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Succulent Plant Management Information System for Nursery Gardening Store

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Abstract: Succulents can be seen for sale in most plant nurseries. The nursery aims to produce high quality succulents for the satisfaction of its customers. However, the quality of the succulent deteriorates easily through some mistakes of its care. This includes watering schedules and other maintenance that must be planned of time. The schedule of tasks in the nursery for watering and planting should be implemented accordingly to ensure that the succulents are healthy and become an inventory ready for sale later. This challenge proposes that a management information system for succulent nurseries is needed to improve task execution efficiency by scheduling, tracking succulent state, and providing reports. Therefore, a succulent nursery store management information system has been developed to address the issues in discussion. A prototype model has been implemented. The functional modules in this system consist of login and registration module, task management module, succulents planting management module, succulent inventory module, and report generation module. Program code is written using PHP, Sublime Text, and Macromedia Dreamweaver 2021 and MySQL and XAMPP are used to administer the database. The system has been developed and is able to perform as intended. The system provides a web-based platform for easier management of succulents and chores, improved security for nursery data, and a database for storing important data to its customers.

Keywords: Succulent, Management Information System, Prototyping Model

1. Introduction

Nursery is described as a place where plants and trees are grown, usually for sale [1]. Babalola [2] stated that seedlings of ornamental plants were in highest demand followed by seedlings of horticultural crops, and forest trees. Ornamental plants are used for beautifying places and succulents are one of those ornamental plants. Succulent is a plant that have specialized water-storing tissues resulting in a swollen appearance of the leaves, stems, roots, or of some combination of these organs [3]. The water content of succulent organs may reach 90% to 95% [4]. A rough, fast draining mix or cactus mix is the best soil for succulents, whether in the ground or in containers [5]. Succulents do not have a set watering

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schedule. When the succulent plant needs to be watered, it is determined by the condition of the soil. If the succulent soil isn't fully dry, don't water it. If the succulents demand it, water them thoroughly until the water flows out of the bottom of the flowerpot. If the succulent is overwatered, the root rots.

This project's aim is to developed management information system for Succulent Shop, a plant nursery in Tanjung Bungah, Penang. For them had encountered problems such as issue with recording succulent plants effectively, managing tasks of succulent cultivation including keeping track of tasks' status, and inability of generating report upon request. Watering monitoring tasks are currently not fixed in the shop and are completed manually by the shop owner and personnel. The business owner analyzes the condition of the succulents daily to determine when to water, fertilize, remove bugs, and provide other succulent care. After the shop owner has made her decision, she will instruct the employees to complete the tasks she has assigned. Employees oversee tasks such as watering the succulents and checking on their condition. Due to the large quantity of succulents in the shop, the watering monitoring tasks are not fixed. Except for those that needed more water, the employees gave the succulents the same quantity of water and fertilizer.

Additionally, the shop does not keep any information about the succulents and just displays some information in their web store, such as the species, pot size, and price. However, the shop's online store backend technology keeps track of succulent inventories. The records are inaccurate due to succulents that are in poor condition or have died while in the shop's care, making them unfit for sale. Otherwise, there are no reports generated by the shop detailing the performance of monitoring duties, the overall condition of succulents, or anything similar. They merely perform a simple analysis of the percentage of plants that died vs. the plant type to determine which species are unsuitable for cultivation in Malaysia.

Therefore, the efficiency of the data storage process on succulent crops in the gardening store can be improved with the help of computer technology and information systems. A succulent plant information management system is proposed in this project for nursery gardening store to manage the process of data collection and report generation. The data collection involved is such as crop information, planting information, stock information for sale and report generation. These functionalities will be included in the system that will be designed to make it easier for the gardening store to save and manage crop information to improve production and sales. The system provides a database to store data that facilitates report generation and decision making for businesses.

This system has two kinds of user, store owner as administrator and employees as normal users. Administrator can access more modules than employees. The system consists of login and registration module, task management module, succulents' cultivation management module, succulent stock module and report generation module. The system is expected to be able to let administrator to register new users, manage succulents, assign tasks, manage stock and generate report. While employees to enter value for room condition, view assigned tasks and update status upon completion. The developed system will be providing easier management of succulents and tasks, better security for nursery information, and a database for storing all information.

This paper contains five sections. Section 1 describes the project background; Section 2 covers the related works. Section 3 elaborates on the methodology, while Chapter 4 summarizes the result and discussion. Section 5 gives the conclusion.

2. Related Work

Succulent Shop, a plant nursery in Tanjung Bungah, Penang, which opened in 2018. In the year 2019, the shop was formally registered. Ms. Caryn Lim established this plant nursery. Mr. Sean Tan is Succulent Company's marketing executive, assisting the shop owner in marketing and management. The store buys succulents' and cactuses' seeds from other distributors. Sometimes the store produces

the seeds themselves for planting more of succulents. The succulents and cactuses are planted in a planting pot with coarse and sandy soil. Then they are watered and fertilized accordingly daily. The additional tasks such as bug removal, repotting and others will be conducted if conditions for those are met. The tasks are assigned to both full-time and part-time employees. If the succulents grown healthy, they are available for sale. The owner will be placing them into inventory and to be sold later.

