Several previous studies have developed web-based plant catalog systems to replace conventional information media.

For example, the design of a medicinal plant information system at the Indonesian Spice and Medicinal Crops Research Institute (BALITTRO) by Rifai et al. (2025) successfully digitized the plant catalog through a PHP- and MySQL-based website, although its implementation had not yet integrated a dynamic physical marker module in the field. In another study, the integration of visual codes such as Quick Response (QR) Codes has been applied for recording and identifying medicinal plants, among others by Pratiwi et al. (2024) and Yazid et al. (2023). Although QR code scanning facilitates access to information, these systems still depend on third-party platforms or secondary document storage media (such as PDF documents on Google Drive) that are not directly connected to a local database server.

Meanwhile, other research on medicinal plant information system design has focused on independent web-based classification (Mangadi et al., 2022) or has been limited to designing user interface prototypes using Figma without a complete database construction (Gamas et al., 2022). The limitations of previous studies reveal a research gap in the provision of an independent digital botanical platform within botanical garden conservation areas. Most systems have not yet integrated physical QR code labels in the field directly into an internal database validated by local managers. This gap is what the design of SITOBAT in this study addresses. The system was built using the Laravel 10 framework and a MySQL database, which independently connects 60 physical specimen QR codes at the UP Botanical Garden to verified local botanical data, complete with multi-actor access control, dynamic content management, and an official printed report export module.

2.2 Website

A website is a hypertext-based information system stored on an internet web server, in which information is presented in various formats such as text, images, and sound (Suli & Nirsal, 2023).

2.3 Medicinal Plants

Medicinal plants are plants with therapeutic properties that produce medicinal effects on the body. They can be used through various methods, ranging from consumption, inhalation, and washing, to direct application (Kemal et al., 2024).

2.4 UP Botanical Garden

Through a strategic collaboration between Universitas Pahlawan Tuanku Tambusai and the National Research and Innovation Agency (BRIN), the UP Botanical Garden has been designated as a conservation area systematically focused on the preservation and protection of nature. Based on the mapping shown in Figure

1.1, the total land area of this site reaches ± 152 hectares, which is administratively divided into two main zones, namely Block A covering 27 hectares and Block B covering 125 hectares (Bachry et al., 2024).

2.5 Laravel

Laravel is an open-source PHP framework developed to optimize efficiency and speed in the process of building website-based applications (L. Rahmawati & Sumarsono, 2024).

2.6 MySQL

In system development, MySQL plays a crucial role in storing all the data contained within the website application being analyzed. This makes MySQL the primary database for maintaining the integrity of information (F. A. A. Setiawan et al., 2022).

2.7 UML

Unified Modeling Language (UML) is an international standard language applied for software modeling (Khairunnisa & Voutama, 2024).

2.8 Prototype Method

This study applies the prototype method to facilitate direct interaction between developers and users, so that the system built can accurately represent user needs (R. Setiawan et al., 2025).

The selection of the Prototype method over alternatives such as Agile or Rapid Application Development (RAD) was driven by the specific operational context of the UP Botanical Garden. While Agile prioritizes rapid sprint-based feature drops suited for large multidisciplinary software teams, and RAD relies on rigid time-boxed component reuse requiring extensive modular parallelism, the Prototype approach is uniquely suited for specialized domain digitization where domain experts (clinical supervisors and conservationists) require tangible visual interfaces and interactive data structures to systematically validate sensitive botanical and medical content.

The prototyping process model is executed through six sequential stages, each linked to a documented artifact (Putri et al., 2023):

a) Requirements Analysis: Identifies and specifies all necessary functional system parameters with garden authorities. Documented artifact: Software Requirements Specification (SRS).

b) Quick Design: Outlines initial architectural flows and interface structures. Documented artifacts: Unified Modeling Language (UML) diagrams, Entity Relationship Diagram (ERD), and preliminary interface layouts.

c) Prototype Construction: Realizes designs into interactive models using Figma and early functional programming with Laravel 10 and MySQL. Documented artifacts: Interactive UI mockups and operational alpha-stage prototypes.

d) Initial User Evaluation: Demonstrates workflow mechanisms to stakeholders to assess system behavior directly. Documented artifacts: Black Box test sheets and User Acceptance Testing (UAT) task protocols.

e) Prototype Refinement: Processes feedback to remediate system defects, such as incorporating medical usage warnings, optimizing catalog navigation, and redirecting QR codes to internal database endpoints. Documented artifact: System revision audit log and refined prototype.

f) Implementation and Maintenance: Deploys the fully validated application onto online hosting servers and enforces periodic maintenance routines. Documented artifact: Live operational web platform.

