Botanical Garden: A QR-Enabled Plant Information System

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Abstract:

Traditional botanical gardens rely on static nameplates that provide minimal information about plants. This research introduces *"***Botanical Garden: A QR-Enabled Plant Information System***"*, a web-based interactive platform designed to enhance learning and plant management. The system integrates QR code technology with a dynamic Django-based database to make plant data accessible through smartphones. Each plant is assigned a unique QR code that redirects to a dedicated webpage containing scientific names, family, uses, and images. Deployed on **PythonAnywhere**, this system improves interactivity, reduces manual maintenance, and promotes environmental awareness. The project demonstrates how modern web technologies can transform conventional gardens into interactive, educational ecosystems.

Keywords: QR Code, Django, Botanical Garden, PythonAnywhere, Web Application, Plant Information System

1. Introduction

Botanical gardens play a vital role in promoting environmental awareness, research, and biodiversity conservation. However, most educational institutions still rely on traditional plant labeling systems that provide only limited information such as the plant's local or scientific name. These static displays reduce opportunities for deeper learning and engagement among visitors and students. With the growing integration of technology in education, there is a need to modernize such systems through interactive digital solutions.
This research introduces the "Botanical Garden: A QR-Enabled Plant Information System," a web-based interactive platform designed to enhance learning and plant data management. The system uses Quick Response (QR) code technology linked to a dynamic Django-based web application. Each plant in the garden is assigned a unique QR code that, when scanned, directs users to a detailed webpage containing the plant's scientific name, family, uses, and images. The platform also includes features such as PDF downloads, feedback submission, and an administrative panel for data management.
By combining environmental education with modern web technologies, this project aims to transform a conventional botanical garden into an interactive, sustainable, and technology-driven learning ecosystem.

2. Literature Review

The use of QR code technology in botanical gardens and environmental education has been widely explored for its potential to enhance accessibility, learning, and plant data management.

Nasir et al. [1] developed a QR-based management system for plant centers, demonstrating that digital tagging can significantly reduce data retrieval time and improve the accuracy of botanical information. Their study showed how QR integration enhances visitor interaction with plant databases. Similarly, **Patil and Patil [2]** proposed the application of QR codes for the digitalization of plant taxonomy, emphasizing its effectiveness in promoting interactive and technology-assisted learning in botanical studies. **Pratiwi et al. [3]** implemented a QR code system for plant identification at Raden Intan Lampung State Islamic University, which improved students' engagement and understanding of plant characteristics through an interactive digital interface. **Truong et al. [4]** applied QR technology for tree management in urban areas, demonstrating how QR codes can support environmental monitoring and facilitate real-time data updates for public awareness.
In addition, **Lee and Huang [5]** discussed the integration of augmented reality (AR) and QR tools in botanical research, highlighting the potential of immersive technologies to enhance both educational and scientific experiences.
While these studies confirm the usefulness of QR-based systems in plant information and environmental management, most lack centralized administrative control and real-time data modification features. Existing implementations primarily focus on static data display and do not support efficient backend management or feedback mechanisms. The proposed system in this research bridges these gaps by developing a Django-based web platform integrated with QR codes and a centralized SQLite database. This design enables dynamic content management, automated QR generation, and real-time updates, thus transforming traditional botanical gardens into interactive, educational, and sustainable digital ecosystems.

3. Methodology

Step 1: System Design

The project follows Django's **Model-View-Template (MVT)** architecture.

- **Model:** Defines database structure for plants, QR codes, and reports.
- **View:** Handles logic for displaying, searching, and updating plant data.
- **Template:** Generates dynamic webpages for each plant.

Step 2: Development Tools

Component	Technology
Programming Language	Python
Framework	Django
Database	SQLite
Libraries	qrcode, pillow, requests, jazzmin
Frontend	HTML, CSS, Bootstrap
Deployment	Pythonanywhere

Step 3: QR Code Integration

Each plant entry automatically generates a static QR code using the *qrcode* library. When scanned, it opens the plant's web page hosted on PythonAnywhere.