The business will have to make a final decision on whether to execute watering monitoring activities according on the weather, species, and region. The shop does not keep any information about the succulents and just displays some information in their web store, such as the species, pot size, and price. However, the shop's online store backend technology keeps track of succulent inventories. The records are inaccurate due to succulents that are in poor condition or have died while in the shop's care, making them unfit for sale. Otherwise, there are no reports generated by the shop detailing the performance of monitoring duties, the overall condition of succulents, or anything similar. They merely perform a simple analysis of the percentage of plants that died vs. the plant type to determine which species are unsuitable for cultivation in Malaysia.

Looking at the situation of business data management methods in this Succulents store, it is seen that it is important for this business to take advantage of the current digital technology facilities which are very much beneficial to the business expansion. The efficiency of the data storage process on succulent crops in the gardening shop can be improved with the help of a combination of computer technology, information systems, databases and Internet technology. Thus, a web based succulent crop information management system is introduced in this project for a gardening shop to manage the process of data collection and report generation.

A web-based information system, also called web information system is an information system which uses Internet web technologies for delivering information and services to users [6]. This technology is a software system and is used to publish and maintain data by hypertext principle. Web-based information system is the combination of one or more web applications, specific functionality-oriented components [7]. Users of traditional information system are mainly professionals in an organizational context, while typical web-based information system users are comprised of both professional and non-professional users in various contexts [8]. These systems perform various functions to fulfill the needs of these two types of end-users, resulting in distinct forms of interactions between the information products generated from the systems and their consumers [9]. Furthermore, the richness of information and the nature of unstructured and highly individually customizable interactions typically exhibited by WIS redefine the standard of user satisfaction in the Web environment [10]. Furthermore, the common features of a web-based information system are to store data into the database through the web system. Processing data is consisted of and no limited to calculating the data, sorting, classifying, and summarizing [11]. Processed data can be used for strategic planning for future decision, organizing, coordinating, directing and controlling.

The above-mentioned feature is critical in today's world of digital technology when all information must be always accessible. Taking this into consideration, it is essential for this company to participate to the advancement of its business data management capabilities using cutting-edge technology. As a result, the succulent crop management system developed makes advantage of the features of a web-based information system to integrate technology into company data management and improve business performance.

For comparative study, three related systems available in market were selected. Each function in the system is examined, namely GARDENA Smart System, My Garden Manager by Homestead Apps

and Shoot PRO. The comparisons between current similar systems and the proposed system will be done and depicted in **Table 1**.

GARDENA Smart System is an Android-based management system designed to simplify users' gardening tasks through its app. The app can be accessed anywhere from users' smartphones as it aims for long-ranged access control to users' garden. The app features remote control scheduling gardening tasks, tracking temperature and moisture through sensors, and discovering plants information tab. On the other hand, My Garden Manager is a web-based garden management software which is designed for the gardener, homesteader, farmer, or hobbyist, which provides users the ability to organize their garden planting and harvest items. All the data are backup daily to ensure they are not lost when problems happen to users' system. Some features that could be automated were left to be handled manually so that users could control how and when income, production, and other information is entered and handled within the system. The third system in this comparison is Shoot, which is a garden management system that helps professional gardeners. This system helps in researching factories, conducting collaborations, and providing advice to their customers. The system can be accessed through the website using both computer and smartphones at https://www.shootgardening.co.uk/.

Table 1: System's Comparison

System / Features	GARDENA Smart System	My Garden Manager	Shoot	Proposed System
Log In	√	√	√	√
Manage Plants Information	Not available	√	√	√
Manage Tasks	√	Not available	Not available	√
Data Entry	Automated sensor	Not available	Not available	Manual data entry
Manage Plant Inventory	Not available	√	√	√
User	Public user	Public user	Experts and Clients	Manager and Employees
Security	Authorization access	Authorization access	Authorization access	Authorization access
Platform	Android	Web	Web and Android	Web

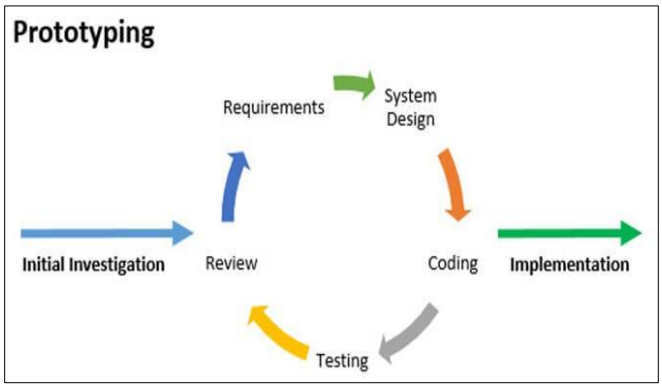

Figure 1: Prototyping

3. Methodology

As shown in **Figure 1**, prototyping is a methodology that evolved out of the need to better define specifications and it entails building a demo version of the software product that includes the critical functionality [12]. Tanvir et al., [13] explains that a prototype is an incomplete picture used to show a rough idea of the expected system so that users can verify requirements before investing additional resources. Rapid prototyping intense interaction between customers, users and developers, and thus may result in early validation of concepts, specifications, artifact designs, and systems [14]. The phases in the prototyping model consist of initial investigation, requirements, system design, coding, testing, review, and implementation.

3.1 Initial Investigation Phase

Initial investigation phase is the first phase that needs to propose a project title, planning project schedule, and acquire the description of expected system behaviors. It requires gathering information and requirements of the system from the client and to be analyzed. It will generate a set of plans and serve as a guideline to the project phases. The activities that will be done in this phase are producing a project proposal, research and analyze the case study and planning out Gantt chart. The requirements are gathered through interview with partial research at Succulent Shop.

