

Halamanan: A Web Application for Aiding Homeowners Visualize Landscape Designs

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Abstract— Landscaping is an essential aspect for creating appealing and functional outdoor spaces. Visualizing the final results of a landscape is a challenge especially for homeowners who are not knowledgeable about the different styles and concepts in landscaping. Most landscape contractors present their designs to their clients through a top view 2d sketch or render. Developed using the MongoDB, Express, React JS, and Node.js (MERN) stack, this web application is designed to facilitate homeowners in easily crafting mockups of their ideas. Additionally, it serves as a tool for contractors to visually demonstrate the potential appearance of the final design to their clients. The application received positive feedback along with an overall score of 76.25. These results not only provided affirmative responses but also offered valuable constructive criticism, guiding further enhancements for the web application.

Index Terms— landscaping, web application, MERN stack

I. INTRODUCTION

A. Background of the Study

Landscape is described as the process of making a yard or other piece of land more attractive by altering the existing design, adding ornamental features, and planting trees and shrubs [1]. Professional landscaping in the Philippines has been practiced, but considered a luxury. During the height of the COVID-19 pandemic, homeowners were confined to their households due to the lockdowns and were given plenty of time to develop new hobbies and interests. Realizing the importance of green spaces and how affordable plants are, homeowners started landscaping their properties and even utilized this opportunity to start their own edible gardens [2].

Traditionally, various Computer Aided Design (CAD) software such as AutoCAD and Virtual Architect have been used by architects and landscape contractors for creating and visualizing their designs faster and more efficiently. Since hiring professionals is expensive in the Philippines and might be excessive for a simple backyard or front yard garden, homeowners are left to design on their own. With the lack of knowledge and experience in landscaping, homeowners struggle picturing their own designs into actual images. The available landscape designing tools either lack features or are complex for a homeowner who has minimal knowledge and prior experience with the CAD. One solution was to build an easy to use CAD web application that allowed users to plan and visualize their designs with the help of photo

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imaging features. Users were able to upload land images that they wished to landscape. This application also allowed users to save their designs on their device. Users have access to a database collection of *hardscapes* (non-plant objects) and *softscapes* (vegetation).

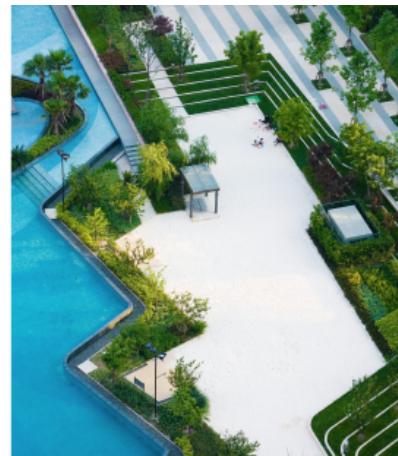


Fig. 1: He Bin Hua Yan Riverside Garden, China



Fig. 2: Basic backyard garden in Los Angeles, California

B. Statement of the Problem

Visualizing completed projects with actual hardscapes and softscape elements is difficult for a homeowner who has little knowledge and experience in the field of landscaping. The available CAD software in the market is designed for professional use and might be too complex for a homeowner who wishes to do simple landscaping or gardening projects. With computers and mobile devices being more accessible each day, the gap between the art of landscaping and technology should become closer. Both homeowners and professionals

greatly benefit from accessible and intuitive tools that assist in visualizing their projects effectively.

C. Objectives of the Study

This project's objective is to create a web application for homeowners who struggle visualizing their own designs and cannot afford to hire professionals for their landscaping projects. The application aims to allow users:

- 1) To create mockup designs for their landscaping projects,
- 2) To use and access the database consisting of different hardscape and softscape materials and use these elements for creating their 2D designs,
- 3) To learn about the different hardscape and softscape materials,
- 4) To save their designs on their devices as PNG files, and
- 5) To add their own images of softscape or hardscape materials to the pre-existing database,
- 6) To manage users that are using the web application,
- 7) To use and navigate a simple and easy to use User Interface.

D. Scopes and Limitations

- 1) The web application was designed to be accessed and used through a Desktop computer.
- 2) An active internet connection is needed to access the web application.
- 3) Further developments in the application would be done to enable smartphone or mobile compatibility and in-app consultation or scheduling with a professional landscaping contractor.

II. REVIEW OF RELATED LITERATURE

A. Landscaping

Landscaping has numerous environmental benefits such as better air quality, decreased soil erosion, and less flooding [3]. Landscaping also has numerous psychological benefits such as stress relief, psychological restoration [4] and enhanced quality of life [5]. Landscaping has different sub-branches and edible gardening is one of these. With the COVID-19 pandemic, homeowners were reminded how important and beneficial it is to have food security. Planting and harvesting their own organic produce increases their security of food supply. The recent environmental disasters that caused immense flooding and devastated the country were also signs that green spaces are important in the environment. Landscape materials are divided into two main categories namely hardscapes and softscapes. Hardscape refers to different non-plant objects, while softscape refers to organic materials.

B. Photo Imaging Software

Photo imaging is a feature in design softwares which allows users to modify 2D images. It is a simple software that allows users to create and visualize designs.



Fig. 3: Landscape Home App landing page

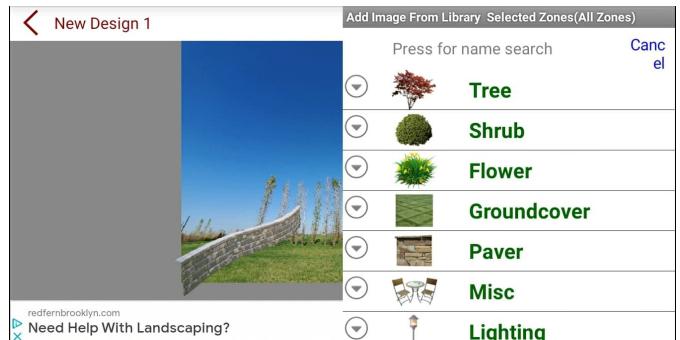


Fig. 4: Landscape Home App material selection interface

This project was inspired by the Landscape Home App (Fig 3 and Fig 4) and iScape where the user takes a photograph using their mobile device or upload an image that they wish to landscape. Pro Landscape Home App is an easy to use CAD software that features a drag and drop of numerous softscape and hardscape materials stored in their online database. The problem with Landscape Home App is that their database collection is focused more on plants that are available in the United States. iScape's functionality is the same, however it is exclusive for iOS devices.

III. METHODOLOGY

A. System Requirements

Halamanan is a web application accessible via desktop computers or tablet devices by visiting <https://sprightly-douhua-6bb24c.netlify.app/> using a web browser that supports modern JavaScript.

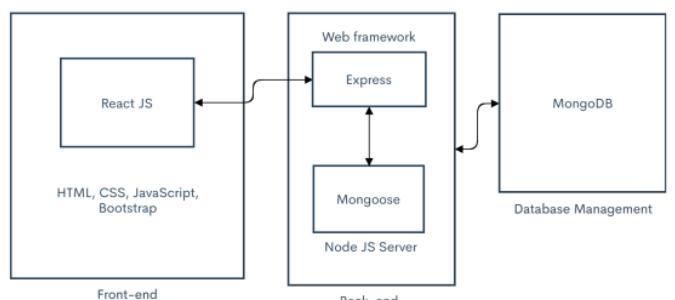


Fig. 5: MERN Stack Diagram

The web application was created using the MongoDB, Express, ReactJS, and Node.js (MERN) stack as observed on Figure 5 .