Step 4: Features

- QR code-based digital plant profiles
- Search and filter functionality
- Download as PDF option
- Report Issue module for users
- Secure admin panel for data management
- Mobile-responsive interface

Step 5: Workflow

1. Admin adds or edits plant data.
2. The system auto-generates a QR code for the plant.
3. QR code is printed and placed near the plant.
4. Visitors scan it to view detailed plant data online.
5. Users can download or report incorrect information.

4. Results and Discussion

The system was tested on the campus garden, linking real plants to digital profiles.

4.1 Functional Testing Results:

Test Case	Expected Result	Actual Result	Status
QR Code Scan	Redirect to plant page	Works successfully	Pass
Search	Returns correct results	Accurate	Pass
Report Issue	Submits form successfully	Works properly	Pass
PDF Download	Downloads plant details	Properly formatted	Pass

4.2 System Output and Interface

The system successfully replaced traditional static labels with interactive QR codes, enhancing the overall learning experience through digital engagement. It also reduced paper usage and maintenance costs, promoting environmental awareness and technological literacy among students. The web application is deployed on PythonAnywhere and provides a responsive, user-friendly interface for accessing plant data. Each plant card includes scientific and local names, detailed descriptions, and high-quality images.

Users can easily:

- Submit feedback using the “Report Issue” form,
- Download plant details as PDFs for offline study, and
- Scan plant-specific QR codes to instantly view complete plant profiles online.

The admin dashboard allows secure and efficient data management through CRUD (Create, Read, Update, Delete) operations and automated QR code generation for each plant entry.