3.2 Requirements Phase

Requirement's phase involves analyzing the requirements for the system. Requirement analysis is the process of determining the requirements a developed system must meet, as well as what users expect from the proposed system. Functional and non-functional requirements, user requirements, and system requirements are all part of the system requirements. The system's functional modules are summarized in **Table 2**.

Table 2: System's Functional Modules

Modules	Function	User
Login and Registration	• Allows users to login into the system through ID and password. • The system will direct valid users to the main page. • The system will show error message to invalid users. • Allows only administrators to create and register new users. • Allows administrators to change the role of users.	Administrators Employees

Tasks Management	• Allows administrators to assign tasks to users. • Allows users to view tasks given. • Allows users to update tasks completion.	Administrators Employees
Succulents Planting Management	• Allows administrators to add and remove the succulents in the list. • Allows administrators to edit succulents' information (e.g., species, date planted, status, price etc.) • The users can enter values (temperature, humidity and weather condition) for the room condition. • The users can edit the values for the room condition.	Administrators Employees
Succulent Inventory	• Allows administrators to enter and remove succulents available to sell. • Able to change succulents sold status.	Administrators
Reporting	• Allow administrators to generate reports.	Administrators

Functional requirements determine the function of a developed system, while its function is described as a specific behavior that converts input into output. Non -functional requirements define the criteria used to evaluate the operation of a system, rather than the behavior or function of a particular system [15]. **Tables 3** and **4** show the functional and non -functional requirements for the proposed system.

Table 3: Functional requirements

Modules	Function
Login and Registration	• The system should allow users to login into the system through ID and password. • The system should direct valid users to the main page. • The system should show error message to invalid users. • The system should allow only administrators to create and register new users. • The system should allow administrators to change the role of users.
Tasks Management	• The system should allow administrators to assign tasks to users. • The system should allow users to view tasks given. • The system should allow users to update tasks completion.
Succulents Planting Management	• The system should allow administrators to add and remove the succulents in the list. • The system should allow administrators to edit succulents' information (e.g., species, date planted, status, price and etc.) • The system should allow the users to enter values (temperature, humidity and room condition) for the room condition. • The system should allow the users to edit the values for the room condition.
Succulent Inventory	• The system should allow administrators to enter and remove succulents available to sell. • The system should be able to change succulents sold status.
Reporting	• The system should be able to generate reports when requested.

Table 4: Non-functional requirements

No.	Requirements	Description
1.	Operational	The system should be user friendly The system should be easily maintained and updated

		The system should be able to work on most web browser
2.	Performance	The system should be available for 24 hours per day
3.	Security	Users can only access their own account with ID and password

The analysis of the system is performed based on object-oriented approach. Unified Modelling Language (UML) is a tool that is used widely as an industry-standard modelling tool for software development. One of the dynamic diagram UML is use case diagram. Shinkawa [16] explained that use case diagram consists of three components. **Figure 2** shows the use case diagram of the Succulents Management Information System. It depicts the overview of the process occurred within the system. The entities involved in this diagram are the users and administrator.

