

# Strawberry Farm Information Management System

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## Abstract

Modern agriculture is increasingly reliant on information management systems to optimize productivity. Implementation of Farm Information Management Systems (FMIS) has become quite the trend in farming. In this context, Healthy Strawberry Farm, traditionally run in the hills of Cameron Highlands for over 50 years, has been facing difficulties in accessing real-time information regarding farm management. Data can be highly unreliable, especially when recorded manually, and crop and labor management is quite a tedious task at present. Therefore, a strawberry farm information management system has been developed to assist the management. The system aims to facilitate the internal operation of the farm while making it not only highly accessible to users but also to provide reliable data. PHP, Xampp, and MySQL are used in system development, and agile techniques for iterative development and change adaptation are applied. The web-based strawberry farm information management system is expected to fulfill the requirements of the farm manager and owner, designed to enhance the productivity of staff, the quality of the crop, and the overall management of the farm. Preliminary results have shown a significant improvement in data accuracy and a reduction in manual labor. To further enhance the system, it is suggested to integrate IoT sensors for real-time monitoring and predictive analytics to anticipate potential issues. This system will help the farm stand out among other traditionally run farms, promoting data-driven decision-making for better productivity.

## 1. Introduction

Strawberries have been farmed as a specialty crop in Malaysia with increasing popularity [1]. Malaysian farmers have effectively modified their farming practices to provide ideal growing conditions for strawberries, even though the nation is tropical in nature [2][3]. Higher heights and lower temperatures make highland regions like Sabah's Cameron Highlands, Genting Highlands, and Kundasang ideal for strawberry plantations. These areas have the climate needed for strawberry production to be effective [4][5]. Markets, farm stalls, and internet platforms are common places to buy strawberries cultivated in Malaysia [6]. Growth in the business has been driven by the desire for locally grown strawberries and the growing interest in agritourism experiences.

In strawberry farming, manual data management is collecting, organizing, and recording data with manual systems or pen and paper. Even though digital approaches are more sophisticated, small-scale enterprises or scenarios with inadequate digital infrastructure might still benefit from manual data management [7]. Many firms in the modern digital era still handle their data manually. This can be attributed to several factors, such as financial aversion to change, ignorance of digital alternatives, and worries about data security [8]. Making the switch to digital data management may be difficult for some industries due to regulatory restrictions [9]. On the

other hand, digital solutions are efficient and scalable, while manual data administration is time-consuming and prone to errors. There is limited real-time access to information, which causes analysis and decision-making to be delayed and less precise.

The subject of this project is Healthy Strawberry Farm, a Pahang-based family farm with nearly 50 years of hydroponically produced strawberry cultivation experience. Tourists can purchase food from the farm. Issues in data management were discovered through observations and discussions with farm owners. To maintain manual records, farms now use spreadsheets and physical files. Information on fruit condition, harvest readiness, runner plant condition, and strawberry clusters are all documented. Labor-intensive and error-prone manual record-keeping processes do not capture relevant data for important areas such as work delegation and labor management. Analyzing patterns in strawberry yield and sales over time is complicated by this, making it difficult to track and find information. Moreover, it becomes challenging to monitor job issues and improve plant care procedures without accurate documentation of completed or incomplete work, which may impact the production of strawberries ready for sale.

As a solution, a web-based strawberry farm information management system is built. A Farm information management system (FMIS) is a management information system designed to assist agricultural farmers to perform various tasks ranging from operational planning, implementation, and documentation for assessment of performed field work. Farmers can administer their enterprises more efficiently by using an online farm management system. They can use it to monitor and control all aspects of their farming operations, such as production, inventory, labour, and financial management. Online farm management solutions can help farmers run their enterprises more profitably and successfully while increasing their sustainability. A well-defined system is necessary for the internal operations within a farm and the team that consists of the manager, the workers, the supervisor and more that is applicable.

This article is organized into six parts, covering various aspects of the project. It begins with background, followed by an analysis of related work. The methodology section describes the project approach and design process. Implementation details and test results are discussed in the fourth section. The project conclusion highlights contributions, limitations, and recommendations for future improvements. The final section expresses gratitude and appreciation to those who supported this project.

## 2. Related Work

In Malaysia, the main method of strawberry cultivation in the highlands is the hydroponic methods planed in greenhouses. This method is highly preferred to maintain the ideal environment for the growth of strawberries [10]. The farm that has been chosen as a case study organization for strawberry farm management system development is Healthy Strawberry Farm. Spreading across 1 to 2 acres of land is a family farm currently owned and managed by Mr. Krishna Ramasamy. The farm is on a windy hill beside Cameron Highlands Resort in Brinchang, Pahang. In Healthy Strawberry Farm, the strawberry runner plants are organically cultivated using a partial hydroponic technique. The method used is fertigation method. Fertigation brings the definition of the practice of applying the dissolved nutrients to crops via a managed irrigation system [11].

One strawberry variety that is majorly cultivated in Healthy Strawberry Farm is Florida Elyana [12] and another Korean variety which is famous for its sweetness. After sowing the runner plants in coconut husk to promote healthy growth of the runner plants, the batch will be manually watered and fertigated for a time ranging from 4 to 6 months. During this time, the plants are taken care of by the workers under supervision by the farm manager. The temperature ranges from 25° to 30° degree Celsius, a mild rise is common by midday but is maintained throughout thanks to the natural weather in Cameron Highlands. The process comprises of many tasks, such as pruning, checking the soil condition, monitoring any pest attacks and so on.

Strawberry stock records are now kept manually on paper forms, which makes data entry time-consuming and prone to errors. Task assignments and cultivation data are frequently recorded on whiteboards or sheets of paper in farming activities, which leads to inaccurate record keeping and challenges in tracking and finding information. It is difficult to analyse trends in strawberry yield and sales over time when records are kept by hand. It is also challenging to manage tasks in the absence of the farm owner/manager because the administration of strawberry growing depends on their decisions. Inadequate documentation of finished or partially completed work impedes improvements in plant care procedures and strawberry yield for commercial purposes, as well as employment problems.

Sustaining a successful strawberry crop and a profitable business needs close attention to several variables. For decision-making and future reference, data collection, recording, and processing is essential. With an understanding of the value of data, Healthy Strawberry Farm collects data on labour performance, runner plant dates, fertilisation schedules, and planting dates. The intricate procedures involved in running a strawberry farm are made simpler by this seemingly trivial data. Information is essential for enabling farmers to make knowledgeable choices at every stage of the farming process. An information management system that facilitates effective recording, organisation, and analysis will be put in place to expedite data gathering and administration.