React JS, an open source JavaScript framework was used for the frontend of the web application. Furthermore, code splitting and lazy loading were implemented to optimize the performance of the web application [6]. MongoDB Atlas, which follows the NoSQL framework, is a cloud based data storage service which was used in the web application to store the database. Express and Node.js were used for setting up the backend and server for the web application. The entity relationship diagram for the database structure can be observed in Figure 6.

Netlify, a cloud based hosting platform, was used for hosting the frontend of the web application since it had direct support for GitHub which synchronized the frontend with the changes in the repository [7]. Heroku, another cloud based hosting platform was used for hosting the backend as it supported server deployments and it was simple and easy to use. [8].

B. User Types

Halamanan supports two types of user roles: *users* and *administrators*. Both roles have distinct privileges and have access to different functionalities.

In this context, individuals designated with a user role represent end-users aspiring to craft personalized landscape designs, adaptable to their preferences. Upon creating a design, these individuals possess the capability to view, modify, and delete their designs. Furthermore, they have the ability to store their designs in PNG format on their devices. Accessible to these users is a categorized gallery of items that can be filtered based on category and type. Lastly, these designated users retain the option to submit requests for the inclusion of new items into the material database.

Additionally, individuals assigned the role of an administrator wield greater authority within the web application. They possess the capability to access the comprehensive user list, modify user roles between user and administrator, manage user information, and have the privilege to deactivate user accounts. Furthermore, administrators hold the authority to oversee, modify, and remove items within the gallery. Moreover, they retain the ability to oversee, alter, and delete item requests submitted by users.

C. System Features and Flow

1) *Design Creation Process*: Upon entering the web application, each user is welcomed by the Sign Up page (Fig. 7). Users are required to sign up and login to access the web application's different features. Upon successful sign up and login, users are automatically directed to the Design page (Fig. 10), granting them the ability to generate new designs and access, modify, or remove existing ones.

Users have the ability to generate new designs by selecting the “Create New Design” button positioned on the left-hand side of the Design page. Users are given the option (Fig. 11) to upload their own image, which is in either JPG, JPEG, or PNG format, or select from the multiple templates backgrounds

offered (Fig. 11). After selecting a background image, they would be redirected to the main design page (Fig. 12).

On the right-hand side of the primary design page, users can access an Item Tray that allows for filtering based on softscape, hardscape, or favorite categories, facilitated by the white filter button

(Fig. 13). Information regarding the items can be accessed by users through the (i) icon located at the bottom of each item within the Item Tray (Fig. 14). With that said, users add items on their design by dragging an item from the item tray over their desired location within the design. Items are initially selected upon adding onto the design. Upon selection, each item offers various options including close, delete, flip, and rotate (Fig. 15). Users can resize an item by dragging the arrow markers located on each edge inward or outward.

Moreover, users have the capability to rename the design, save the current state of the design, download it in PNG format, replace the design’s background image, or reset all items within the design (Fig. 16). To ensure data safety, an autosave feature is running on the background at intervals of sixty seconds. For illustrative purposes showcasing the different features of the web application, a before and after design created by the client is depicted on Fig. 17and Fig. 18.

2) *Gallery*: The gallery page is accessed by clicking on the “Gallery” button found on the navigation bar on the top right of the page (Fig. 19). One of the main features of Halamanan is an expandable gallery (Fig. 20). Initially, the database is composed of forty items, thirty softscape materials and ten hardscape materials. Furthermore, clicking an item found in the Gallery displays more information about said item. Users have the ability to create a curated list of favorite items by selecting the star icon located at the top left of each item (Fig. 21). Users of Halamanan are allowed to request items that they wish to be added to the gallery as well. To do this, the user should click on the “Request New Item” button which would display the item request form (Fig. 22). Accessing the Profile page via the navigation bar (Fig. 19) and selecting the Requested Item tab situated on the left-hand side of the page (Fig. 23) enables users to oversee and handle item requests. Item requests are then reviewed, and modified if necessary, by an administrator. Once approved, the item would be transferred to the approved section containing the correct information and image that pass the application’s specifications.

3) *System Management*: Upon login, users with the administrator role are directed to the Admin Dashboard (Fig. 24). Administrators possess comprehensive control over Halamanan’s system, enabling them to view, modify, and remove various user profiles (Fig. 25), gallery items (Fig. 26), and item requests (Fig. 27). Furthermore, administrators have the authority to elevate a user’s status from user to admin and vice versa. However, admin accounts lack the capability to create or access designs. Yet, accounts transitioned from user to admin retain their existing designs, accessible only upon reverting to the user role.

4) *Authentication and Authorization*: Halamanan uses Passport.js since it is a well established middleware library. The system manages various authentication strategies, capable of accommodating both present and future requirements of