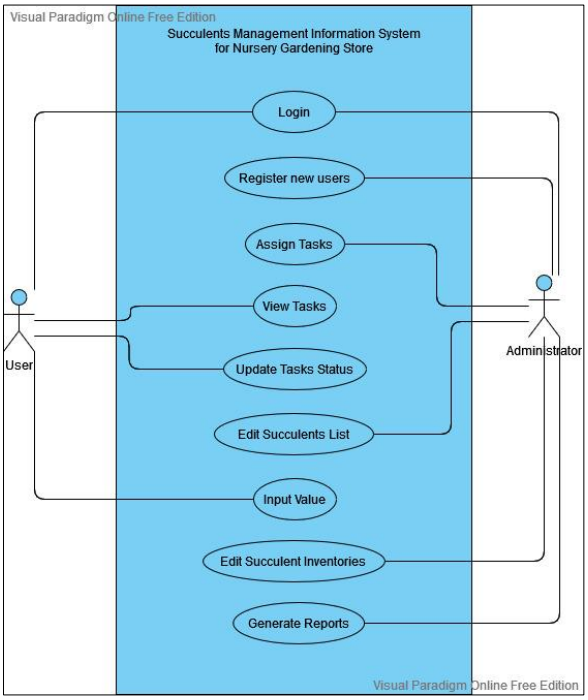

Figure 2: Use Case Diagram

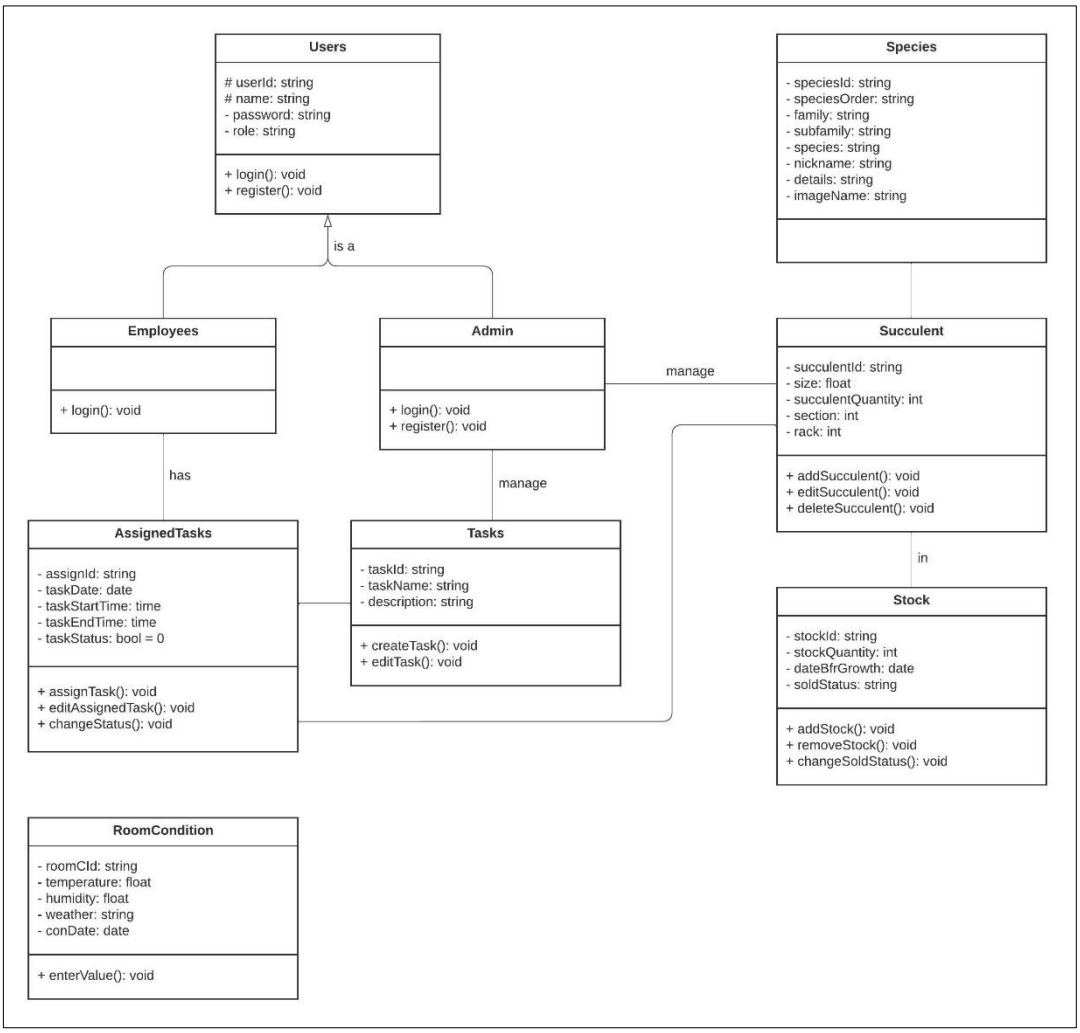

Figure 3: Class Diagram

On the other hand, the class diagram depicts the application's static view. It depicts the many types of objects in the system as well as their relationships. Data modelling can also be done with class diagrams. **Figure 3** shows the class diagram.

Figure 4 shows the flowchart of this system. System flowcharts show how data flows through a system and how decisions are made to regulate occurrences. Symbols are used to demonstrate this. They're linked to show what happens to data and where it ends up.