2.9 Black Box Testing: User Acceptance Test (UAT)

Black Box Testing is a software evaluation technique that focuses on testing the features and functionality of an application without needing to understand the details of its internal structure or source code. This approach plays a crucial role in validating that the system operates in accordance with its specified requirements and is able to produce accurate output based on the input provided, without regard to the underlying data-processing mechanism (Fauzi & Yunial, 2025).

User Acceptance Testing (UAT) is the final verification stage in which users directly try out the system to ensure that the resulting digital solution meets their needs (Nurvalentini et al., 2024).

3. Research Methodology

3.1 Research Approach

This study employs an integrated research design combining a qualitative descriptive approach for requirements elicitation with structured software engineering evaluation methods. The research was conducted at the Medicinal Plant Collection Garden of the UP Botanical Garden on Jalan Tuanku Tambusai No. 23, Bangkinang Kota, Kampar Regency, Riau.

Data collection engaged three purposively selected key informants based on institutional governance and clinical qualifications: the Head of the UP Botanical Garden (Dr. Syamsul Bachry, M.Si.) for institutional policy and conservation directives; the Person in Charge of the Collection Garden (Ners Riani, M.Kes., a registered nursing professional holding a Master of Health degree) for validating botanical attributes, empirical efficacy, and medical usage warnings; and field maintenance staff (Habibi Saputra) for on-site specimen verification and visitor interaction insights. Primary data were gathered through structured field observations and in-depth interviews from February to May 2026.

Inclusion criteria were strictly limited to the 60 living medicinal plant species cultivated within the 1-hectare collection zone. To maintain scientific accountability, a tiered evidence hierarchy was implemented: (1) botanical identity and taxonomic nomenclature (scientific Latin names) were cross-checked against garden records and standardized botanical references; (2) medicinal properties were classified as empirical traditional knowledge and verified against accredited ethnobotanical peer-reviewed journals and pharmacological textbooks rather than absolute clinical claims; and (3) each plant profile incorporates a mandatory "Medical Usage Warning" field approved by the health supervisor to prevent improper self-medication. Any discrepancies between generic online repositories and garden specimens were resolved by the Collection Supervisor and the Garden Director.

Data trustworthiness was verified through threefold triangulation: source triangulation (reconciling supervisor catalog records with daily field staff observations); technique triangulation (combining direct field observations, informant interviews, original photographic documentation, and literature reviews); and time triangulation (periodic consistency audits conducted throughout the development timeline from February to May 2026).

3.2 Prototype Development Stages

System development applied the Prototype method across six continuous stages, delivering concrete outputs at each iteration:

1) *Requirements Gathering and Analysis:* Identified stakeholder requirements through on-site observations and semi-structured interviews with the Head of the UP Botanical Garden, Collection Supervisor, and maintenance staff. This stage yielded a Software Requirements Specification covering 10 functional and 5 non-functional requirements, encompassing the digitization of 60 medicinal plant species, botanical news, photo galleries, visitor traffic statistics, review moderation, and formal PDF reporting.
2) Quick Design: Modeled system behavior using Unified Modeling Language (UML)—including use case diagrams, activity diagrams, sequence diagrams, and a 9-class diagram. The relational schema was formulated through an Entity Relationship Diagram (ERD), while user interface layouts were designed as interactive Figma mockups.
3) Build Prototype: Constructed a functional web application using the Laravel 10 framework and MySQL database. Outputs included public catalog modules uniquely linked to 60 on-site physical QR codes via URL slugs alongside secure administrative management dashboards.
4) User Evaluation: Conducted structured evaluations involving 5 participants (3 public Visitors, 1 Administrator, and 1 Garden Supervisor). Functional paths were evaluated through Black Box Testing across 28 scenarios, while user acceptance was assessed via User Acceptance Testing (UAT) comprising 12 guided task-completion cases conducted on mobile smartphones (Android/iOS) and desktop browsers with 15–30 minutes per testing session.
5) Refining Prototype: User feedback drove four key refinements: (a) incorporating structured medical usage warning attributes

into plant profiles upon recommendations by the health supervisor; (b) streamlining main navigation layouts and adding search filters; (c) repointing physical QR code references from Wikipedia to internal database endpoints; and (d) enforcing rigorous server-side form validation rules to prevent null inputs and submission errors.