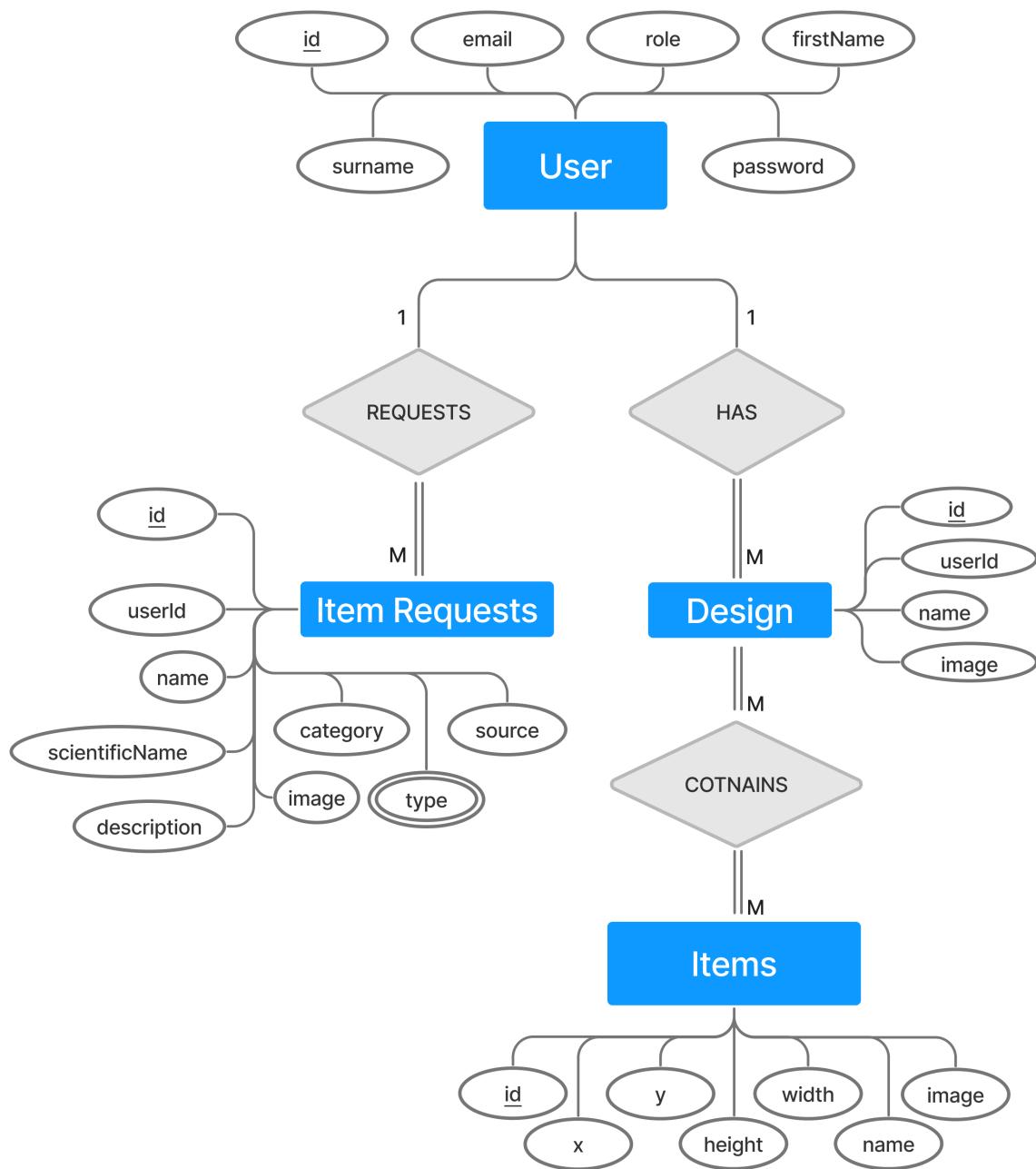


Fig. 6: Database Entity Relationship Diagram

Halamanan. Additionally, it seamlessly integrates with Express and MongoDB, as cited in Passport documentation [9]. Upon successful authentication, each user is redirected to their respective landing pages and has access to different functions and features in the web application according to their respective roles. Users without authentication can solely access the Gallery and How To Use pages. Any attempt to access other pages lacking the required authorization tokens will redirect them to the Sign Up page. Upon successful authentication, access to pages without the proper authorization keys would either display a page that notifies a user regarding restricted access or bring the user back to their respective landing page. As previously stated, an administrator has the capability to alter a user's role within the system. With that said, a pre-determined administrator account is in the database with a fixed administrator role which ensures that there exists an account with full administrator privileges at all times. Furthermore, a general overview of the web app flow diagram for both "user" and "admin" could be seen on Figure 9.

D. Usability Evaluation

The System Usability Scale (SUS) was used to evaluate the web application. It is standardized approach that is commonly used for evaluating an application's usability [10]. The questionnaire consists of ten statements, each rated using a five-point Likert scale which includes options ranging from 'strongly disagree' to 'strongly agree.'

The respondents included the main client, a professional landscaping contractor, who used the application both from a perspective of a user and an administrator, as well as individuals living in different environments such as condominiums, apartments, and houses, providing a user's perspective, which amounts to a total of 28 respondents.

IV. RESULTS AND DISCUSSION

The web application has been successfully evaluated and deployed at <https://sprightly-douhua-6bb24c.netlify.app/>. The average usability score that was computed among 28 respondents was 76.25 which was above 68 and interpreted to be acceptable and above average according to the SUS guidelines [11]. The application's usability was assessed using the following standardized SUS statements:

- 1) I think that I would like to use this system frequently.
- 2) I found the system unnecessarily complex.
- 3) I thought the system was easy to use.
- 4) I think that I would need the support of a technical person to be able to use this system.
- 5) I found the various functions in this system were well integrated.
- 6) I thought there was too much inconsistency in this system.
- 7) I would imagine that most people would learn to use this system very quickly.
- 8) I found the system very cumbersome to use.
- 9) I felt very confident using the system.
- 10) I needed to learn a lot of things before I could get going with this system.

Among the negative statements, statement 4 received the lowest average score while among the positive statements, statement 3 has received the highest average score. These computed average scores indicate that the users found the web application easy to navigate, use, and learn on their own. The first set of respondents have requested additional item manipulation features such as flip and rotate which were then immediately implemented before the second set of respondents. Smoother drag and drop feature, wider initial gallery and addition of average size per plant, other item functions such as warping, and integration of Google Maps API to see and contact nearby landscaping contractors, were some of the suggestions for improving the overall functionality of the application.

V. CONCLUSION AND FUTURE WORK

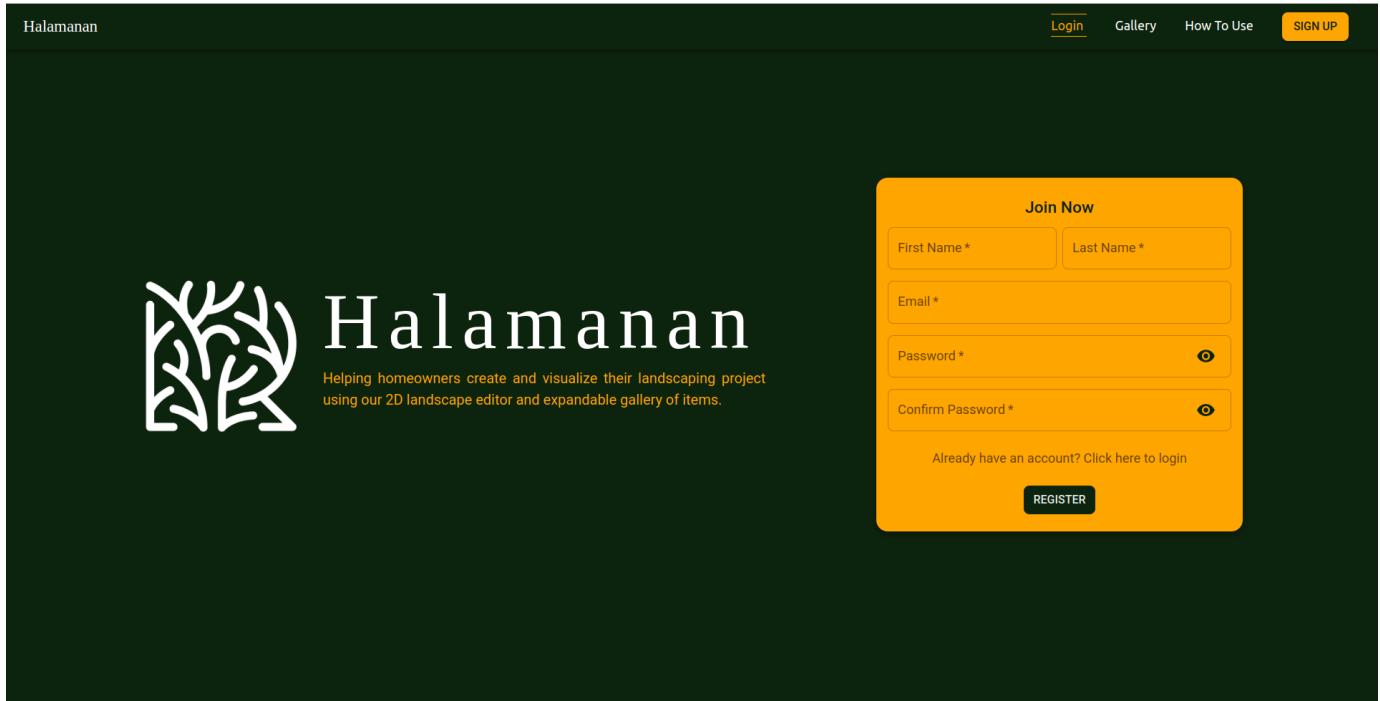
The primary focus of this research was to aid homeowners in envisioning their landscape endeavors visually. The effective deployment and testing of Halamanan successfully met this objective, providing users with an effortlessly navigable web platform featuring an intuitive interface and comprehensive functionalities tailored to their project needs. The study's success is underscored by an average usability score of 76.25 attained from feedback provided by 28 respondents

Moving forward, integrating user suggestions alongside potential enhancements like in-app design quote requests and mobile optimization holds potential for augmenting the system's capabilities, improving usability, and broadening accessibility.

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APPENDIX



The screenshot shows the Halamanan sign-up page. At the top, there is a navigation bar with links for 'Login', 'Gallery', 'How To Use', and a prominent yellow 'SIGN UP' button. Below the navigation, the Halamanan logo (a stylized tree icon) and the word 'Halamanan' in large white font are displayed. A subtitle below the logo reads: 'Helping homeowners create and visualize their landscaping project using our 2D landscape editor and expandable gallery of items.' To the right of this text is a yellow rectangular sign-up form. The form has a title 'Join Now' at the top. It contains four input fields: 'First Name *' and 'Last Name *' in separate boxes, followed by 'Email *' and 'Password *'. There is also a 'Confirm Password *' field with an eye icon. Below these fields is a link 'Already have an account? Click here to login'. At the bottom of the form is a dark blue 'REGISTER' button.