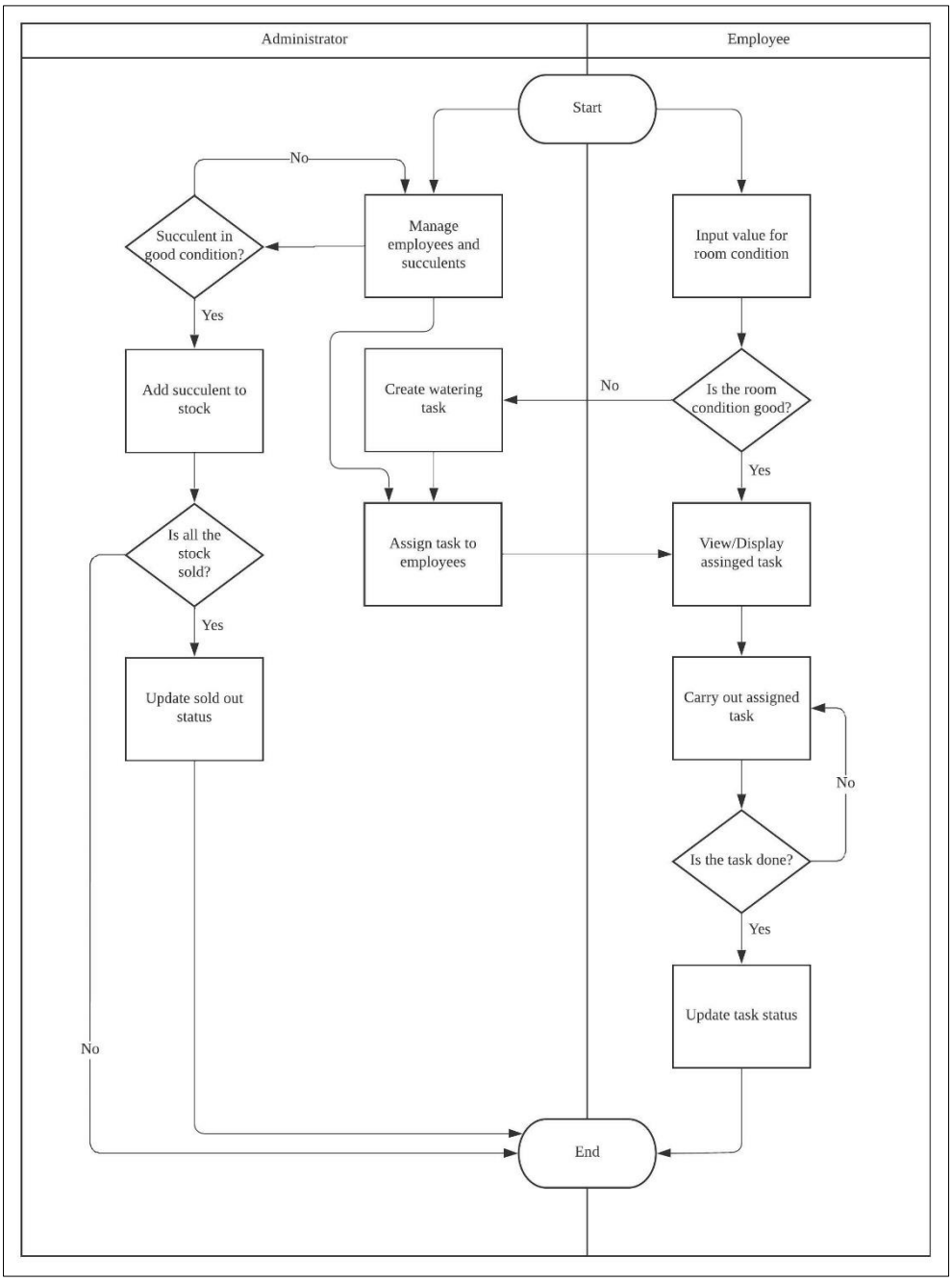

Figure 4: Flowchart of the System

3.3 System Design Phase

System design phase is to create a simple and quick design of the expected system. This gives the users insights of what the system does. System architecture is model concept that defines the structure, behaviors of the system and providing a visual representation of the system. **Figure 5** shows the architecture of the system.

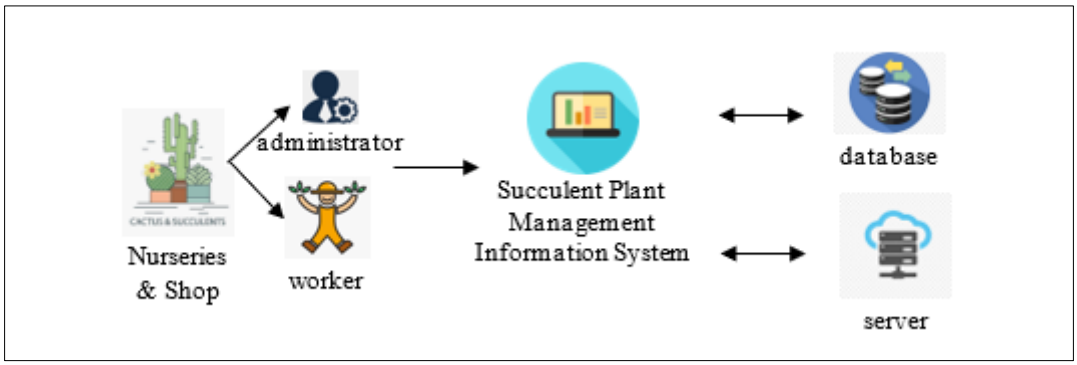

Figure 5: System Architecture

Database schema is listed in the following

i. `Users (userId, password, name, role)`
ii. `Tasks (taskId, taskName, description)`
iii. `AssignedTask (assignId, taskDate, taskStartTime, taskEndTime, taskStatus, taskId, userId, succulentId)`
iv. `Species (speciesId, speciesOrder, family, subfamily, species, nickname, details, imageName)`
v. `Succulent (succulentId, speciesId, size, succulentQuantity, section, rack)`
vi. `Stock (stockId, stockQuantity, dateBfrGrowth, soldStatus, succulentId)`
vii. `RoomCondition (roomCId, temperature, humidity, weather, conDate)`

The user interface for the system modules is designed in this phase. One of the important modules in this system is `Manage Succulent`. The interface design is as shown in **Figure 6**. The interface shows all succulents information that are recorded with its information. Update function is provided together with add new function to support the data entry and management.

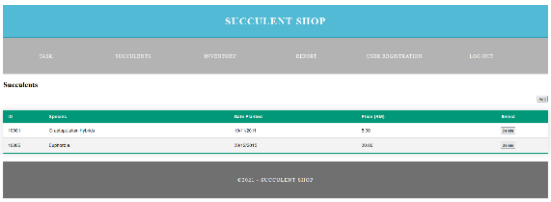

Figure 6: Succulent Interface

Figure 7: Adding Page

Figure 7 shows the function for adding a new succulent entry. Meanwhile, **Figure 8** shows the `Manage Task` interface. It is designed to display the task assignment for succulent care schedule. The status can be checked by users that indicating the task given have been completed.

The design of `Manage Stock` page is as shown in **Figure 9**. The page will display the succulent that have been added as stock. The sold status can be checked by users that indicating the following succulent has been sold.