6) Implement Product and Maintain: The final application was deployed online under HTTPS/SSL protocols to secure data transmission. Maintenance procedures include scheduled SQL database backups, server uptime monitoring, and ongoing botanical record updates by authorized administrators.

Traceability among user requirements, data structures, interface features, and system testing (Requirements Traceability) is mapped as follows:

1) Plant Collection & Medical Warnings: Visitor needs for validated botanical data are met through the functional requirement of QR code scanning, modeled in the tanaman_obats and kategoris database entities, implemented in the Plant Detail Page interface (/tanaman/{slug}), and tested through scenarios F-05, F-06, NF-05, and UAT-TC-03.
2) Conservation Publication & Gallery: Information needs for garden activities are met through news article and visual gallery features, stored in the beritas and galeris entities, accessed through the News and Interactive Gallery interfaces, and tested through scenarios F-07, F-08, UAT-TC-04, and UAT-TC-05.
3) Public Feedback: User interaction needs are accommodated through review submission and moderation, recorded in the ulasans entity, displayed on the public review form and the admin moderation table, and verified through test cases F-09, F-10, F-21, UAT-TC-06, and UAT-TC-09.
4) Master Data & QR Code Management: The admin's botanical governance needs are realized through data CRUD features and QR code printing, operating on the tanaman_obats entity, provided in the administrative panel (/admin/tanaman), and tested through cases F-17, F-18, F-19, and UAT-TC-08.
5) Visit Monitoring & Reporting: Evaluation needs of the garden's Person in Charge are met through traffic visualization and official PDF export, utilizing the pengunjungs and tanaman_obats entities, presented on the analytics chart dashboard and the print-report button, and tested through F-12, F-26, F-27, UAT-TC-11, and UAT-TC-12.

Information security and technical governance are maintained through several protocols:

1) Role-Based Access Control (RBAC) & Authorization: System access is strictly partitioned via Laravel middleware into three operational tiers: Visitors (read-only public access), Administrators (full CRUD access to plants, categories, news, galleries, and review moderation), and the Person in Charge (read-only analytical monitoring and certified PDF report exports).
2) Password Storage & Session Handling: User credentials are encrypted using one-way Bcrypt hashing within the users table. Session security is enforced through unique session tokens that are invalidated and cleared upon user logout.
3) Input Validation & Data Protection: Server-side validation is enforced on all input forms to safeguard against Cross-Site Scripting (XSS) and empty submissions. Image uploads are restricted to a maximum of 2 MB with strict MIME-type validation (jpg/png). Public review submissions are queued in an administrative moderation pipeline prior to public display to mitigate spam.

Visitor Privacy & Audit Logging: Non-personally identifiable visit logs (IP address, user agent, country of origin, and timestamp) are stored within the pengunjungs table solely for aggregate traffic analytics, ensuring that sensitive personal visitor data is never captured.

4. Results and Discussion

4.1. System Requirements Analysis

The requirements analysis established a role-governed information system featuring three primary actors to ensure data accountability and eliminate unauthorized clinical assertions:

1) Visitor: Public users who interact with the front-end interface in a read-only capacity

without authentication. Visitors can scan on-site QR codes to inspect the taxonomic profiles, empirical uses, and safety warnings of 60 medicinal plant species, browse garden news and image galleries, and submit feedback reviews through a secured public form.

2) Admin: Technical operators entrusted with data management. The administrator authors, updates, and maintains master records (plants, categories, news, and galleries), generates and downloads printable on-site QR code assets, manages internal user credentials, and moderates inbound visitor reviews to eliminate spam.
3) Person in Charge (PIC): Garden and healthcare supervisory authorities (holding clinical and conservation credentials) tasked with reviewing and approving botanical entries and medical usage warnings prior to public release. The PIC monitors live visitor analytics, responds to public feedback, and generates certified periodic PDF management reports.

To safeguard against the inadvertent dissemination of unverified therapeutic claims, operational boundaries are formally defined in the Role-Permission Matrix presented in Table 1.