Fig. 7: Halamanan Sign Up form



The screenshot shows the Halamanan login page. At the top, there is a navigation bar with links for 'Login', 'Gallery', 'How To Use', and a prominent yellow 'SIGN UP' button. Below the navigation, the Halamanan logo (a stylized tree icon) and the word 'Halamanan' in large white font are displayed. A subtitle below the logo reads: 'Helping homeowners create and visualize their landscaping project using our 2D landscape editor and expandable gallery of items.' To the right of this text is a yellow rectangular login form. The form has a title 'Login' at the top. It contains two input fields: 'Email *' and 'Password *'. Below these fields are two buttons: a dark blue 'REGISTER' button on the left and a dark green 'LOGIN' button on the right. The overall layout is clean and modern, with a dark background for the main content area.

Fig. 8: Halamanan Login form

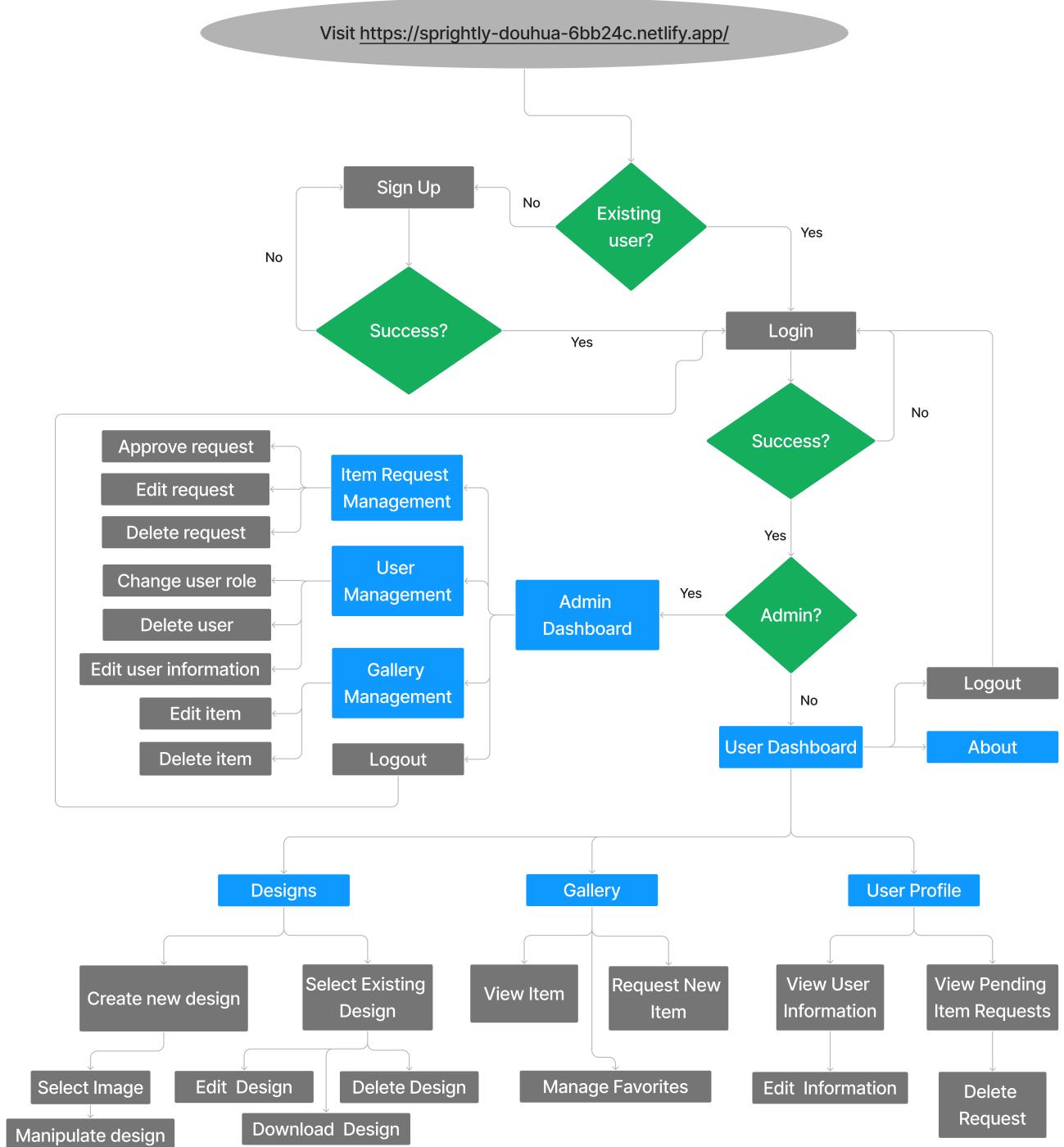


Fig. 9: Web App Flow Diagram for Halamanan. Blue: web pages that a user has access to; Gray: actions that a user could perform; Green: conditional statements

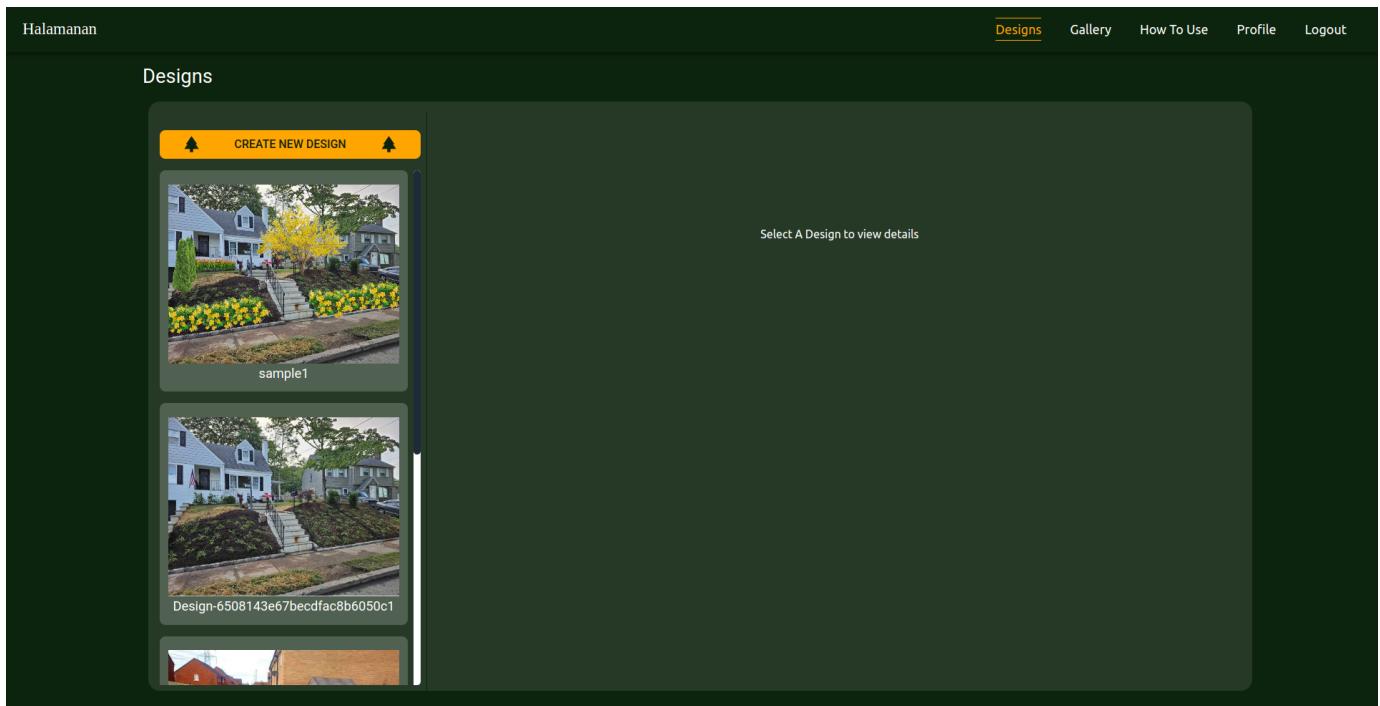


Fig. 10: Design page which enables users to create a new design or see existing designs