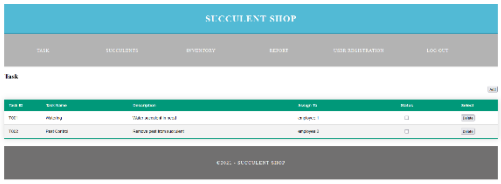

Figure 8: Task Interface

Figure 9: Stock Interface

3.4 Coding Phase

In the coding phase, the system will be written using the information collected in requirements phase and system design phase. Here, the prototype system is constructed accordingly. The activity in this phase is to develop the prototype system according to the design output. PHP, Sublime Text, and Macromedia Dreamweaver 2021 are used to write program code, and MySQL and XAMPP are used to manage the database. The result of the coding phase is explained in Section 4.

3.5 Testing Phase

The testing phase is conducted right after the coding phase is finished. Testing is done for getting evaluation including feedback from users and to be reviewed. It is needed to ensure the system is working and align with the desired and expected output. The activity will be done is letting users test the prototype system. The testing will be conducted each time a module is completed. The users will be the shop owner and the staff. The system will be tested for its user-friendliness, functionality, and responsiveness. The testing result is explained in Section 4.

3.6 Review Phase

After testing, review phase will be carried out with tested users giving feedback and suggestions towards the prototype system. It is then used to tweak and adjusted next time as the improvement for the system. The activity will be carried out is having users providing feedback and suggestions to review what the system lacks, and improvement needed.

3.7 Implementation Phase

After the cycle of prototyping, implementation phase will be started. The final system will be developed based on the final prototype, tested as a whole, and implemented as a product. The activities are implementing the final version of the system, have users test it and giving final verdict to the system. After all of it meets the requirements, it will be deployed as an application for real-life usage.

4. Result and Discussion

A web platform was used to build the system. This section presents the results of the system programming and testing. The HTML, CSS, JavaScript, and PHP computer languages were used to build the system website. XAMPP and Adobe Dreamweaver are the software used.

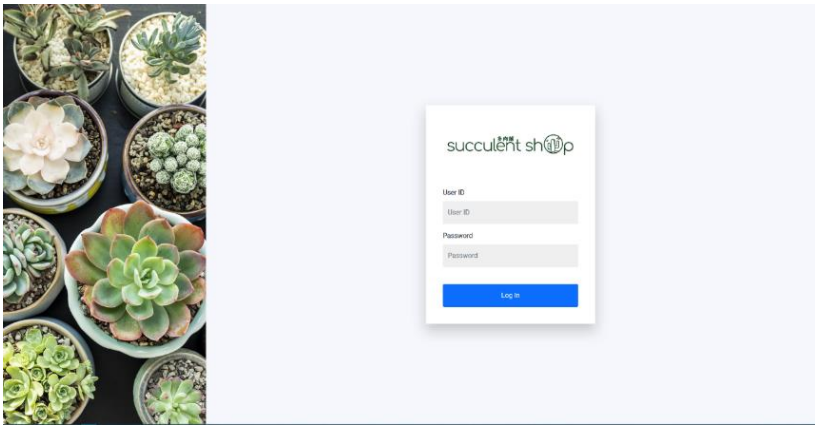

Figure 10: User Login Interface

4.1 `Login and Registration` Module

Figure 10 shows the user interface of the login page. **Table 5** shows the test case for Login and Registration module. There are total of five test cases for this module. The goal of this test is to see if users can log in to the system, if the system will redirect users to the appropriate page and display an error message if an erroneous credential is entered, and if the administrator can create accounts and change the roles of users. Table 5 demonstrates that all five tests were successful.

Table Error! No text of specified style in document.**: Test Case for `Login and Registration` Module**

Test Case ID	Description	Expected Result	Actual	Result
T1-1	To check whether users can login into the system	The user should be able to login into the system	The user has successfully logged into the system	Pass
T1-2	To check whether the system redirect users to respective page after correct credential is entered	The system should redirect users to respective page after correct credential is entered	The system redirected users to respective page after correct credential is entered	Pass
T1-3	To check whether the system will show error message whenever a wrong credential is entered	The system should show error message when an incorrect credentials has been entered	The system showed error message when an incorrect or no credentials has been entered	Pass
T1-4	To check whether administrator can register for an account	The administrator should be able to create for an account	The administrator has successfully created for an account	Pass
T1-5	To check whether administrator can change the role of users	The administrator should be able to change the role of other users.	The administrator has successfully changed the role of other users.	Pass