A web-based information system (WBIS) gives users access to and control over data and information on the internet or within an intranet of an organization by utilizing web technology [13]. The restrictions of traditional standalone software applications have been replaced by an innovative approach to data management that gives users the freedom to interact with data and complete activities from almost anywhere with an internet connection using web browsers. Using the web system to store data in a designated database is a typical component of web-based information systems. This is the basic idea behind the general operation of WBIS. Web-based information systems convert the data that is saved into valuable information, much like traditional information systems do [14]. Calculating the data, sorting, classifying, and summarising are examples of data processing techniques [15]. Data that has been processed can be used to organize, coordinate, direct, and manage decisions in the future. Requesting real-time data access is another element of web-based information systems. The limitations of managing a typical information management system can be avoided with this feature, which offers periodic updates and flexibility in data storage and retrieval.

An investigation has been carried out to compare the proposed information system with existing farming system software available in the market to further improve the notion. Because of their unique characteristics, three systems—Farmable, Conservis, and NavFarm—were chosen for the comparative analysis.

**Table 1** Comparison of Existing Systems

Features/ System	Farmable	Conservis	NavFarm	Strawberry Farm Information Management System (FIM)
User management module	√	√	√	√
Crop management and farming module	√	√	√	√
Labor management module	√	X	X	√
Crop marketing and sales management module	√	√	√	√
Reporting and analytics module	√	√	√	√

**Table 1** summarizes that the three chosen systems were evaluated. A few important findings are identified through this comparative study. All the systems share a user management module which is the login and registration by the divided for administrator and staff (normal users).

Essential components of all three systems are the agricultural and crop management modules. Each system, however, uniquely uses these modules. For instance, Conservis has integrated input tracking and features a harvesting module, giving users access to real-time data for decision-making. Additionally, NavFarm and Farmable approach farming and crop management in distinct ways. A crop farming module designed to support strawberry producers and broaden their knowledge base is the goal of a suggested information management system for strawberry farms, which is based on these observations. One feature that sets this suggested system apart from the others is its labour management module, which enables farmers to track their productivity and produce proof of work. To determine monthly salary and potential performance-based bonuses, it also tracks working hours through clock-in and clock-out times. With the use of past and current data, this function enables farmers to evaluate their productivity.

These findings have led to the development of an information management system that will specifically help strawberry farmers by offering a crop farming module that will broaden their knowledge base and support them. With the labor management module included in this suggested system, farmers can track their production and give proof of work, setting it apart from the others. To compute monthly compensation and possible performance-based bonuses, it also tracks working hours through clock-in and clock-out times. Farmers can use both historical and current data to evaluate their productivity.

The above-mentioned feature is essential in today's world of digital technology when all information must be always accessible. Taking this into account, Healthy Strawberry Farm needs to participate in the advancement of its business data management capabilities using cutting-edge technology. Therefore, the strawberry farm information management system that is proposed takes advantage of the features of a web-based information system to integrate technology into the management of the farm thus improving the overall business performance.

### 3. Methodology

Agile system development methodology was chosen for this project. IT projects have traditionally been conducted using waterfalls or predictive methodologies. However, organizations have turned to iterative or Agile approaches because of the poor success rate of this approach [16]. There are six stages in the system development process, and the project should take 28 weeks to complete. The project will be divided into two 14-week parts corresponding to the work of two academic semesters. The first phase will last from October 8, 2023, to January 7, 2024; the second phase will run from 17 March 2024 to 29 June 2024. A Gantt chart that shows the project's timeline and job dependencies over 28 weeks is included in **Appendix A**.

The tasks and results linked to each phase that need to be completed during the project development process are listed in **Table 2**. It is important to note that every output was finished in the allotted time. This project aims to solve the shortcomings of conventional methods and guarantee a more adaptable and iterative development process by implementing Agile methodology. Project phase assignments and defined timeframes offer an organized framework for productive development and effective project completion.

**Table 2** Software development activities

Phase	Task	Output
Requirement	<ul style="list-style-type: none"> <li>Proposed the project.</li> <li>Interview the farm manager.</li> <li>Determine the project schedule, activities, and output.</li> </ul>	<ul style="list-style-type: none"> <li>Project proposal.</li> <li>Gantt chart.</li> <li>DFD</li> <li>ERD</li> <li>Flowchart</li> </ul>
Quick Design	<ul style="list-style-type: none"> <li>Design a basic system.</li> </ul>	<ul style="list-style-type: none"> <li>system architecture</li> <li>Database design</li> <li>System's user interface design</li> </ul>
Build Prototype	<ul style="list-style-type: none"> <li>Choose the appropriate prototyping tools or software based on the project's needs.</li> </ul>	<ul style="list-style-type: none"> <li>Prototype (I)</li> </ul>
User Evaluation	<ul style="list-style-type: none"> <li>Involve end-users, clients, and stakeholders in user acceptance testing.</li> </ul>	<ul style="list-style-type: none"> <li>Test case</li> </ul>
Refining Prototype	<ul style="list-style-type: none"> <li>Refine the high-fidelity prototype based on feedback. Pay attention to visual design, functionality, and fine-tuning the user experience.</li> <li>Finalize the prototype based on the feedback and testing results.</li> </ul>	<ul style="list-style-type: none"> <li>Prototype (II)</li> </ul>

#### 3.1 System Requirements Analysis

Requirements analysis is the process of determining the requirements that must be met by the developed system, as well as the requirements that are determined according to the user's needs. System requirements consist of functional and non-functional requirements, user requirements, and system requirements. Requirements are defined as conditions or capabilities that must be met or met by a system to meet a contract, standard, specification, or other officially imposed document [17]. Functional requirements are described as capabilities that a system must exhibit to solve a problem. On the other hand, dysfunctional needs are described as acting to constrain solutions [18]. **Tables 3** and **4** show the functional and non-functional requirements for the proposed strawberry farm information management system. User requirements are described in **Table 5**. The users that have been identified for the proposed system consist of farm managers and owners as administrators, also including staff as secondary users.