Table 1. Role-Permission Matrix across System Content and Modules

Content Type / Module	Visitor	Administrator	Person in Charge (PIC)
Medicinal Plant Catalog	Read	Create, Edit, Delete	Review, Approve, Read
Medical Usage Warnings	Read	Edit (under PIC oversight)	Author, Review, Approve, Read
QR Code Generation & Export		Create, Download	Read, Download
Plant Categories	Read	Create, Edit, Delete	Read
News & Botanical Articles	Read	Create, Edit, Delete, Publish	Review, Read
Photo Galleries	Read	Create, Edit, Delete, Publish	Read
Visitor Feedback Reviews	Read	Moderate, Delete	Read, Respond
Visitor Traffic Analytics	Create (Submit)	Read	Monitor, Analyze
Certified Periodic PDF Reports			Generate, Export (Download)
User Account Administration		Manage (CRUD)	Read

Legend: Create (input entry), Read (view only), Edit (modify record), Delete (remove record), Author (formulate clinical text), Review (audit accuracy), Approve (authorize publication), Moderate (verify public reviews prior to rendering), Respond (reply to user inquiries), Generate/Export (produce official PDF summaries).

4.2. System Interface Implementation

The Medicinal Plant Information System (SITOBAT) was implemented with a public interface featuring Home, Medicinal Plants, Gallery, News, and Reviews navigation menus, along with a dynamic language selector. The homepage presents a "Most Popular Plants" collection—determined by QR-code scan frequency and catalog traffic—along with real-time visitor-reach statistics categorized by country of origin (Figure 3).

The visitor-country analytics module operates via automated server-side IP-based geolocation lookup triggered upon accessing public routes, rather than relying on self-reported inputs or commercial tracking services. To preserve user privacy, data minimization is enforced through subnet IP anonymization (masking the final octet) prior to database insertion in the pengunjungs table, ensuring records remain completely non-personally identifiable. Visit logs are governed by a 12-month retention policy to fulfill the botanical garden's annual institutional reporting cycles before being converted into aggregated statistical counts. Operational accuracy constraints are explicitly recognized, as location inference reflects ISP gateway routing or active Virtual Private Network (VPN) endpoints rather than exact physical coordinates.

The language selector supports multiple global languages via a dynamic localization engine, featuring Indonesian as the primary baseline reference alongside English as the international translation standard to accommodate foreign visitors. This mechanism provides consistent translation across navigation menus, taxonomic profiles for all 60 medicinal

plant species, empirical therapeutic descriptions, and vital medical usage warnings. In contrast, official administrative management PDF reports are generated exclusively in formal Indonesian to adhere strictly to institutional compliance and archival documentation standards.

Each medicinal plant has a dedicated detail page displaying its local vernacular name, scientific botanical name, medicinal category, morphological description, geographic origin, empirical therapeutic benefits, and medical usage warnings, thereby replacing the generic Wikipedia reference with verified institutional data (Figure 4).

Because therapeutic claims and contraindications constitute safety-critical content, the plant detail view is governed by a structured content schema incorporating species-specific literature citations, reviewer credentials, and a last-updated revision timestamp. All botanical data, taxonomic scientific names across the 60 cultivated species, empirical therapeutic properties, and medical warnings were rigorously validated by the Person in Charge of the Medicinal Plant Collection Garden (Ners Riani, M.Kes., a qualified healthcare professional) against verified ethnobotanical literature and on-site collection standards. Once fully audited and approved by the Collection Supervisor, the validated records were handed over to the Administrator for input into the system and publication on the public web catalog.

To mitigate public health risks associated with uncontrolled self-medication, a prominent public-health disclaimer is embedded across all species detail pages. The notice clarifies that cataloged entries represent traditional ethnobotanical knowledge compiled for conservation and educational purposes rather than clinical prescriptions. Visitors are explicitly instructed to seek direct clinical consultation from qualified medical practitioners for diagnostic evaluations and formal pharmacological interventions.

This page serves as a documentation space for the activities and medicinal plant collection of Universitas Pahlawan in the form of a digital album (Figure 5).

The news page presents an organized catalog of news articles and operational updates concerning the Medicinal Plant Collection Garden at the Universitas Pahlawan Botanical Garden (Figure 6).