4.2 `Tasks Management` Module

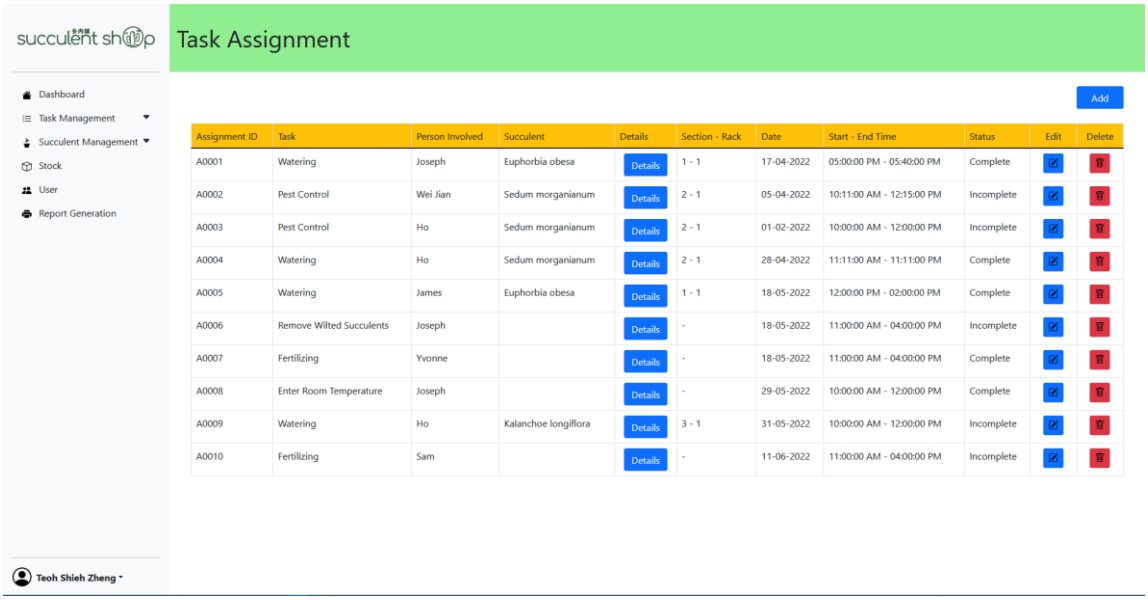

Figure 11: Task Management User Interface

Figure 11 depicts the user interface of task management. It shows task information such as its ID, the task assigned, the person assigned to, date, time, status, and others. After clicking the "Details" button, it will show succulent information. The Tasks Management module's test case is shown in **Table 6**. For this module, there are three test cases. The goal of this test is to see if the administrator can assign tasks to users, as well as whether users can access and amend the status of tasks they have been assigned.

Table 6: Test Case for Tasks Management Module

Test Case ID	Description	Expected Result	Actual	Result
T2-1	To check whether administrator can assign tasks to users	The administrator should be able to assign tasks to users	The administrator has successfully assigned tasks to users	Pass
T2-2	To check whether the users can view tasks given	The user should be able to view tasks given	The user has successfully viewed tasks given	Pass
T2-3	To check whether the users can update tasks completion status	The user should be able to update tasks completion status	The user has successfully updated tasks completion status	Pass

4.3 `Succulents Planting Management` Module

```
public function insert($table_name, $data){
    $string = "INSERT INTO ".$table_name." (";
    $string .= implode(",", array_keys($data)) . ') VALUES (';
    $string .= "'" . implode("','", array_values($data)) . "')";
    if(mysqli_query($this->con, $string)){
        return true;
    }
    else{
        echo mysqli_error($this->con);
    }
}
```

Figure 12: SQL for Adding Page

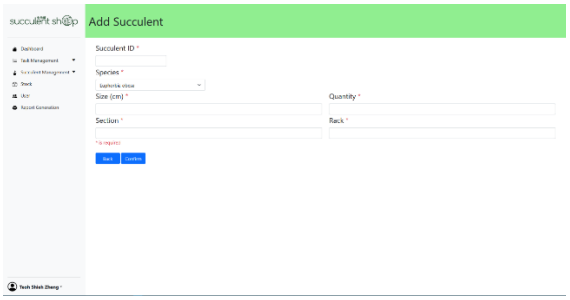

Figure 13: Adding Page User Interface

In this module, the program detects if the button "submit" has value in it. If it does, it will pass all the values from the form into the array called $inserted_data. Afterward, it will call the `insert ()` function to pass the array. SQL INSERT as depicted in **Figure 12** will be executed and return true if it succeeds.

Figure 13 shows the user interface of adding page. The administrator will need to enter the succulent ID, species, its size, quantity, section and rack. After all are filled, administrator can click "Confirm" button to add the record into the database. The "Back" button will redirect administrator back to View Succulent Page.

Table 7 show the test case for `Succulents Planting Management` module. There are total of four test cases for this module. The purpose of this test is to verify whether the administrator can add and remove succulents, edit succulents' information, whether the users can enter room's values and edit it. Table 7 shows that all the four tests had passed the test.

Table 7: Test Case for `Succulents Planting Management` Module

Test Case ID	Description	Expected Result	Actual	Result
T3-1	To check whether administrator can add and remove succulents	The administrator should be able to add and remove succulents	The administrator has successfully added and removed succulents	Pass
T3-2	To check whether administrator can edit succulents' information	The administrator should be able to edit succulents' information	The administrator has successfully edited succulents' information	Pass
T3-3	To check whether the users can enter room's values	The user should be able to enter room's values	The user has successfully entered room's values	Pass
T3-4	To check whether the users can edit room's values	The user should be able to edit room's values	The user has successfully edited room's values	Pass