**Table 3** *Functional requirements*

Module	Description
1. User Management Module	<ul style="list-style-type: none"> <li>• Permit the existing users to log in with the id and password.</li> <li>• Redirect the valid users to the dashboard when successfully login.</li> <li>• Display error message upon invalidated login</li> <li>• Allows only the administrator to create and register new users.</li> </ul>
2. Crop Management and Farming Module	<ul style="list-style-type: none"> <li>• Allow the administrator to add new records for batch creation.</li> <li>• Allow the administrator to enter yield information.</li> <li>• Allow the administrator to edit the record.</li> <li>• Allow the administrator and staff to record harvest entries during and after each picking round.</li> <li>• Allow the administrator and staff to insert notes and images for each batch of strawberries.</li> <li>• Allow the administrator and staff to view data that has been input by the administrator and staff.</li> </ul>
3. Labor Management Module	<ul style="list-style-type: none"> <li>• Allow the administrator to add, delete, or update staff data.</li> <li>• Allow the administrator to create custom jobs.</li> <li>• Allow the administrator to assign the tasks evenly.</li> <li>• Allow the staff to access the add and edit records feature.</li> <li>• Allow the staff to check their schedule.</li> <li>• Allow the staff to input proof of work done such as pictures and notes.</li> </ul>
4. Crop Marketing and Sales Management Module	<ul style="list-style-type: none"> <li>• Permit the administrator to enter sales data.</li> <li>• Allow the administrator to set the price per kilogram for the strawberries.</li> <li>• Allow administrators and staff to view graphical output of monthly sales.</li> <li>• System can calculate revenue based on harvest, yield, and sales data.</li> </ul>
5. Reporting Module	<ul style="list-style-type: none"> <li>• Administrator able to generate reports about their sales and account statements for accountants.</li> </ul>

**Table 4** *Non-functional requirements*

Module	Description
1. Performance	<ul style="list-style-type: none"> <li>• The loading time required for the system is not more than 1 minute.</li> <li>• The system should be available for 24 hours a day.</li> </ul>
2. Operational	<ul style="list-style-type: none"> <li>• The system should be user-friendly.</li> <li>• The system should be able to work on any web browser.</li> <li>• The system should be easily maintained and updated.</li> </ul>
3. Security	<ul style="list-style-type: none"> <li>• The system should only allow authorized access through a valid username and password.</li> </ul>
4. Usability	<ul style="list-style-type: none"> <li>• The system should be able to work on any web browser.</li> <li>• The system should be easy to use and appealing to users.</li> </ul>

**Table 5** *User requirements*

No	Requirement
1.	Users must have an account with a valid id and password.
2.	The user should be able to input a username and password to login into the system.
3.	The user should be able to update the strawberry batch status.
4.	The user should be able to view a list of strawberry batches.
5.	Users should be able to upload pictures/ notes about each strawberry batch if necessary.
6.	The user should be able to input sales data.
7.	The user should be able to view sales data.
8.	Staff should be able to update task status.
9.	The administrator should be able to delete or update staff records.
10.	The administrator should be able to assign tasks.
11.	The administrator (only) should be able to register a new user.
12.	The administrator should be able to add, update, and delete strawberry batch information.
13.	The administrator should be able to generate the report.

### 3.2 System Analysis

The results of the system analysis, which is a use case diagram and entity relationship diagram, are defined in this sub-section. To perform system analysis, a systematic approach is used.

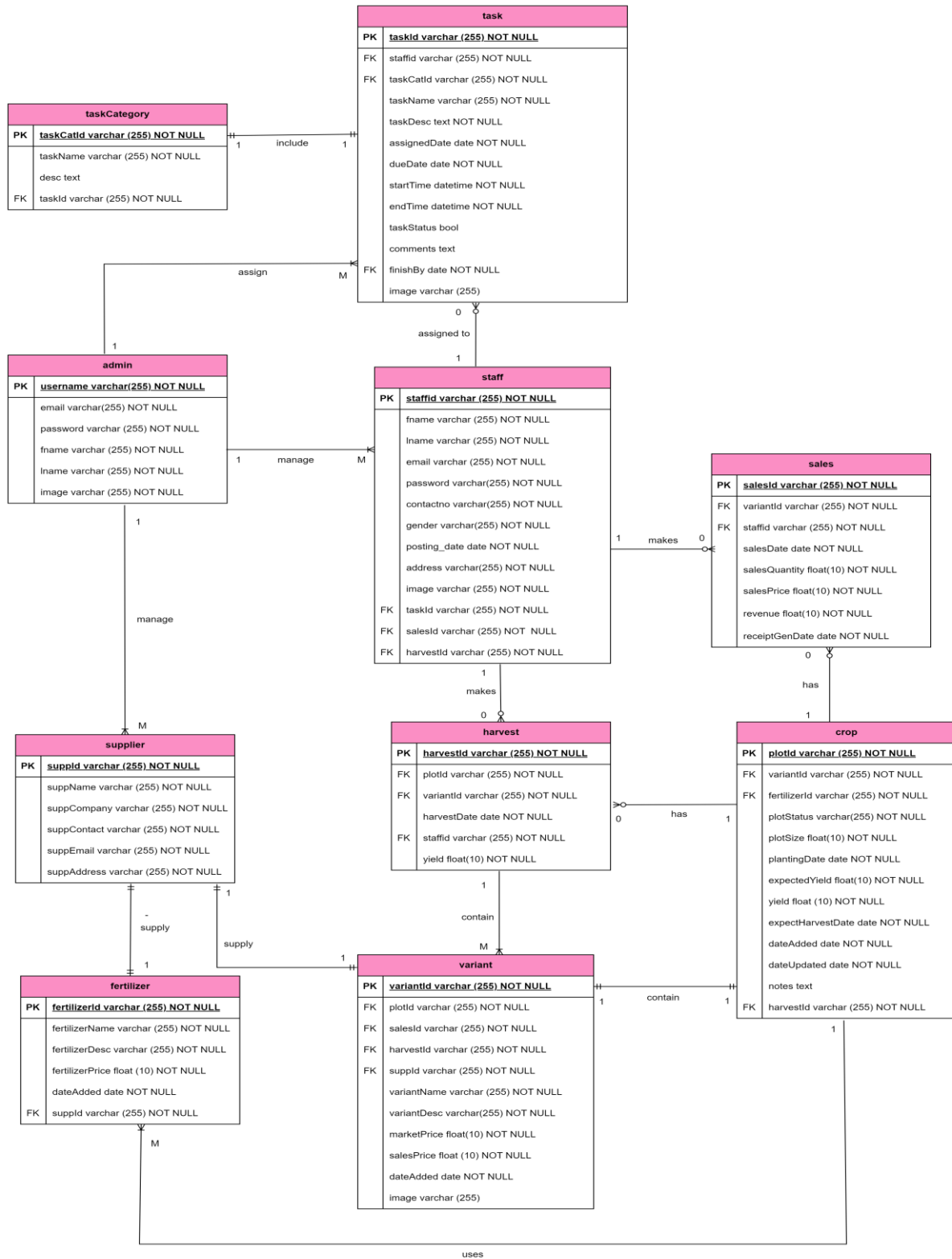
#### i. Use Case Diagram

The use case diagrams, activity diagrams, and sequence diagrams are used in system modeling to describe the activity structure and behavior of information management systems for strawberry farms. The use case diagram mainly consists of three components, the use case that represents a piece of functionality provided by the system, the actor that represents the user, and the association that connects the actor with the use case [19].