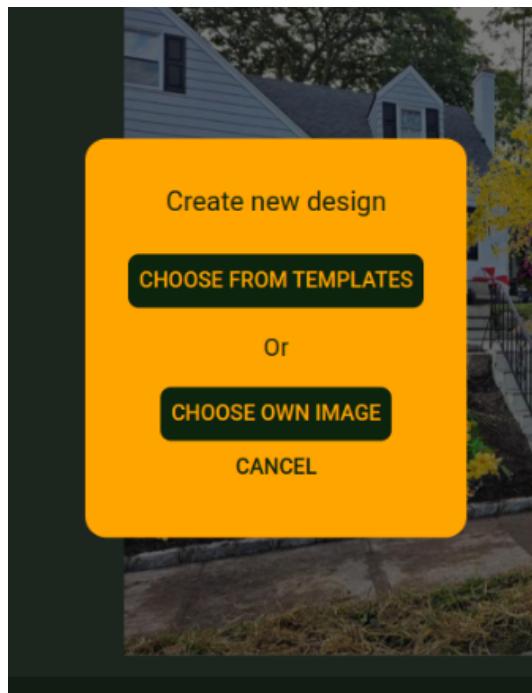


Fig. 11: Prompt for user to choose between using a template or uploading their own image to landscape

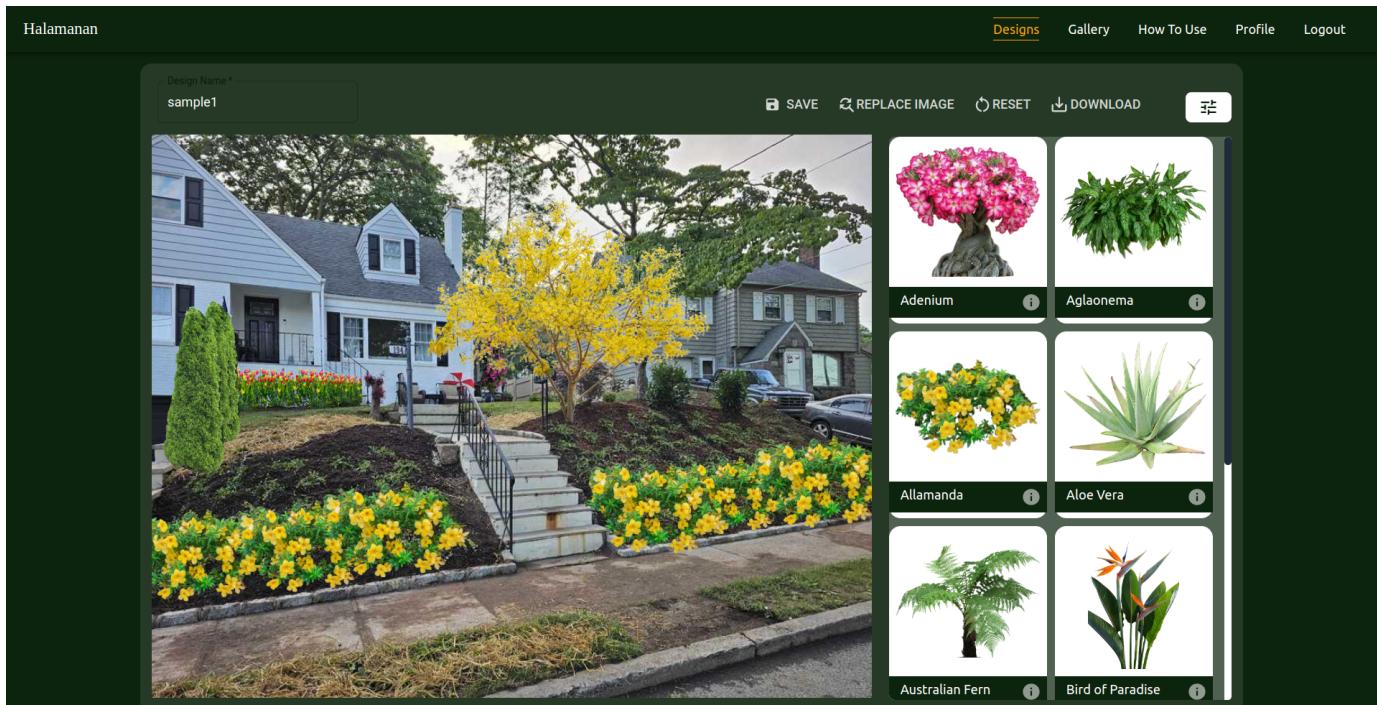


Fig. 12: Main Design Page where the user edits their design

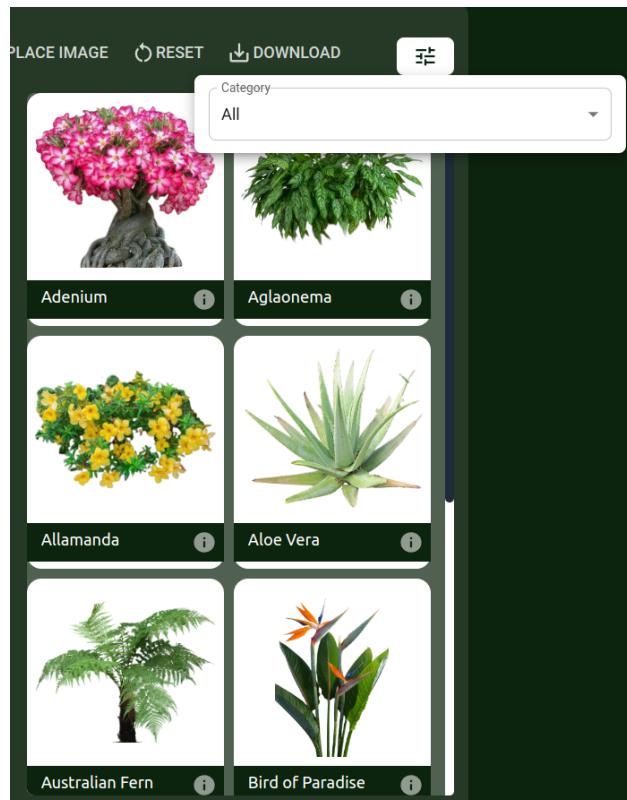


Fig. 13: Item tray filtered using “All”

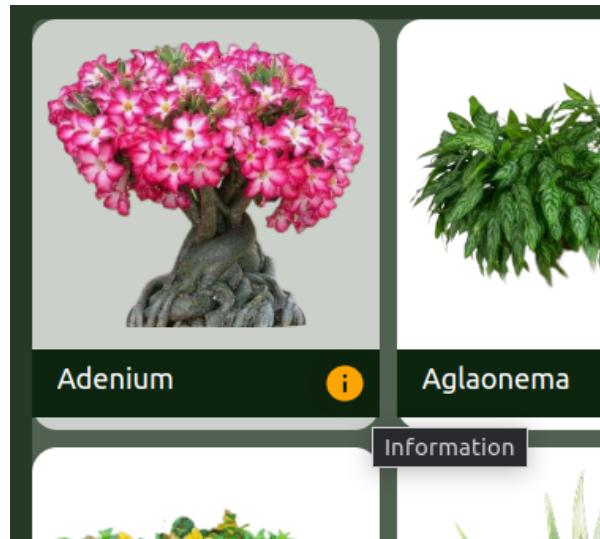


Fig. 14: An information icon is found on the bottom right of each item inside the item tray