The public web interface, including the news feeds and media galleries, was developed to satisfy core usability and web accessibility criteria for on-site field engagement. The layouts follow a mobile-first responsive architecture using Bootstrap grids, ensuring that text blocks and photographic assets adapt seamlessly across diverse smartphone screen viewports without horizontal scrolling defects. Navigation efficiency is supported by a persistent header menu alongside breadcrumb trails for intuitive transitions between articles and botanical catalog archives. Visual readability is reinforced through clean sans-serif typography calibrated to maintain a contrast ratio of at least 4.5:1 against light backgrounds in accordance with WCAG 2.1 Level AA standards, securing legibility under direct outdoor sunlight. Furthermore, all photographic media feature descriptive HTML alternative text attributes to assist screen-reading tools and manage low-bandwidth network environments, while a dynamic localization selector ensures broad language accessibility by presenting clear vernacular terminology alongside formal botanical nomenclature.

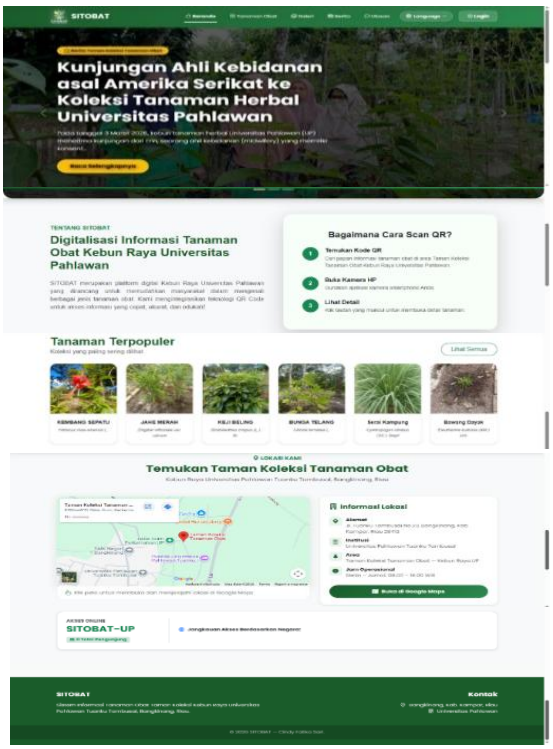


Figure 3. Homepage

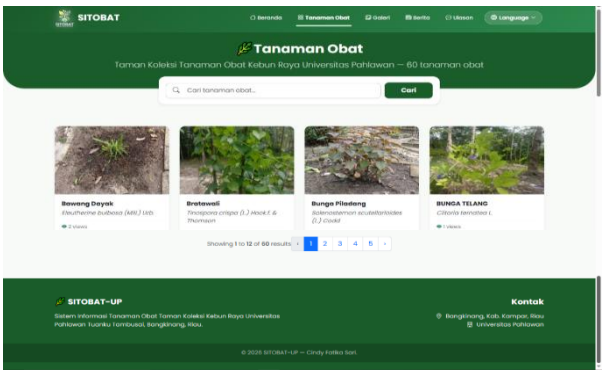