**Fig. 1** Use Case Diagram

**Figure 1** shows the use case diagram of Strawberry Farm Information Management System. It portrays the overview of processes that take place within the system. Entities that are involved in this diagram are the administrator and staff. The use case of this information management system will be discussed and presented in the next section by using the use specification.



**Fig. 2** Entity Relationship Diagram (ERD)

**Figure 2** shows the Entity Relationship Diagram of Strawberry Farm Information Management System. Here illustrated are nine main tables that will be present in the database. The connection between the tables is also depicted accordingly.

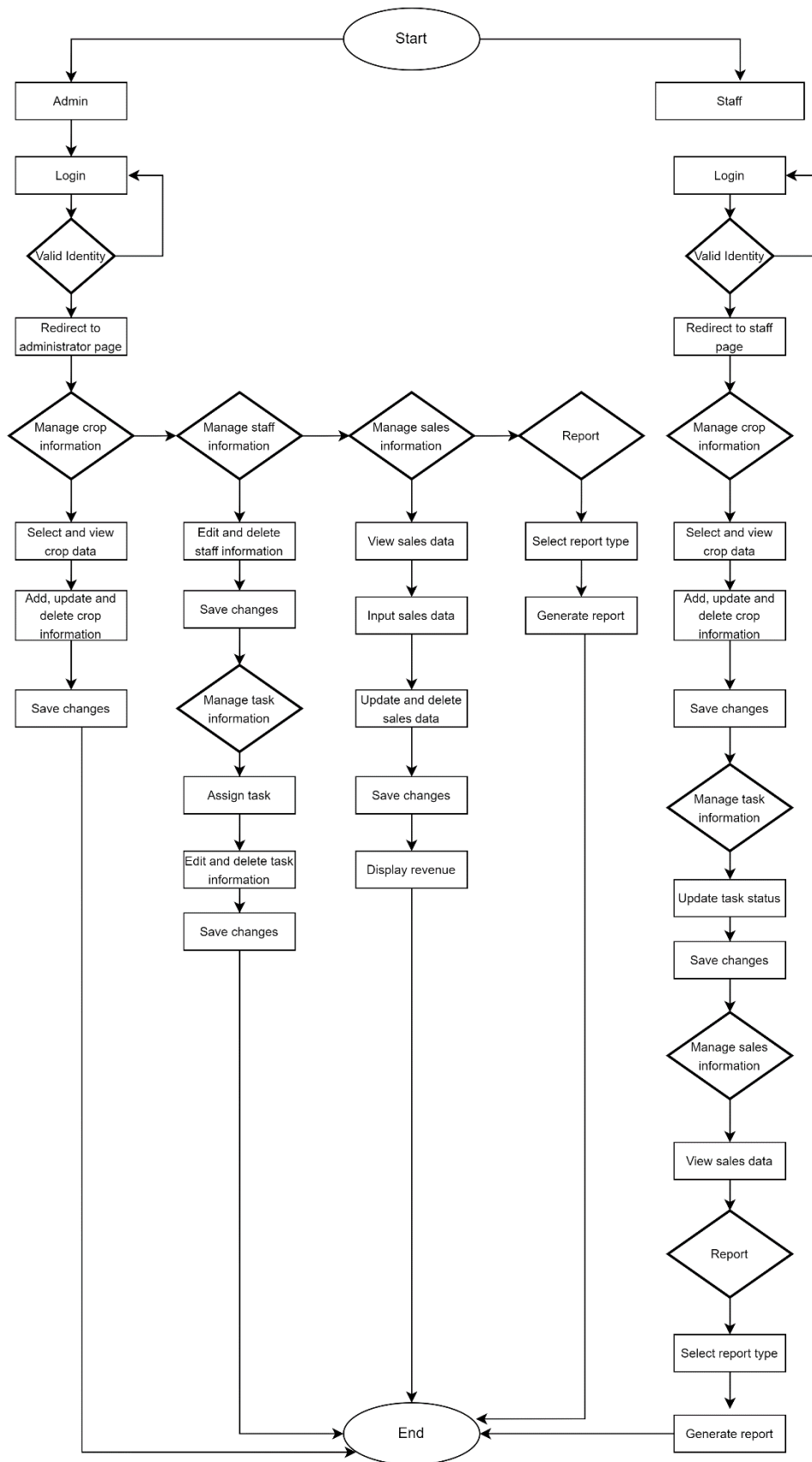
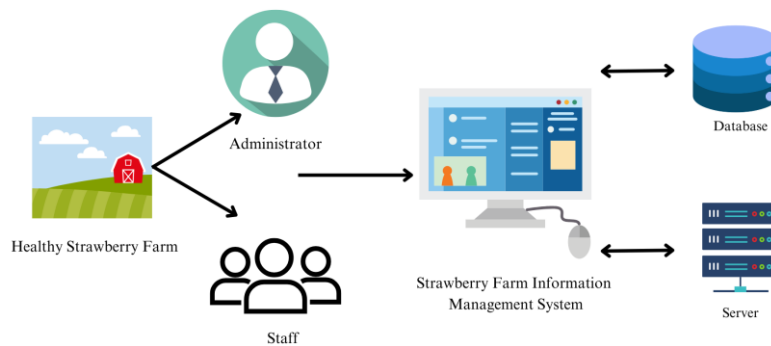


Fig. 3 Flowchart of Proposed System

**Figure 3** shows the flowchart of the Strawberry Farm Information Management System. There are two main users which are administrator and staff, each of them having access to distinct features of the system respective to their roles.

### 3.3 System Design

This section encompasses the system architecture, relational schema, and graphical user interface (GUI) of the developed Strawberry Farm Information Management System. System architecture is made up of the system's exterior properties, internal components, and relationships between them. The system architecture for this system is illustrated in **Figure 4**.