Fig. 15: As seen from top to bottom: Close options button, delete button, flip button, and open rotation slider button. Resize arrow markers in green are found along the edges of the selected item

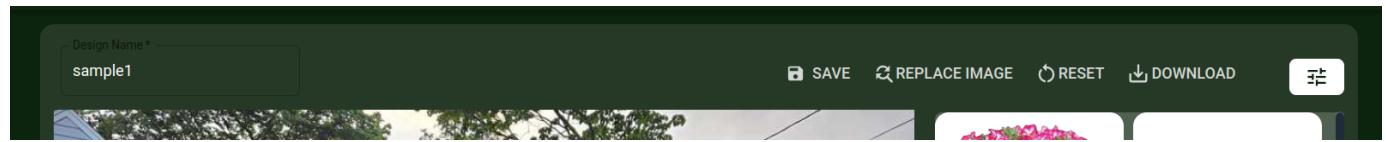


Fig. 16: As seen from left to right: Design name, Save button, Replace Image button, Reset design button, Download button, and Item Tray Filter button

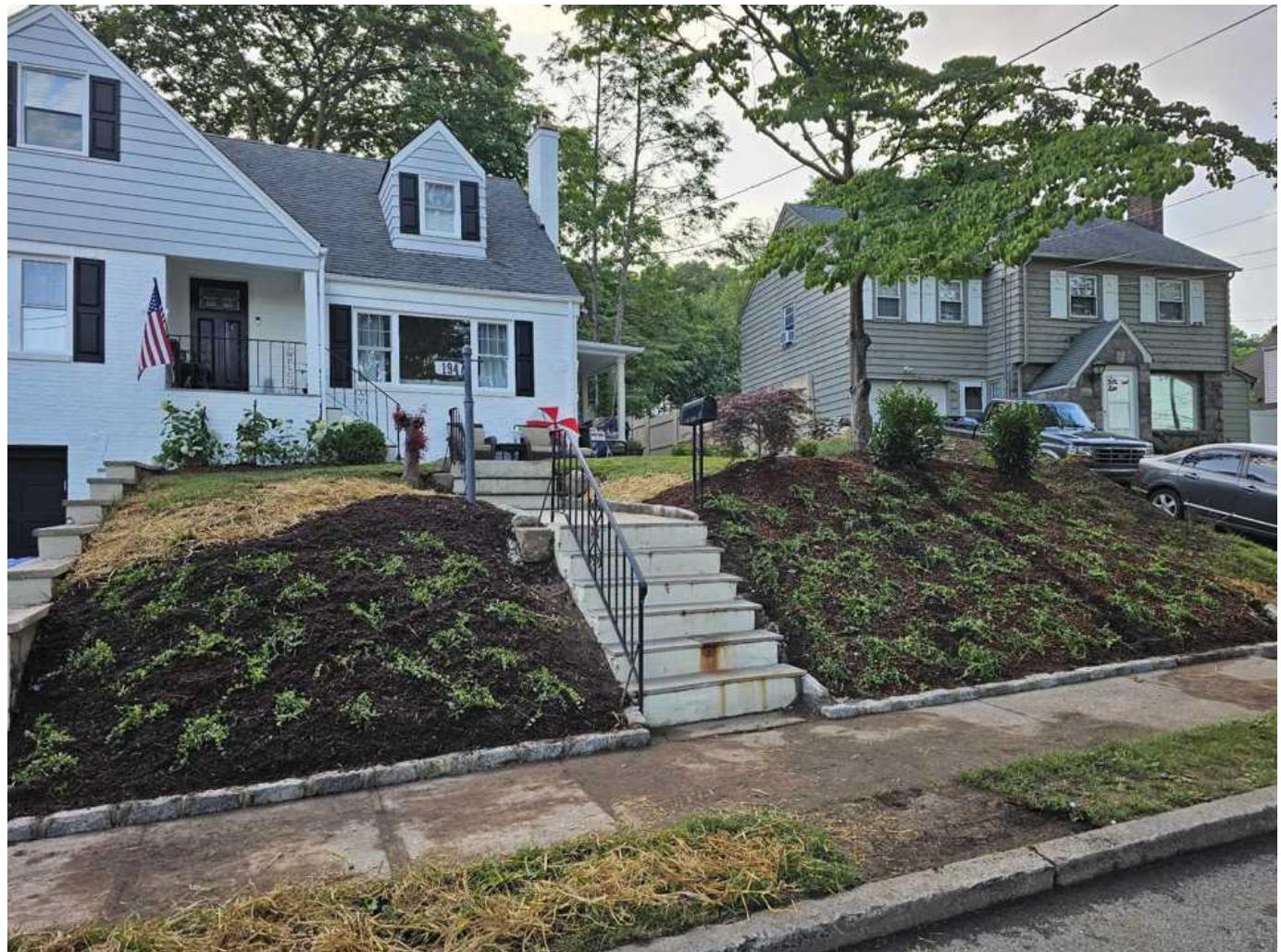


Fig. 17: An image of client's project last spring of 2023

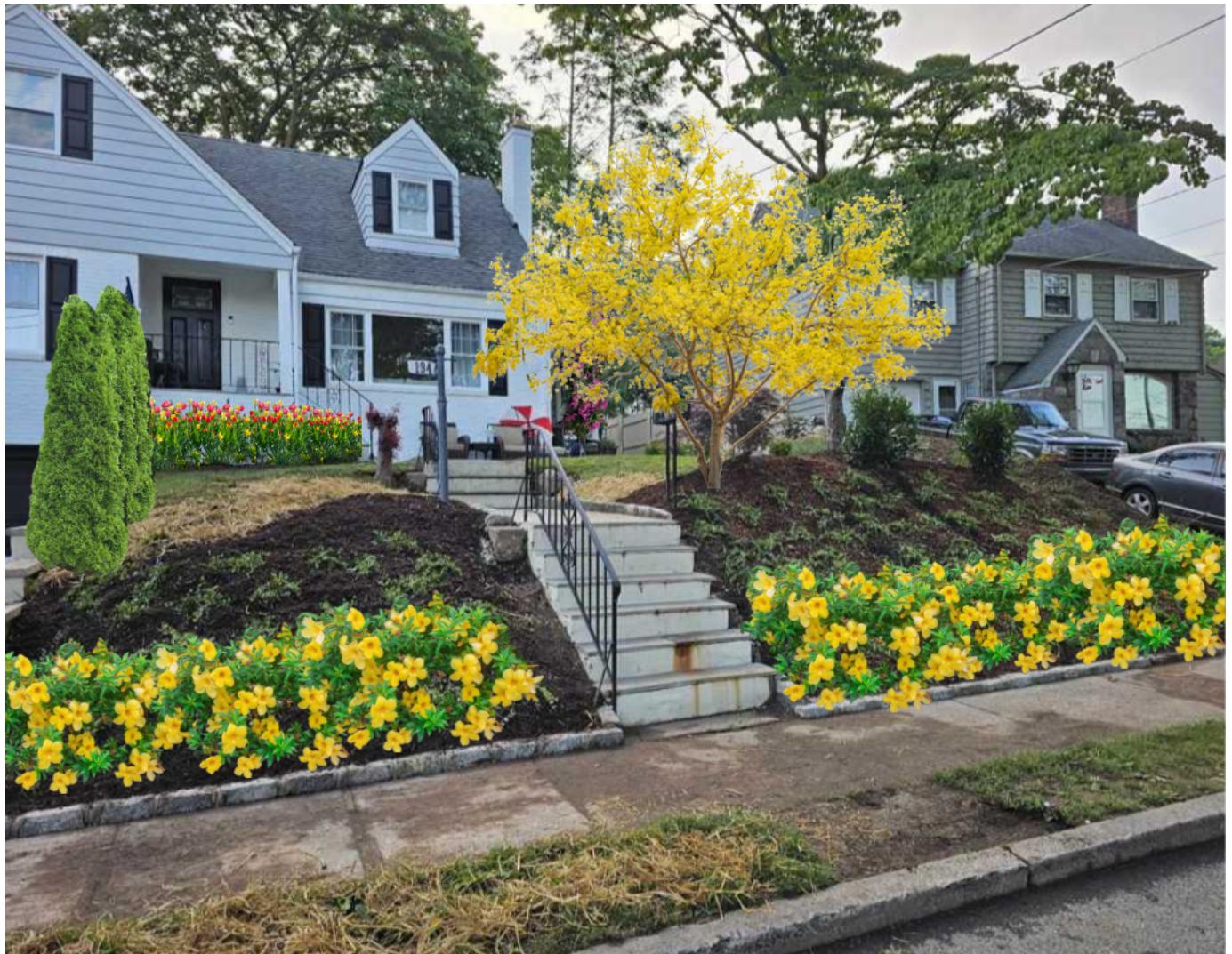