 Deployed Website: https://ishratjahan.pythonanywhere.com

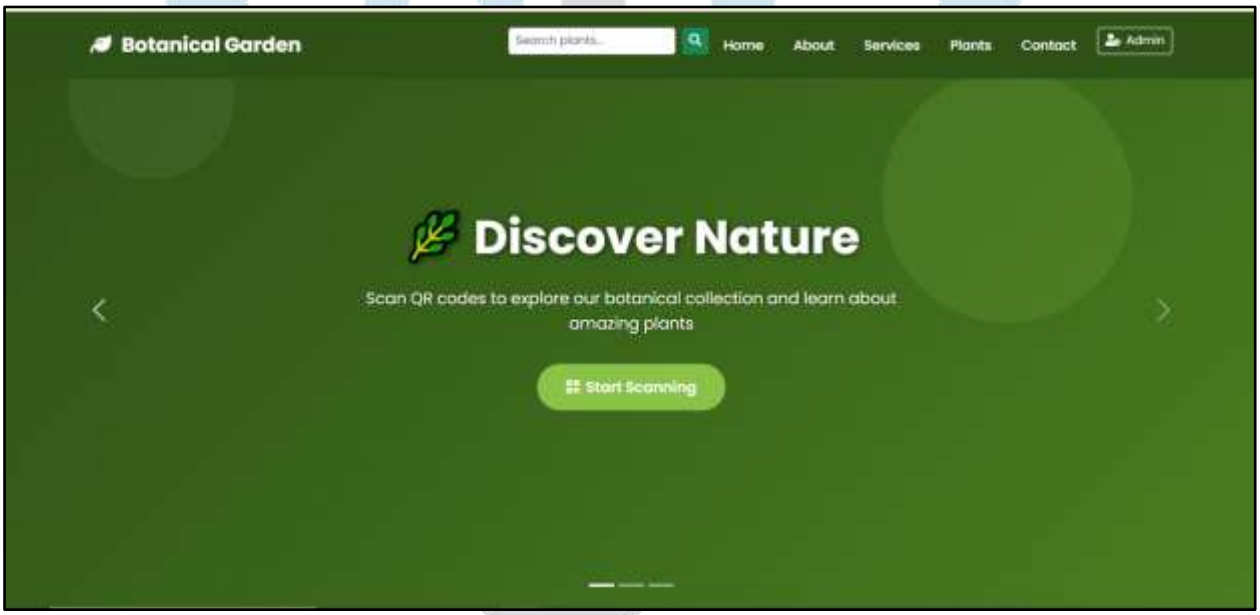


Figure 4.2.1 Home page