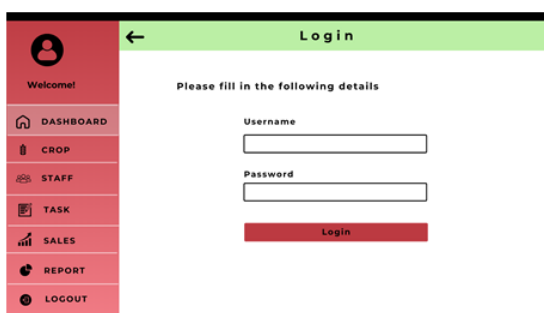


**Fig. 4** System Architecture

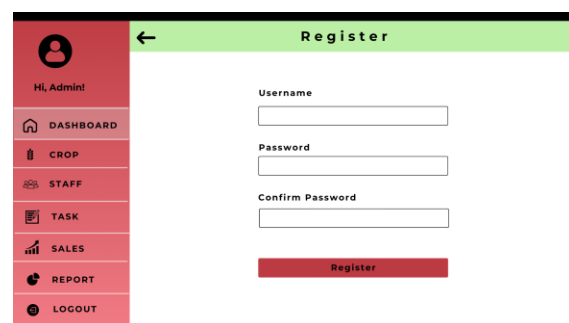
The relational schema of database tables in the strawberry farm information management system is as follows:

- admin (id, username, email, password, fname, lname, image)
- staff (id, staffid, fname, lname, email, password, contactno, gender, address, posting\_date, image, salesId, harvestId, taskId)
- crop (id, plotId, variantId, fertilizerId, plotStatus, plotSize, plantingDate, expectedYield, yield, expectHarvestDate, dateAdded, dateUpdated, notes)
- variant (id, variantId, variantName, variantDesc, marketPrice, salesPrice, dateAdded, image)
- fertilizer (id, fertilizerId, fertilizerName, fertilizerDesc, fertilizerPrice, dateAdded)
- task (id, taskId, taskCatId, taskDesc, staffid, assignedDate, dueDate, startTime, endTime, taskStatus, comments, finishBy, image)
- taskCategory (id, taskCatId, taskName)
- sales (id, salesId, salesDate, salesQuantity, salesPrice, revenue, variantId, receiptGenDate)
- supplier (id, suppId, suppName, suppCompany, suppContact, suppEmail, suppAddress)
- harvest (id, harvestId, harvestDate, yield, plotId, variantId)

The user interface (UI) serves as the crucial point of interaction between users and digital systems, facilitating seamless navigation and enhancing overall user experience [20]. It encompasses a range of elements, including menus, buttons, and visual design, all carefully orchestrated to optimize user engagement. The following figures illustrate the user interface design for this system.

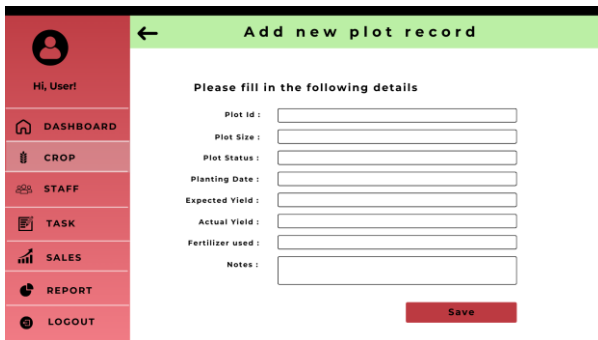


**Fig. 5** Login page

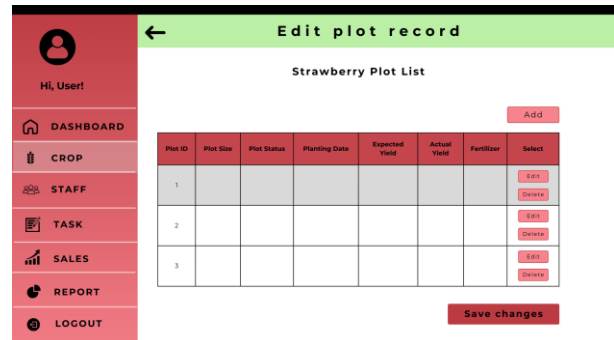


**Fig. 6** Register page

**Figure 5** illustrates the “Login” page of the system. The page prompts the user to fill in details such as username and password. Upon clicking log in, the system can validate the user and redirect the user to the respective dashboard. **Figure 6** depicts the “Register” page. This page is only accessible to the administrator. The administrator should set the username and the password and confirm the password. The administrator should be able to successfully create a staff account upon clicking the “Register” button. Upon completion a confirmation message implying successful registration shall show up.



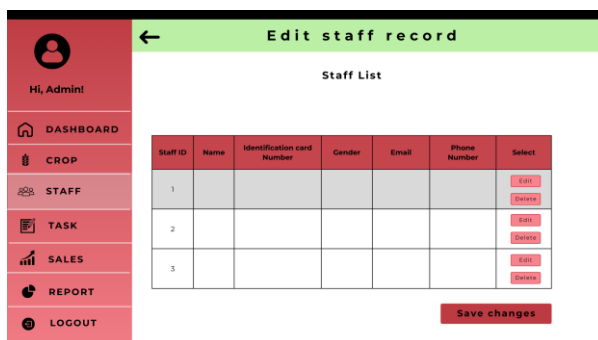
**Fig. 7** Add new plot record page



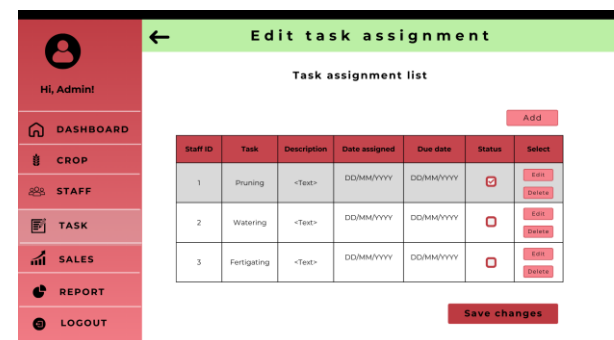
**Fig. 8** Edit plot record page

The "Add new plot record" page UI, shown in **Figure 7**, requires users to fill in certain information. Plot ID, Plot Size, Plot Status and Planting Date are among the necessary details. By selecting the "Save" option in the bottom right of the page, users can save the data they have put into the database. The "Strawberry Plot List" table will then be updated appropriately.

In **Figure 8**, the "Edit plot record" page is displayed with the table labelled "Strawberry Plot List." Data like Plot ID, Plot Size, Plot Status, Planting date, Expected Yield, Actual Yield and Fertilizer are displayed in the table. An "Add" button at the top of the table lets users add more strawberry plots to the farm management system. The record can be edited or deleted completely using the choices in the table's final column. Users can click the "Save changes" button to save their edits on a record. A confirmation box will show up whenever a user wants to remove a strawberry plot record, making sure the record is deleted. At that point, the "Strawberry Plot List" table will be updated appropriately.