Figure 4. Medicinal Plants Page

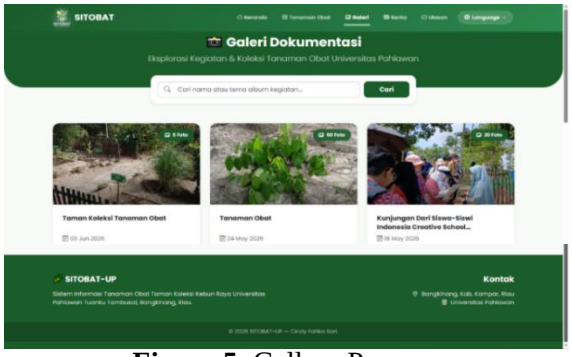


Figure 5. Gallery Page

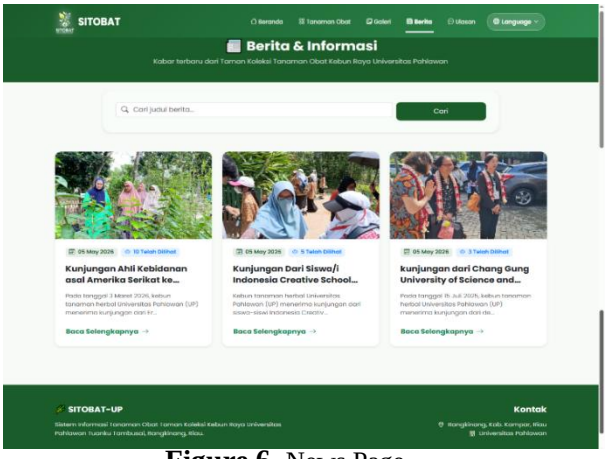


Figure 6. News Page

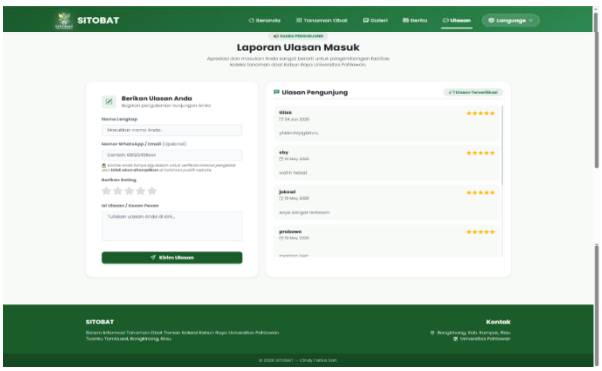


Figure 7. Reviews Page

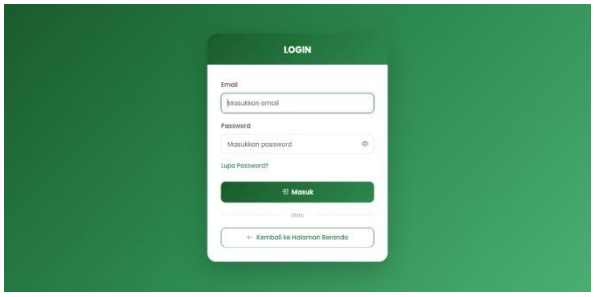


Figure 8. Login Page

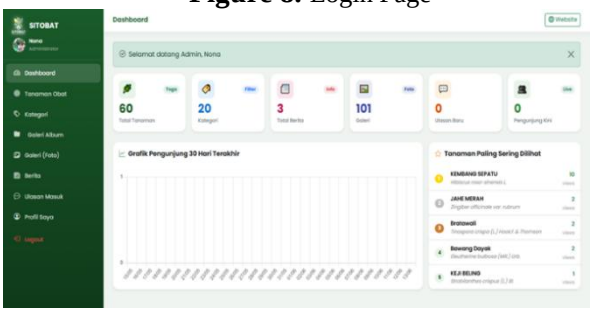


Figure 9. Admin Dashboard Page

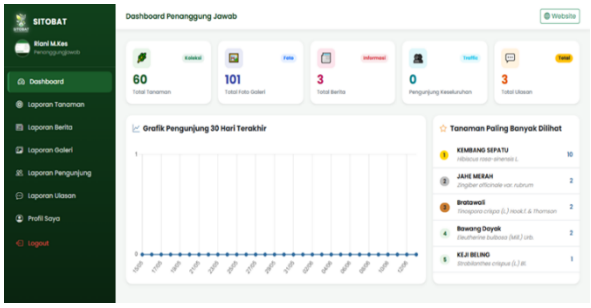


Figure 10. Person-in-Charge Dashboard Page

4.3. System Testing Results

Functional verification was executed using the Black Box Testing method to validate software reliability without inspecting internal source code structures. Testing was conducted between May 15 and May 20, 2026, across diverse testing environments: mobile browsers (Google Chrome v124 on Android 13/14 and Safari on iOS 17) and desktop browsers (Google Chrome v124 and Microsoft Edge v124 on Windows 11). A total of 28 test scenarios were formulated, encompassing standard operational workflows as well as rigorous negative test cases (*boundary inputs, invalid uploads, access-control violations, and 404 error fallbacks*). All 28 scenarios achieved a 100% success rate (*Pass*), as detailed in Table 2.

Table 2. Black Box Functional Test Execution Matrix (28 Scenarios)