4.4 `Succulent Stock` Module

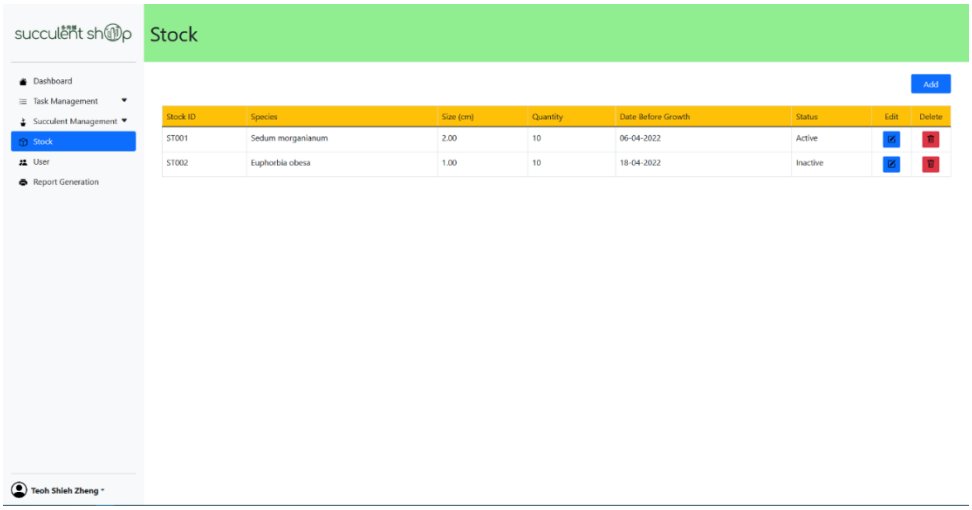

Figure 14: View Stock User Interface

From **Figure 14**, it shows the user interface of view stock page. There is a column named "Delete", the column consists of a delete button. Once clicked, a confirmation message will pop out **Table 8** show the test case for Succulent Stock module. There are total of two test cases for this module. The purpose of this test is to verify whether the administrator can enter and remove succulents available to sell, and change succulents sold status. **Table 8** shows that all the two tests had passed the test.

Table 8: Test Case for `Succulent Stock` Module

Test Case ID	Description	Expected Result	Actual	Result
T4-1	To check whether administrator can enter and remove succulents available to sell	The administrator should be able to enter and remove succulents available to sell	The administrator has successfully entered and removed succulents available to sell	Pass
T4-2	To check whether administrator can change succulents sold status	The administrator should be able to change succulents sold status	The administrator has successfully changed succulents sold status	Pass

4.5 `Report Generation` Module

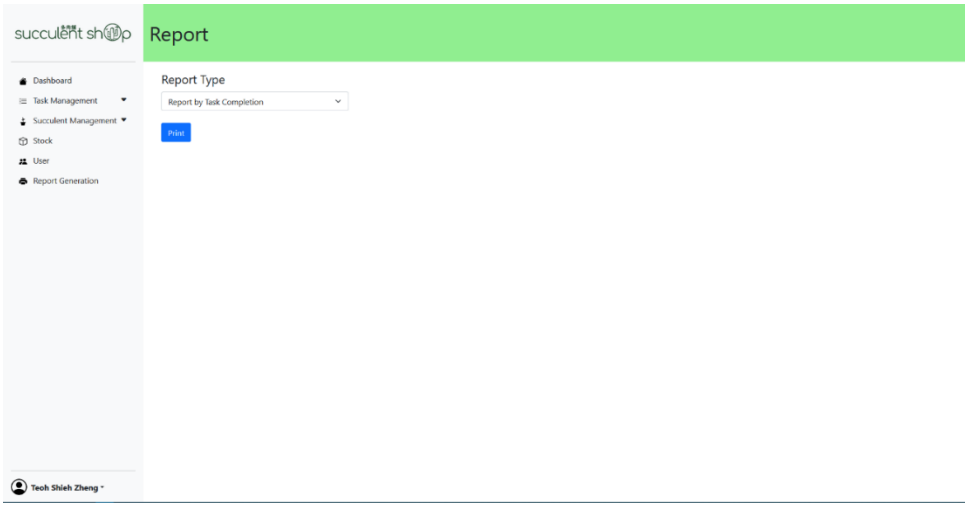

Figure 15: Select Report Type User Interface

succulent shop **Report**

Printed by : Teoh Shieh Zheng
Printed Date : 2022/06/07

Approved By

Task Completion

Status - Complete

Assign ID	Task Name	Person Involved	Date
A0001	Watering	Joseph	17-04-2022
A0004	Watering	Ho	28-04-2022
A0005	Watering	James	18-05-2022
A0007	Fertilizing	Yvonne	18-05-2022
A0008	Enter Room Temperature	Joseph	29-05-2022

Status - Incomplete

Assign ID	Task Name	Person Involved	Date
A0003	Pest Control	Ho	01-02-2022
A0002	Pest Control	Wei Jian	05-04-2022
A0006	Remove Wilted Succulents	Joseph	18-05-2022
A0009	Watering	Ho	31-05-2022

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Figure 16: Report for Task Completion

Figure 15 depicts the user interface for a specific report type. The report types are listed in the selection box. It will direct the administrator to the relevant report once they have chosen one. A report based on task completion, for example, can be printed as illustrated in **Figure 16**. **Table 9** shows the test case for `Report Generation` module. There is only one test case for this module. The purpose of this test is to verify whether the administrator can generate reports.

Table 9: Test Case for `Report Generation` Module

Test Case ID	Description	Expected Result	Actual	Pass/Fail
T5-1	To check whether administrator can generate reports	The administrator should be able to generate reports	The administrator has successfully generated reports	Pass

5. Conclusion

Administrators of succulent nursery stores can use the designed system to better manage the care schedule and succulents for sale. The system has two types of users: administrators and employees. Looking at the current condition of this Succulents store's business data management methods, it's evident that this firm needs to leverage contemporary digital technology skills, which are incredibly beneficial to the company's growth. The efficiency of the data storage process on succulent crops at the gardening store might be improved by combining computer technology, information systems, databases, and Internet technology.

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