**Fig. 9** Edit staff record page



**Fig. 10** Edit task assignment page

**Figure 9** shows the UI for the “Edit staff record” page. On the page, there is a table named “Staff List” that displays data such as Staff ID, Identification card Number, Gender, Email, and Phone Number. There are also buttons “Edit”, and “Delete” to edit the record and delete the record respectively. This page is only accessible to the administrator, and upon updating the table admin should be able to save the changes upon clicking the button “Save changes”.

**Figure 10** illustrates the “Edit task assignment” page UI, which is only accessible to the administrator. Here, the administrator will be able to add a new task, edit the existing task, or delete the task. There is a table named “Task assignment list” with information such as Staff ID to indicate the staff assigned to the task, Task, Description, Date assigned, Due date, and Status. Administrators can view the status of tasks from this page. Upon clicking the button “Save changes” the table will be updated accordingly.



Fig. 11 View the task assignment page

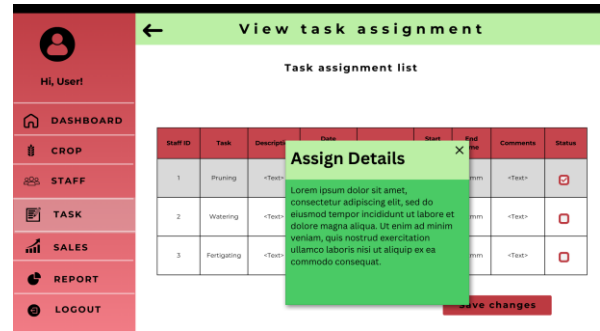


Fig. 12 Assign details pop-up window

The "View task assignment" page, shown in **Figure 11**, displays a table named "Task assignment list". This page is accessible to both administrators and staff. Staff can view additional details such as Start Time and end Time and can input completion comments under the column Comments. There is also a checkbox provided under the column Status which staff can tick after finishing the assigned task. The editing can be done by clicking the "Edit" button under the Action column. Upon clicking the button "Save changes" the table will be updated accordingly.

**Figure 12** shows the pop-up window titled "Assign Details". Here staff can view the assigned details, if any, upon clicking on the task. The assigned details are entered by the administrator in the "Edit task assignment" page.

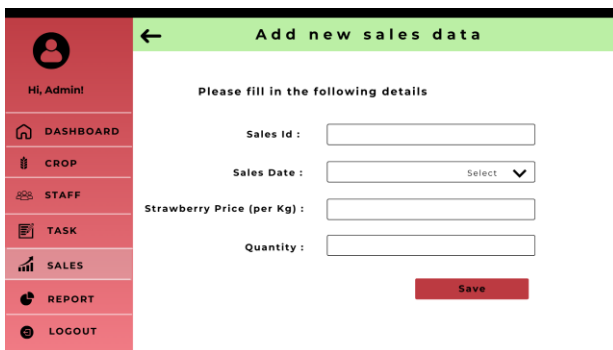


Fig. 13 Add new sales data page



Fig. 14 Edit sales data page

The "Add new sales data" page, shown in **Figure 13**, requires users to fill in certain information. Sales ID, Sales Date, Strawberry Price, and Strawberry Quantity are the necessary details. By selecting the "Save" option in the bottom right of the page, users can save the data they have put into the database. The "Strawberry Batch List" table will then be updated appropriately. Furthermore, this page is also only accessible to administrators.

**Figure 14** depicts the "Edit sales data" page. The table "Sales data" encompasses information such as Sales ID, Sales date, Strawberry Price, Quantity, and Revenue. Administrators can opt to edit or delete any of the sales records. Upon clicking the button "Save changes" the table will be updated accordingly.

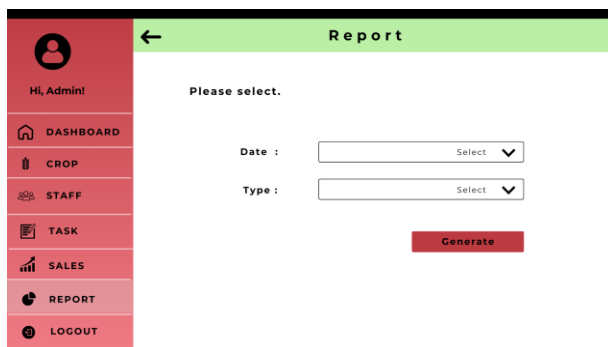


Fig. 15 Report page

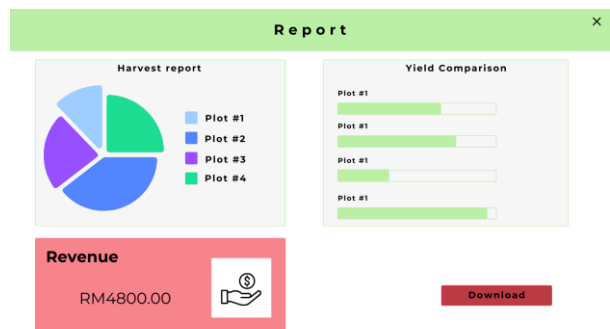
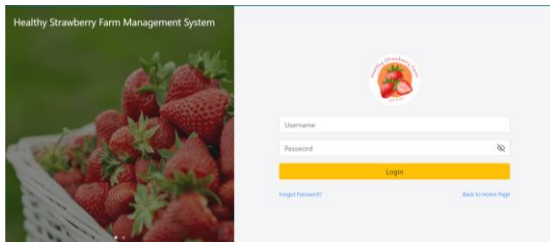


Fig. 16 Report output

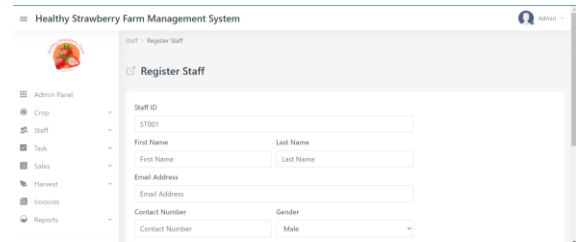
**Figure 15** shows the UI report page of the system. This page is only accessible to administrators. The administrator can select the date and type of report to be generated through two drop-down menus respectively. The UI for report output is shown in **Figure 16**. The information includes Harvest Report, Yield Comparison, and Revenue. There is an option to download the generated report and the administrator should be able to download the report of their preference in a PDF format.

#### 4. Result and Discussion

A web platform was used to build the system. This section presents the results of the system implementation and testing. The HTML, CSS, and PHP programming languages were used to build the system. XAMPP and Microsoft Visual Studio Code are the software used.