ID	Feature/Module	Test Scenario & Data	Expected Result	Status
F-01	Home page	Visitor opens the main URL of the medicinal plant information system.	The homepage loads displaying a brief profile, navigation menu, medicinal plant catalog, latest news, activity gallery, and visitor reviews without error.	Pass
F-02	Main Menu Navigation	Visitor clicks one of the navigation menus (Category, Gallery, News, etc.).	The system directs the visitor to the page corresponding to the selected menu without *error*.	Pass
F-03	Local Name Search	Visitor types a plant's local name into the search field (e.g., "Sirih").	The system displays a list of plants matching the entered local name keyword.	Pass
F-04	Scientific Name Search	Visitor types the plant's scientific/Latin name (e.g., "Piper betle").	The system displays the plant matching the entered scientific name.	Pass
F-05	Benefit Category Search	Visitor selects or types a specific benefit category (e.g., "Anti-inflammatory").	The system displays the list of plants included in the selected benefit category.	Pass
F-06	Search With No Results	Visitor enters a keyword that is not registered in the database.	The system displays a message that no data was found without generating an error.	Pass
F-07	Medicinal Plant Detail	Visitor clicks one of the plants in the catalog or search results.	The detail page fully displays the local name, scientific name, origin, description, medical benefits, and an original photo of the plant.	Pass
F-08	Submit Suggestion/ Review	Visitor fills out the suggestion/review form with valid data, then presses the submit button.	The message is saved to the system and the visitor receives a notification that it was successfully sent.	Pass
F-09	Review Form Validation	Visitor submits the suggestion/review form without filling in a *field* required field.	The system displays a validation message and rejects saving the empty data.	Pass
F-10	*Login* Internal User	Admin/Person in Charge enters a correct *email* and password on the *login* page.	The system successfully authenticates and redirects the user to the dashboard corresponding to their respective role.	Pass
F-11	*Login* Failure	Internal user enters an incorrect *email*/password combination.	The system denies access and displays a message that the credentials are invalid.	Pass
F-12	*Logout*	Admin/Person in Charge presses the exit (*logout*) button on the dashboard.	The user session ends and the system redirects back to the *login* page; the dashboard cannot be accessed without logging in again.	Pass
F-13	Admin Dashboard	Admin successfully *login*s into the system.	The dashboard displays a summary of the total plant, category, news, gallery, and incoming review data.	Pass
F-14	Person in Charge Dashboard	Person in Charge successfully *login*s into the system.	The dashboard displays a summary of the total plant, category, news, gallery, and review data according to the Person in Charge's access rights.	Pass
F-15	Add Plant Data	Admin fills out the add-plant form with valid and complete data.	The new plant data is successfully saved and displayed in the plant data list.	Pass
F-16	Edit Plant Data	Admin edits one of the existing plant records.	The data changes are saved and displayed according to the latest *input*.	Pass
F-17	Delete Plant Data	Admin deletes one of the plant records.	The plant data is deleted from the system and no longer appears in the data list.	Pass

F-18	Plant Form Validation	Admin saves the plant data form with a required *field* left blank.	The system rejects the save and displays a validation message for the required *field*.	Pass
F-19	Generate QR Code	Admin presses the generate button for a plant's QR code.	The system creates a unique QR code linked to the corresponding plant's detail page.	Pass
F-20	Download QR Code	Admin presses the download button on the generated QR code.	The QR code file is successfully downloaded as an image file.	Pass
F-21	Manage Category Data	Admin adds, edits, or deletes plant category data.	The category data is saved, changed, or deleted according to the action performed and appears in the category list.	Pass
F-22	Manage Photo Gallery Album	Admin uploads new photos and manages the activity gallery album.	The album and photos are correctly saved and displayed on the public gallery page.	Pass
F-23	Manage News Content	Admin adds, edits, or deletes internal news content.	The news content is saved/changed/deleted according to the action and appears on the latest news page.	Pass
F-24	Plant Recapitulation Report	Person in Charge opens the plant data recapitulation report menu.	The system accurately displays the plant data recapitulation according to the stored data.	Pass
F-25	Visitor Statistics Chart	Person in Charge opens the visitor statistics dashboard.	The system displays a chart of daily visitor count statistics according to the recorded data.	Pass
F-26	Incoming Review Monitoring	Person in Charge opens the visitor review/suggestion menu.	The system displays the list of reviews or suggestions submitted by visitors.	Pass
F-27	Print Report	Person in Charge presses the print button on the plant data report page.	The system generates a *print preview* of the report matching the current data.	Pass
F-28	Export Report to PDF	Person in Charge presses the download/export PDF button on the report page.	The system successfully generates a PDF report file that can be downloaded properly.	Pass