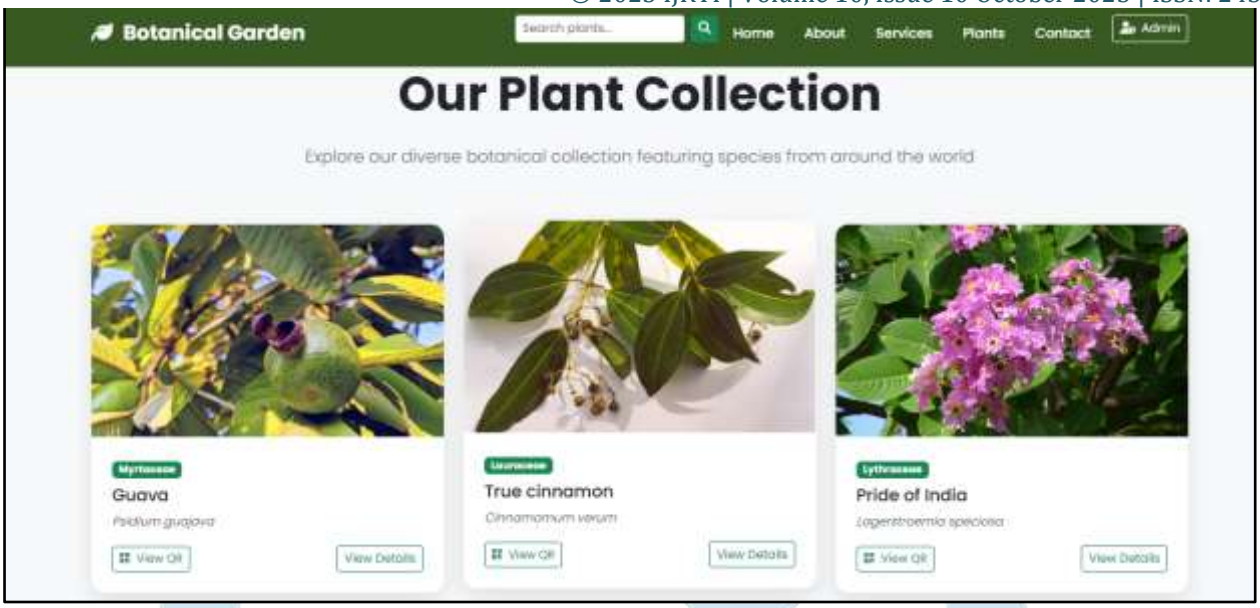


Figure 4.2.2 Plant Gallery page

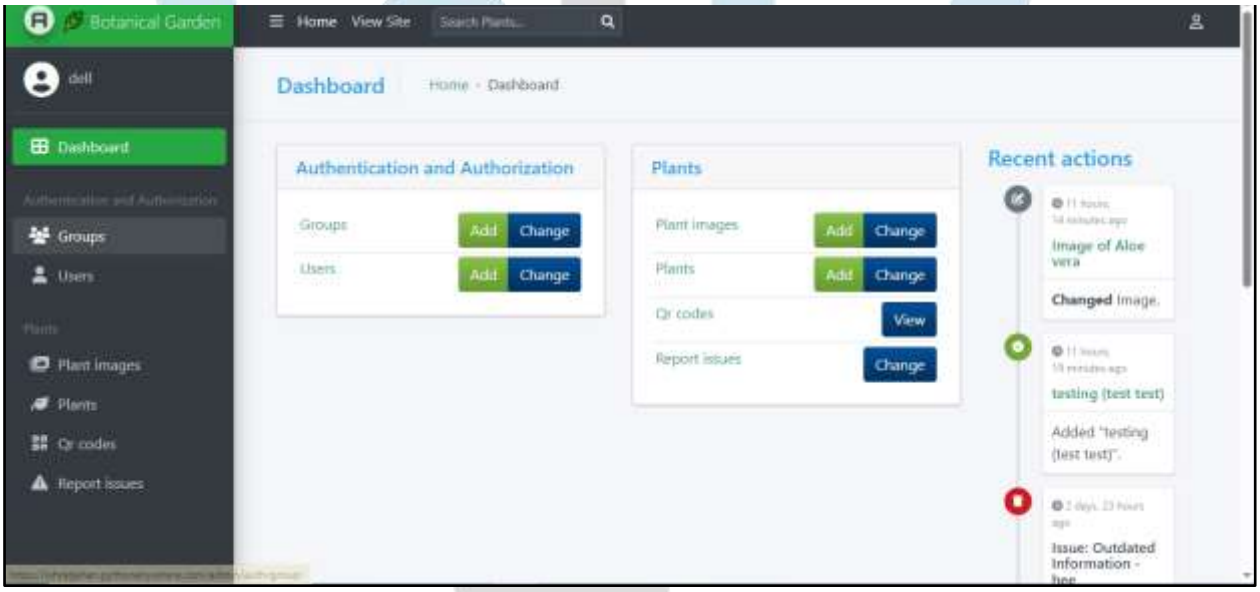