**Fig. 17** Administrator Login Interface



**Fig. 18** Register Staff Interface

**Figure 17** shows the user interface for the admin login page while **Figure 18** shows the register staff interface for the administrator. There are 2 input text boxes for username and password, followed by a button to execute the command of login. There are a total of 5 test cases for this module. The purpose of this test is to verify whether the user can log into the system, whether the administrator can register for the staff account, whether the system will restrict login if unauthenticated credentials, and whether the system redirects the user to the respective page upon login. Table 5.1 shows that all the three (5) tests had passed the test.

**Table 6** Test Case for User Management Module

Test Case ID	Description	Expected Output	Actual Output
M1-1	To check whether users can log in to the system.	The users should be able to log into the system.	As expected
M1-2	To check whether the administrator can register for an account.	The administrator can create an account for staff.	As expected
M1-3	To check whether the system will restrict login whenever a wrong credential is entered.	The system should restrict login when incorrect credentials have been entered.	As expected
M1-4	To check whether the system redirects users to the respective page after the authenticated credential is entered.	The system can redirect users to respective pages after authenticated credentials are entered.	As expected
M1-5	To check whether users can update their profile details as needed.	The users can update their profile details as needed.	As expected

**Figure 18, Figure 19, Figure 20,** and **Figure 21** depict the system interface for managing information for crops consisting of plots, strawberry variants, and fertilizer. Upon creating a record, the administrator (and user) can add, update, view, and delete items from the table. The data can also be searched and sorted based on the preferences of the admin and user. The test case for the crop management and farming module is shown in **Table 7**. The purpose of this test is to verify whether the user can create, update, delete, and view details of the plot, strawberry variant, fertilizer, and harvest and whether the form submits if incomplete/invalid input is present.

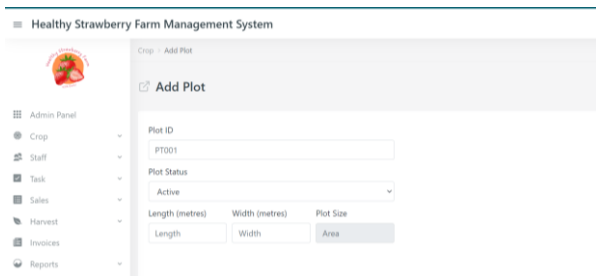


Fig. 18 Add Plot Interface

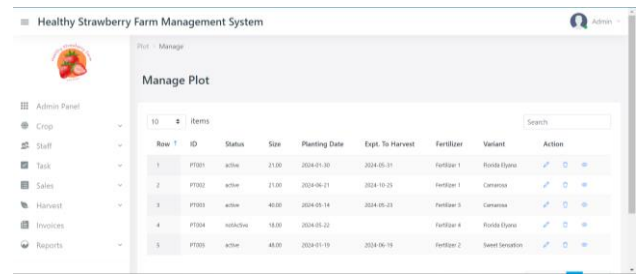


Fig. 19 Manage Plot Interface

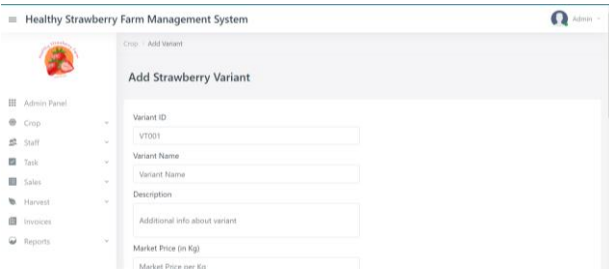


Fig. 20 Strawberry Variant Interface

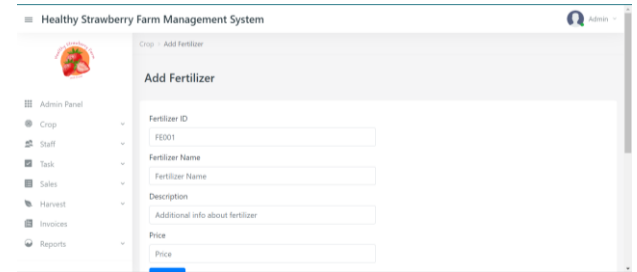


Fig. 21 Fertilizer Interface

Table 7 Test Case for Crop Management and Farming Module

Test Case ID	Description	Expected Output	Actual Output
M2-1	To check whether administrators (and users) can add, edit, and remove plots.	The administrator (and users) can add, edit, and remove plots.	As expected
M2-2	To check whether administrators (and users) can add, edit, and remove the strawberry variant.	The administrator (and users) can add, edit, and remove the strawberry variant.	As expected
M2-3	To check whether administrators (and users) can add, edit and remove fertilizer.	The administrator (and users) can add, edit, and remove fertilizer.	As expected
M2-4	To check whether the administrator and user can record harvest entries.	The administrator and user can record harvest entries.	As expected
M2-5	To check whether the form is submitted when all input fields are not filled in.	The error message is shown when all input fields are not filled in but try to submit.	As expected
M2-6	To check whether administrators and users can view input details of the plot, strawberry variant, fertilizer, and harvest.	The administrator and users can view details of the plot, strawberry variant, fertilizer, and harvest.	As expected

Figure 18 to Figure 21 depict the system interface for managing staff and task information. An administrator creates a task, then assigns the task to staff and views the task status while staff can only view the task assigned to them and update the status based on progress. Table 8 shows the test case for the Labor Management module. There are a total of 5 test cases for this module. The purpose of this test is to verify whether the administrator able to add, delete, and update custom tasks, assign tasks to staff, and view task status meanwhile whether staff can view tasks and update task status. Table 8 shows that all the five (5) tests had passed the test.