Fig. 18: A sample design created by the client for a previous on-site project

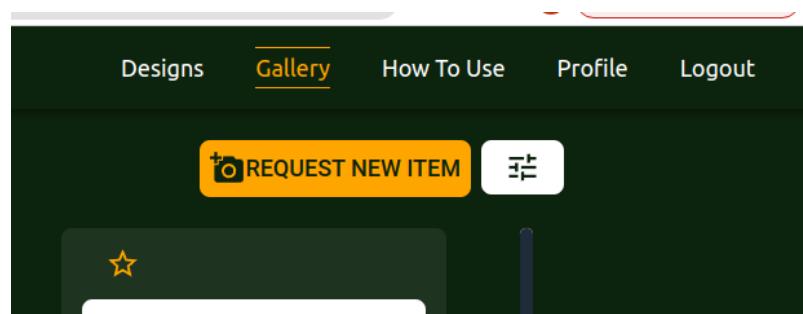


Fig. 19: Navigation bar which contains the Designs page, Gallery page, How to use page, Profile page, and Logout button. Seen underneath is the Request New Item button and Filter button

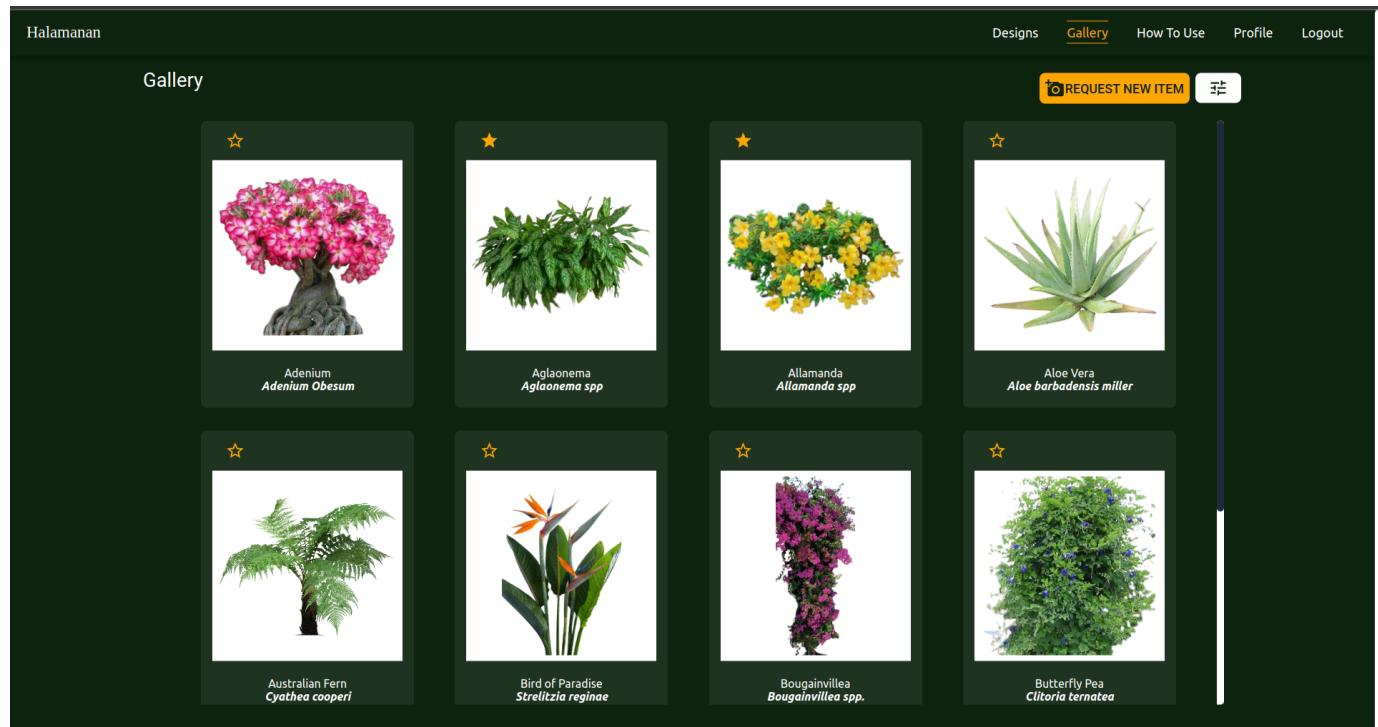


Fig. 20: Preview of different gallery items

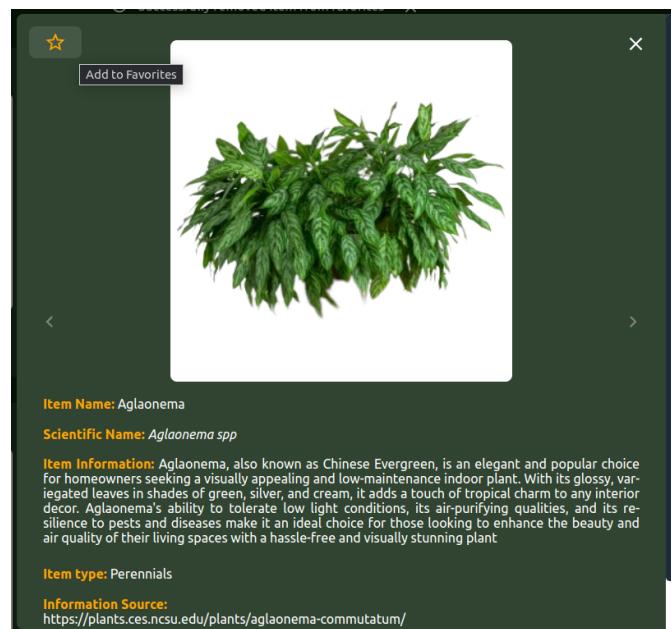


Fig. 21: Detailed Information about an item found in the Gallery. A star icon is found on the top left corner to depict if an item is in the user's Favorites list