Table 3. Non-Functional Testing

ID	Testing Aspect	Test Scenario & Data	Expected Result	Status
NF-01	*Usability* (Ease of Use)	User opens and operates the system from a smartphone or computer device, then navigates through the main navigation menu structure.	The layout remains neat, adapting to screen size (*responsive*), buttons are properly clickable, and the navigation structure is easy to understand, facilitating digital literacy about medicinal plants.	Pass
NF-02	*Availability* (Availability)	User accesses the medicinal plant information system URL at various times, including outside working hours, over the internet.	The system can be accessed *online* by the public 24 hours a day without limitations of space or time.	Pass
NF-03	*Security* (Security)	(1) Password encryption testing. (2) Attempted access to Person in Charge features/ menus using an Admin account, and vice versa.	Passwords are stored in encrypted form; the system enforces access separation between Admin and Person in Charge according to the *Role-Based Access Control* (RBAC).	Pass
NF	*Performa*	Visitor	The system	Pass

-04	*nce* (Performance)	scans a plant's QR code using a smartphone camera directly in the field (Botanical Garden).	responds to the scan request quickly (*real-time)* and immediately displays the corresponding medicinal plant's detail page.	
NF-05	*Environment* (Environment)	User accesses the system (based on PHP, *framework* Laravel 10, and a MySQL database) using several different types of browsers such as Chrome, Firefox, and Edge.	The system can be accessed and runs normally on all tested browsers, without any display or functional errors.	Pass

Operational acceptance was quantitatively evaluated through a structured User Acceptance Testing (UAT) protocol administered across 5 representative stakeholders: 3 public visitors, 1 technical administrator, and 1 collection supervisor (qualified healthcare practitioner). Testing utilized a guided task-completion methodology comprising 12 predefined test assignments (UAT-TC-01 through UAT-TC-12) executed over 15–30 minute testing sessions. The predefined acceptance threshold was established at a minimum of 80% independent task completion without researcher intervention.

Quantitative findings confirmed that all participants executed their designated assignments with a 100% completion rate (task completion rate = 100%), comfortably exceeding the 80% target threshold. A summary of actor allocations, task scenarios, and quantitative outcomes is shown in Table 4.

Table 4. User Acceptance Test

Actor Group	Participants	Task Code	Task Scenario Description	Success Metric	Task Completion Rate
Visitors	3	UAT-TC-01	Navigate homepage and browse conservation news	Page renders fully and content is read easily	100% (3/3)
		UAT-TC-02	Search and filter catalog of 60 medicinal species	Locates specified species accurately	100% (3/3)
		UAT-TC-03	Scan physical QR code and review medical warnings	Accesses species slug endpoint instantly	100% (3/3)
		UAT-TC-04	Switch language interface via dynamic selector	Full UI labels and plant content switch cleanly	100% (3/3)
		UAT-TC-05	Submit a visitor review and star rating	Review submitted; displays success feedback	100% (3/3)
Administrator	1	UAT-TC-06	Execute authentication into admin dashboard	Gains access; session token initializes	100% (1/1)
		UAT-TC-07	Create a new botanical record with photo upload	Botanical record committed to database	100% (1/1)
		UAT-TC-08	Generate and download plant QR code graphic	High-res PNG QR asset downloads locally	100% (1/1)
		UAT-TC-09	Review and approve inbound visitor review	Status changes; review renders publicly	100% (1/1)
		UAT-TC-10	Publish news update and garden photo gallery	Media and news update render on public	100% (1/1)

				UI	
Person in Charge	1	UAT-TC-11	Monitor visitor-country distribution graphs	Geolocation analytics chart loads in real-time	100% (1/1)
		UAT-TC-12	Filter and export periodic PDF management report	Structured PDF report compiles and downloads	100% (1/1)

5. Conclusion

The delivery of information regarding the UP Botanical Garden's medicinal plant collection can now reach the public more widely without limitations of space and time through a QR-code-integrated catalog, news, gallery, and review features. This system successfully replaces general Wikipedia links with a self-hosted garden database containing verified plant details and safe medical usage warnings. The testing results confirmed that all features operated properly during both functional tests and user trials.

Nevertheless, this study still has several limitations: the database currently covers only 60 medicinal plant species, the number of informants and test participants was limited to the internal garden environment (3 informants and 5 testers), the research period only ran from February to May 2026 without tracking long-term public usage, and updating plant data still relies on manual checks by garden staff before being uploaded by the admin. For future development, it is recommended to add an interactive plant location map, develop a mobile application that can scan QR codes offline, expand the plant collection list, and observe how the public uses the website over a longer period.

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