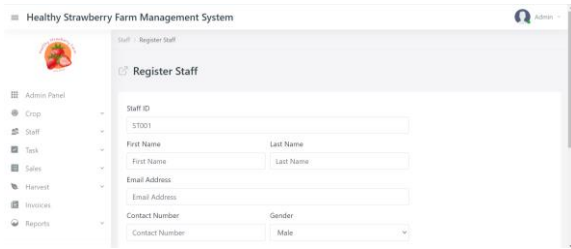


Fig. 18 Register Staff Interface

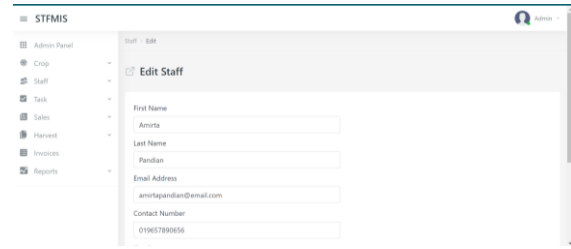


Fig. 19 Edit Staff Interface

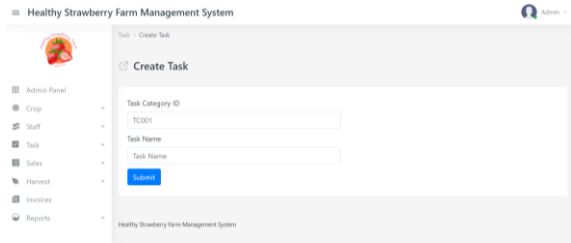


Fig. 20 Create Task Interface

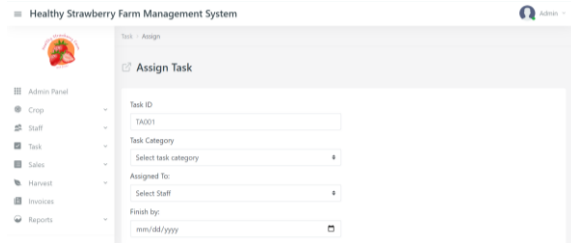


Fig. 21 Assign Task Interface

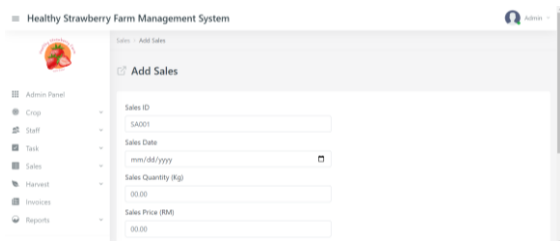
Table 8 Test Case for Labor Management Module

Test Case ID	Description	Expected Output	Actual Output
M3-1	To check whether the administrator can add, delete, or update staff data.	The administrator can add, delete, or update staff data.	As expected
M3-2	To check whether the administrator can create, delete, and update custom jobs.	The administrator can create custom jobs.	As expected
M3-3	To check whether the administrator able to assign tasks to staff.	The administrator can assign tasks to staff.	As expected
M3-4	To check whether staff can view and update task status.	The staff can view and update task status.	As expected
M3-5	To check whether staff can upload proof of work and related images of tasks (not required).	The staff can upload proof of work, and related images of tasks (not required).	As expected

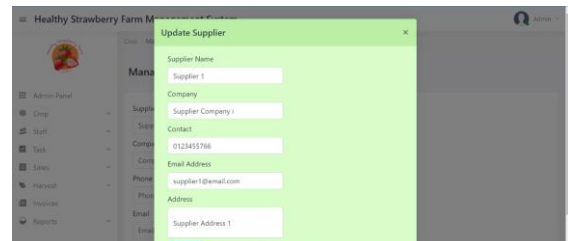
Figure 22 and Figure 23 depict the system interface for managing sales and supplier information. Sales can be added and stored in the database to be used for report generation and future reference. Administrators and staff both can access this module. Table 9 shows the test case for the Crop Marketing and Sales Management module. There are a total of 3 test cases for this module. The purpose of this test is to verify whether administrators and users can create, update, delete, and view sales data, whether supplier details are accessible to users. Table 9 shows that all the three (3) tests had passed the test.

**Table 9** Test Case for Crop Marketing and Management Module

Test Case ID	Description	Expected Output	Actual Output
M4-1	To check whether administrators and users are able to create, update, delete, and view sales data.	The administrator and users are able to create, update, delete, and view sales data.	As expected
M4-2	To check whether revenue is able to be calculated through form submission.	The revenue is able to be calculated through form submission.	As expected
M4-3	To check whether supplier details can be created, updated, deleted, and viewed.	The supplier details can be created, updated, deleted, and viewed.	As expected



**Fig. 22** Add Sales Interface

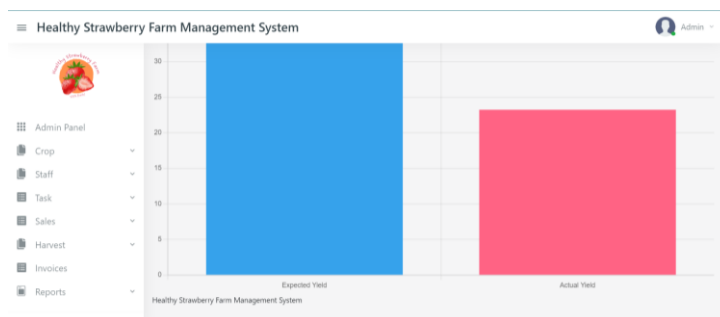


**Fig. 23** Supplier Interface

**Figure 24** depicts the system interface for reporting and analytics. The administrator can generate reports and download them in PDF format. **Table 10** shows the test case for the Reporting and Analytics module. There are a total of 2 test cases for this module. The purpose of this test is to verify whether the administrator can generate reports. **Table 10** shows that all the two (2) tests had passed the test.

**Table 10** Test Case for Reporting and Analytics Module

Test Case ID	Description	Expected Output	Actual Output
M5-1	To check whether the administrator can generate reports.	The administrator can generate reports.	As expected
M5-2	To check whether the administrator can download the generated report in PDF format.	The administrator can download the generated report in PDF format.	As expected



**Fig. 24** Reporting Interface

## 5. Conclusion

Adopting digital tools can help to increase efficiency, optimize processes, secure and correct data, and offer insightful information that will help with decision-making. Currently, it is imperative that companies assess their present procedures and investigate the advantages that digital data management may offer to their corporate operations. In summary, strawberry farms are expected to be managed more orderly and effectively with the help of a farm management system, which will also give users immediate access to critical data and analytics. This helps managers and farmers make decisions based on reliable data, which in turn raises the quality of strawberries that are produced. All things considered, a management system for strawberry farms promises to increase output, efficiency, and data-driven decision-making, all of which will contribute to the farm's continued success and sustainability. Future work should focus on integrating advanced technologies such as IoT sensors and drones for real-time monitoring and data collection. Machine learning algorithms could be employed to predict crop diseases and optimize resource usage. Additionally, developing a mobile application for on-the-go access and real-time alerts could further enhance the system's usability and effectiveness. Expanding the system's capabilities to include detailed weather forecasting and automated irrigation control can also be explored. Finally, conducting longitudinal studies to measure the long-term impacts of the management system on farm productivity and sustainability will provide valuable insights for continuous improvement.

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## Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

## Author Contribution

The authors confirm contribution to the paper as follows: **study conception and design:** Amirta Pandian, Nureize bt Arbaiy; **data collection:** Amirta Pandian, Nureize bt Arbaiy; **analysis and interpretation of results:** Amirta Pandian, Nureize bt Arbaiy. **draft manuscript preparation:** Amirta Pandian, Nureize bt Arbaiy. All authors reviewed the results and approved the final version of the manuscript.

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