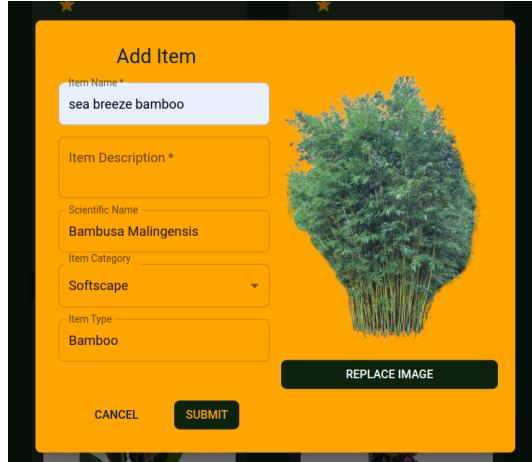


Fig. 22: Requesting a new item to be added onto the database

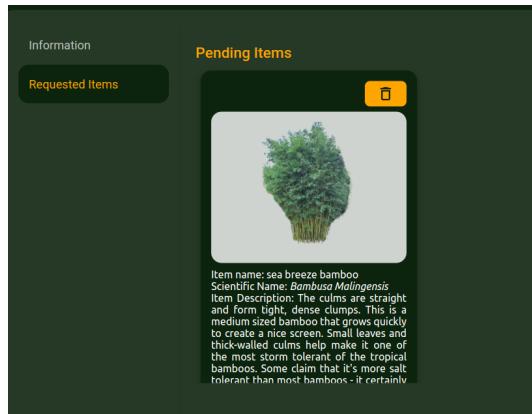


Fig. 23: User's view of pending item requests

Halamanan

Admin

- DASHBOARD** (Selected)
- USERS
- GALLERY ITEMS
- ITEM REQUESTS
- DESIGN QUOTES

Dashboard

Users

Admin Count: 1 User Count: 40

id: 6497a1eb424c96609e75e26e
Name: admin admin
Email: admin@admin.com
Role: admin

id: 6508143e67becdfac8b6050c
Name: test test
Email: test@test.com
Role: user

Item Requests

Pending requests: 18

Item Name: Philippine Jasmine

Item Name: Yellow Bell

Design Quote Requests

No quote requests as of the moment (future feature)

Fig. 24: Admin dashboard where user list information and current item request information is displayed

Halamanan					Logout	
Admin		Users				
		User Email	First Name	Last Name	Role	Actions
DASHBOARD	admin	admin@admin.com	admin	admin	admin	PROMOTE TO ADMIN EDIT DELETE
ITEM REQUESTS	test	test@test.com	test	test	user	PROMOTE TO ADMIN EDIT DELETE
DESIGN QUOTES	sandrocaesarah@gmail.com	Caesarah Mae	Sandro	Servañez	user	PROMOTE TO ADMIN EDIT DELETE
GALLERY ITEMS	deservanez@up.edu.ph	Dionelyn	Servañez	user	PROMOTE TO ADMIN EDIT DELETE	
	bernardopio123@gmail.com	Pio	Bernardo	user	PROMOTE TO ADMIN EDIT DELETE	
	gcpatienza@gmail.com	Gian Carlo	Atienza	user	PROMOTE TO ADMIN EDIT DELETE	
	jdredor@up.edu.ph	Judith	Redor	user	PROMOTE TO ADMIN EDIT DELETE	
	jamciano@up.edu.ph	Justine	Diana	user	PROMOTE TO ADMIN EDIT DELETE	
	ivanjohnmauricio5@gmail.com	Ivan	Mauricio	user	PROMOTE TO ADMIN EDIT DELETE	
	mattinderella@gmail.com	Mattie	Manuel	user	PROMOTE TO ADMIN EDIT DELETE	
	fabianmarieantonette@gmail.com	Marie Antoinette	Fabian	user	PROMOTE TO ADMIN EDIT DELETE	

Fig. 25: Admins have the ability to view, edit, or delete users from the Halamanan database

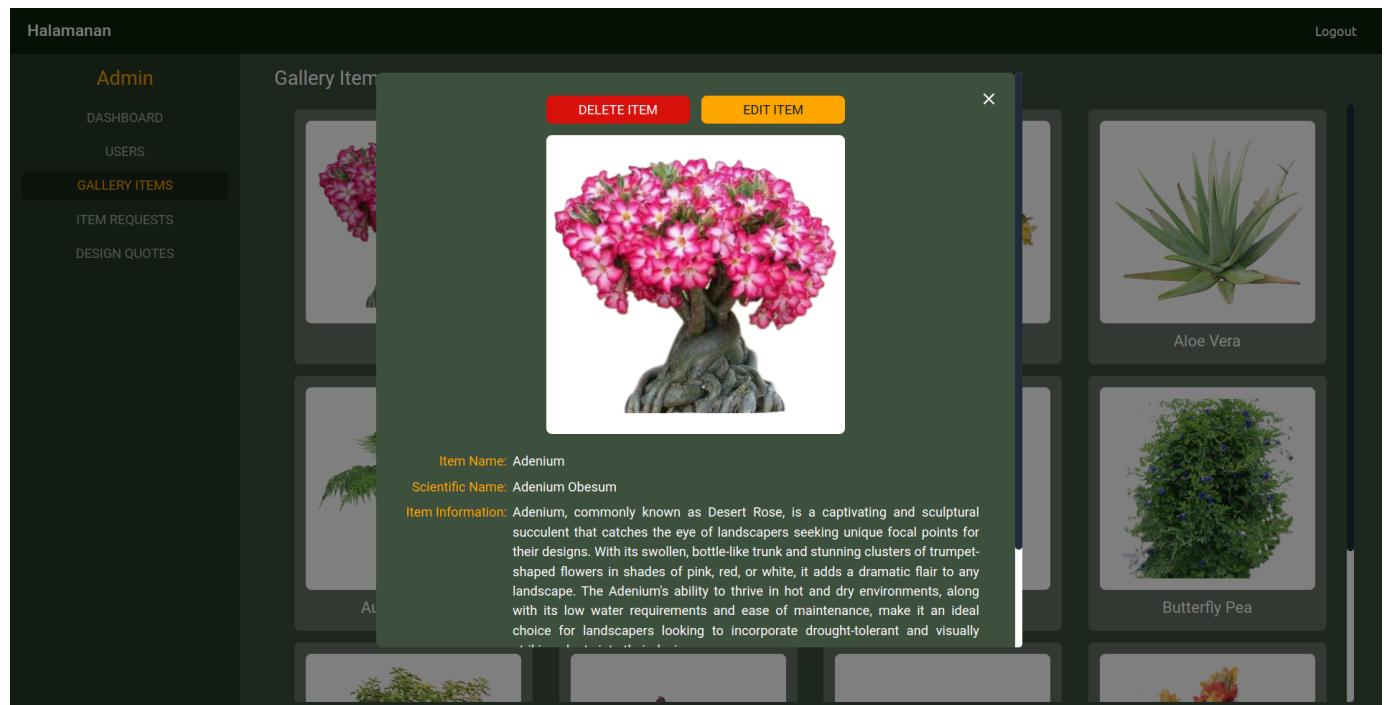


Fig. 26: Admins have the ability to view, edit, or delete gallery items from the Halamanan database

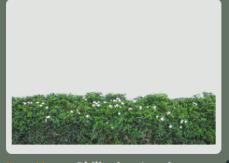
Halamanan

Logout

Admin

- DASHBOARD
- USERS
- GALLERY ITEMS
- ITEM REQUESTS**
- DESIGN QUOTES

Item Requests



Item Name: Philippine Jasmine
Item Description: Philippine Jasmine or Sampaguita, scientifically known as Jasminum



Item Name: Yellow Bell
Item Description: Esperanza or Yellow bells is an irregularly shaped, deciduous shrub, normally



Add New Item

+

ADD IMAGE

ADD ITEM

Fig. 27: Admins have the ability to view, edit, or delete item requests from the Halamanan database