Figure 4.2.3 Admin page

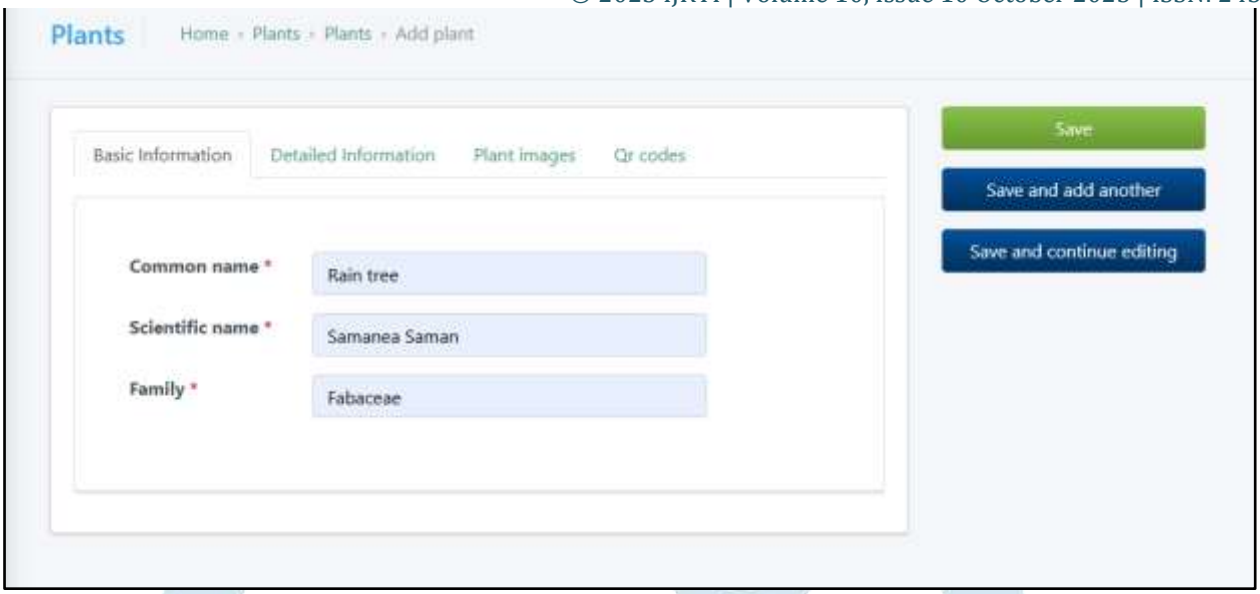
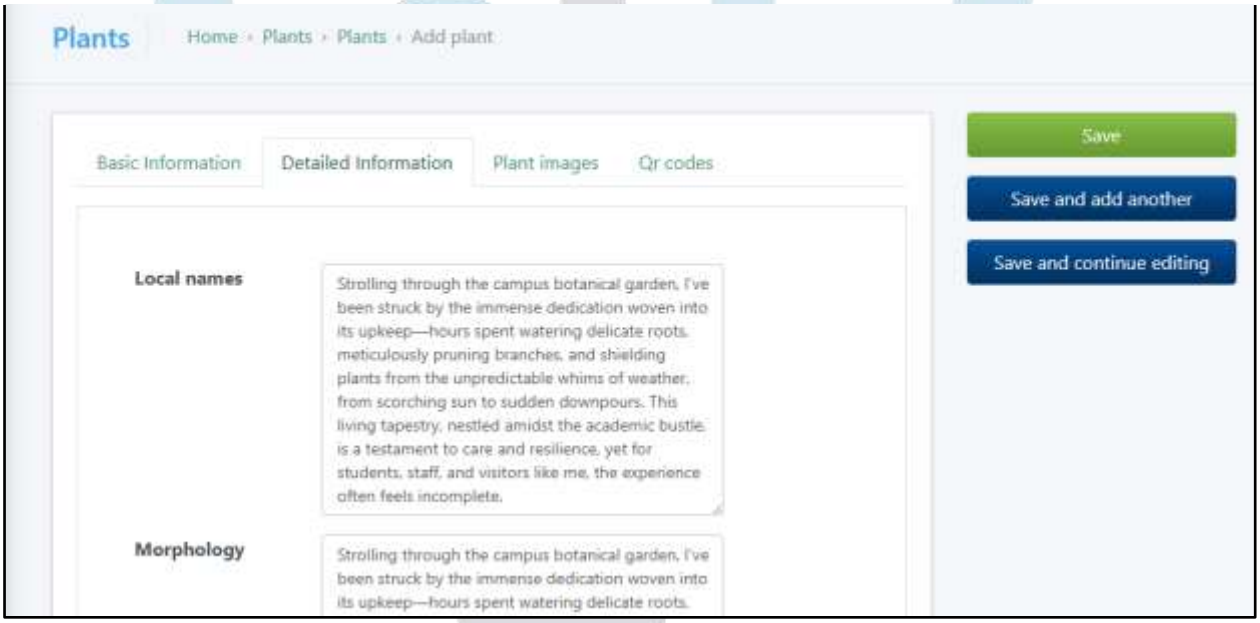


Figure 4.2.4 Add plant details form



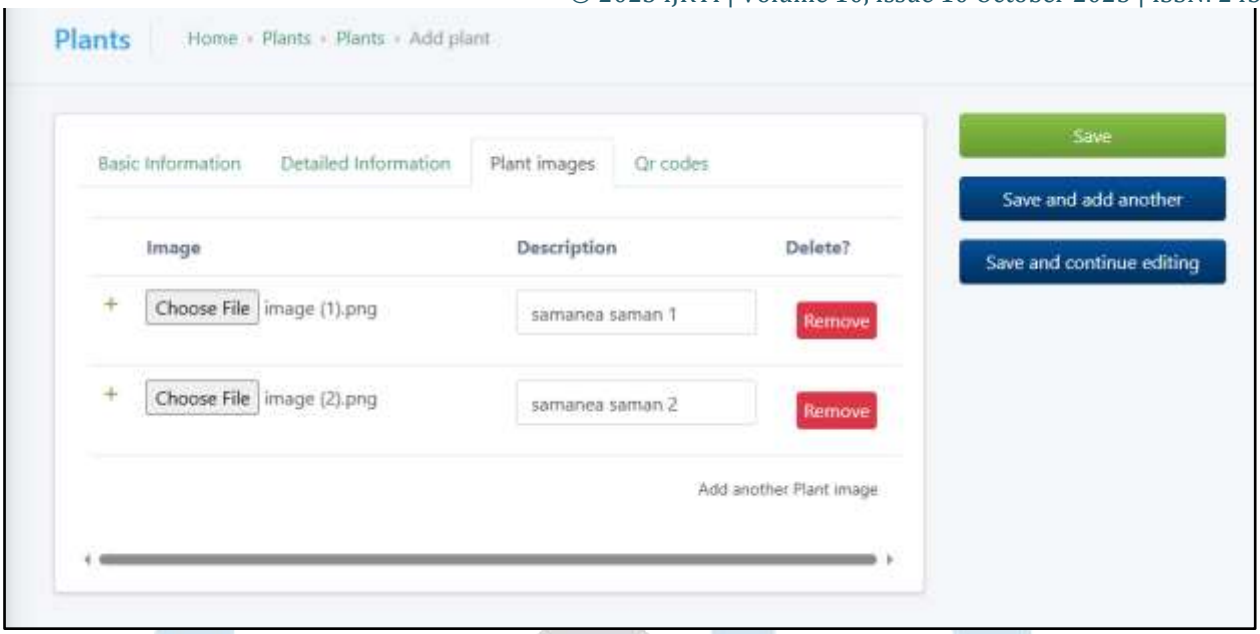


Figure 4.2.5 Add Images page

Figure 4.2.6 QR page

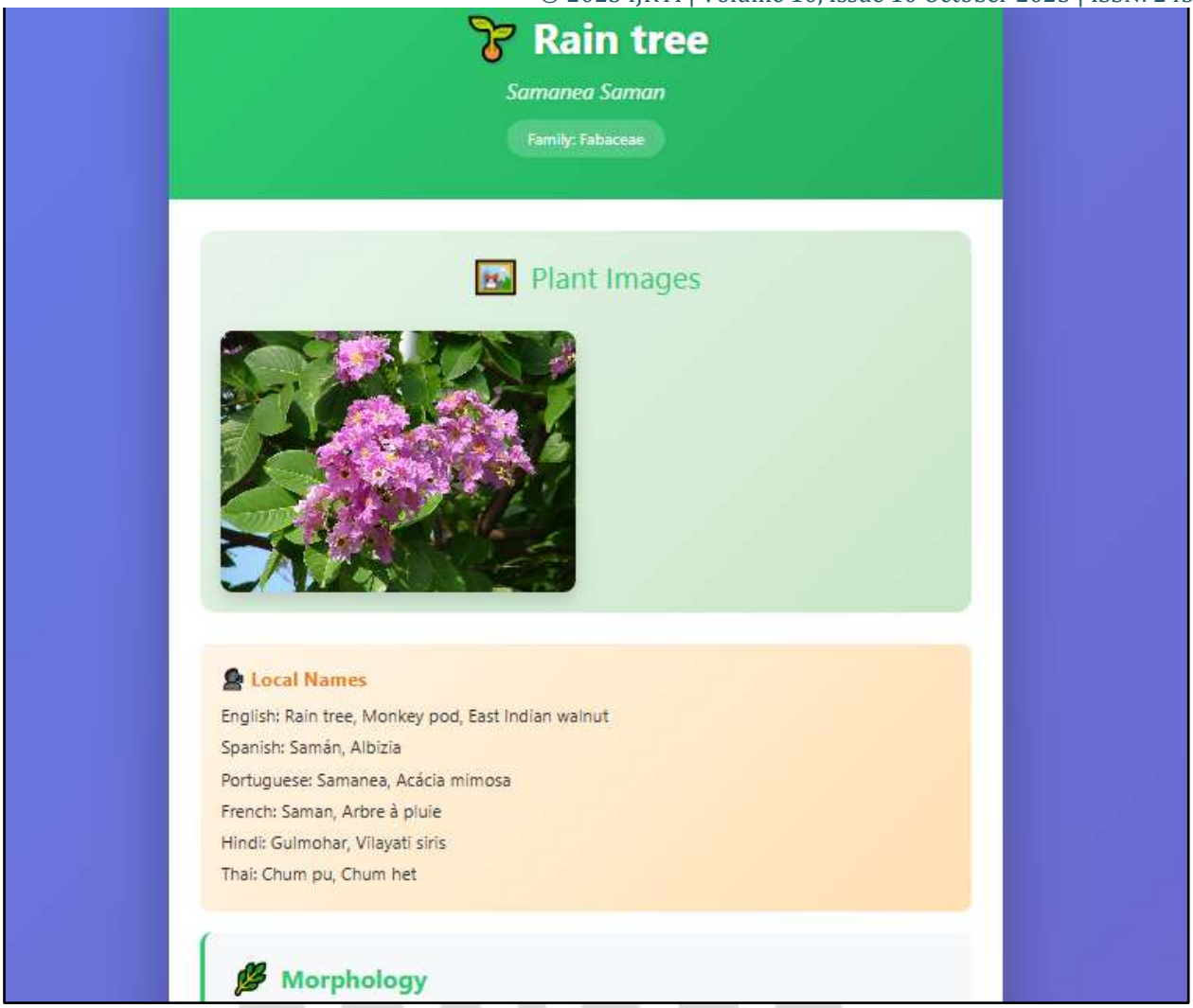


Figure 4.2.7 Plant Detail page

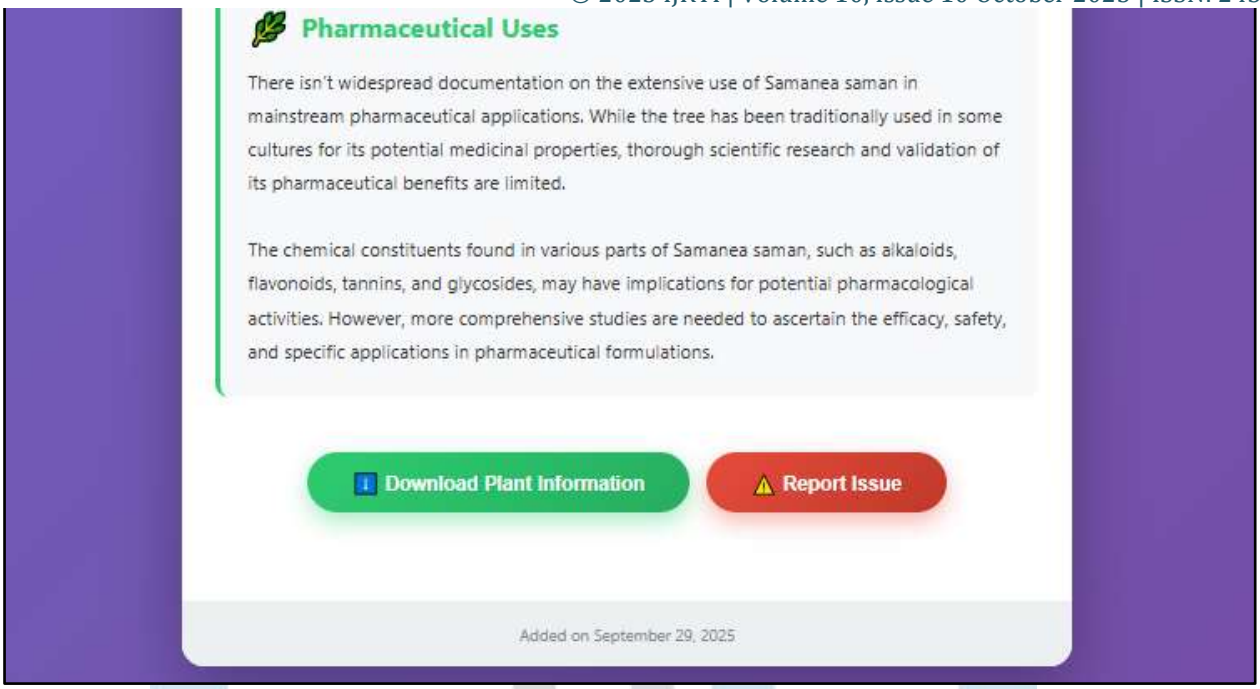


Figure 4.2.8 Download & Report button

Conclusion

The **Botanical Garden: A QR-Enabled Plant Information System** effectively bridges the gap between technology and environmental education. By integrating QR codes with Django-based web development, it transforms a traditional garden into a smart and interactive learning ecosystem. The system enhances accessibility, encourages self-learning, and supports sustainable practices by minimizing paper use. It empowers students and visitors to explore plant information instantly while allowing administrators to maintain and update data efficiently. Overall, the project demonstrates how simple digital tools can create impactful educational innovations that align with modern sustainability goals.

Future Scope

1. In the future, this system can be expanded with additional smart features such as **Augmented Reality (AR)** for immersive plant visualization, **IoT-based sensors** for monitoring environmental data, and **AI-powered image recognition** for automatic plant identification.
2. Multi-language support can make it accessible to a wider audience, while a dedicated **mobile application** will enable offline learning and data synchronization.
3. The addition of an **analytics dashboard** will also help administrators track plant growth and health, making the system a holistic digital ecosystem for plant management and education.

References

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