American International University-Bangladesh (AIUB)

Department of Computer Science

Faculty of Science & Technology (FST)

SunlitHarvest: Sustainable Cultivation Enhanced by Solar Solutions

A Software Engineering Project Submitted
By

Semester: Summer_21_22		**Section:A**	**Group Number:5**	
SN	Student Name	Student ID	Contribution (CO1+CO2)	Individual Marks
1	Waliul Hasnat Wasif	21-45600-3	20%	
2	Shraboni Biswas Naboni	22-47701-2	20%	
3	MD.SABBIR HOSSAIN	21-45605-3	20%	
4	Sadik Saleh	21-45570-3	20%	
5	Md Safwan Bhuiyan Sohan	21-45599-3	20%	

The project will be Evaluated for the following Course Outcomes

CO3: *Select* appropriate software engineering models, project management roles and their associated skills for the complex software engineering project and evaluate the sustainability of developed software, taking into consideration the societal and environmental aspects	Total Marks	
Appropriate Process Model Selection and Argumentation with Evidence	[5 Marks]	
Evidence of Argumentation regarding Process Model Selection	[5Marks]	
Evaluate the sustainability of the developed software in terms of both society and the environment (Impact identification)	[5Marks]	
Submission, Defense, Completeness, Spelling, grammar and Organization of the Project report	[5Marks]	
CO4: *Develop* project management plan to manage software engineering projects following the principles of engineering management and economic decision process	Total Marks	

Develop the project plan, its components of the proposed software products using WBS and testcases	[5Marks]	
Identify all the activities/tasks related to project management and categorize them within Project estimation, and schedule of the tasks using appropriate resources	[5Marks]	
Identify all the potential risks in the specific project and prioritizing/categorizing those, and also mitigation plan to overcome the risk factors.	[5Marks]	

Description of Student's Contribution in the Project work

Student Name: Shraboni Biswas Naboni
Student ID: 22-47701-2
Contribution in Percentage (%): 20
Contribution in the Project:

- Contribution Description 1 : Background Description ,Process model selection
- Contribution Description 2 : functional requirements : Automatic Irrigation, solar powered egg incubation, Pest and disease monitoring
- Activity Diagram
- UI design – Weather integration, pest and Disease , Automatic Irrigation
- Test case-Soil Moisture Sensor , Automatic Irrigation , pest and disease monitoring System ,, Solar powered Tractor with battery storage .
- Effort Estimation , WBS, Time line chart 1 , Time line chart 2, EVA Analysis ,Risk Management
-

_____Shraboni _____
Signature of the Student

Student Name: Sadik Saleh
Student ID: 21-45570-3
Contribution in Percentage (%): 20
Contribution in the Project:

- Contribution Description 1 : Background Description ,Process model selection
- Contribution Description 2: functional requirements : Integration with Agricultural Equipment, Community Collaboration Platform, Energy market integration.
- Class Diagram
- Ui design : login page , Solar panel monitoring, integration with agricultural equipment
- Test case: Weather integration functionality validation, Integratiion with agriculral equipment functionality validation, Community collaboration Platform functionality validation
- Effort Estimation , WBS, Time line chart 1 , Time line chart 2, EVA Analysis ,Risk

Management

-

_____Sadik _____
Signature of the Student

Student Name: MD. SABBIR HOSSAIN
Student ID: 21-45605-3
Contribution in Percentage (%): 20
Contribution in the Project:

- Contribution Description 1 :Background Description ,Process model selection
- Contribution Description 2 : functional requirements : user authentication, password recovery, Solar panel monitoring
- Use case diagram.
- Ui design: sign up, forget password, Collaborations farmers
- Test case: User authentication, account recovery,Solar panel monitoring.
  Effort Estimation , WBS, Time line chart 1 , Time line chart 2, EVA Analysis ,Risk Management
-

_____SABBIR_____
Signature of the Student

Student Name: Waliul Hasnat Wasif
Student ID: 21-45600-3
Contribution in Percentage (%): 20
Contribution in the Project:

- Contribution Description 1: Background Description, Process model selection
- Contribution Description 2: functional requirements: Smart Energy Storage Management, Crop Energy Demand Forecast, Financial Planning and Subsidy Integration, Regulatory Compliance Guidance, Weather Integration, Mobile Application Integration
- Ui design: Home page, Smart Energy Storage Management, Crop Energy Demand Forecast
- Test case : smart energy storage management, crop energy demand forecast,financial planning and subsidy intergartion

  Effort Estimation , WBS, Time line chart 1 , Time line chart 2, EVA Analysis ,Risk Management

_____Wasif_____
Signature of the Student

Student Name: Md Safwan Bhuiyan Sohan
Student ID: 21-45599-3
Contribution in Percentage (%): 20
Contribution in the Project:

- Contribution Description 1: Background Description ,Process model selection
- Contribution Description 2: functional requirements :Automated Maintennance Scheduling, Automated Emergency Response System, Solar-Powered Tractor with battery storage
- Sequence Diagram
- Ui design: , community collaboration platform , intro page ,Financial planning and subsidy integration
- Test case: regulatory compliance guidance ,gps navigation

  Effort Estimation , WBS, Time line chart 1 , Time line chart 2, EVA Analysis ,Risk Management

_____Safwan_____
Signature of the Student

1. PROJECT PROPOSAL

1.1 Background to the Problem

Background Description:

Agriculture and renewable energy, particularly solar power, have converged in recent years, becoming a crucial area for innovation and development. Agriculture, one of humanity's oldest

endeavours, faces exacerbated challenges due to resource scarcity, climate change, and increasing energy consumption. Traditional agricultural practices, heavily reliant on fossil fuels, contribute to environmental degradation and greenhouse gas emissions. Moreover, the absence of reliable electricity grids in rural areas—where agriculture predominates—hampers productivity growth and socioeconomic advancement. Solar energy offers a viable solution to these challenges. Advancements in photovoltaic technology and decreasing costs make it increasingly feasible and profitable to integrate solar power into agriculture. Solar-powered agriculture contributes to sustainability objectives by reducing dependency on fossil fuels, lowering emissions, and improving access to energy in rural communities. To fully realize its potential, solar-powered agriculture must overcome obstacles such as intermittency, energy storage, budget constraints, and regulatory frameworks. Solar power not only reduces reliance on finite resources and mitigates the risk of fuel shortages and supply disruptions but also provides a dependable and sustainable alternative. Investing in solar energy infrastructure stimulates local economies, enhances food security, and boosts agricultural productivity. Solar-powered farms can operate independently during disruptions, ensuring the continuity of food supply chains and production. Furthermore, transitioning to solar energy aligns with broader sustainability goals, including emission reduction, climate change mitigation, and safeguarding natural resources for future generations.

Root Cause:

The main source of the issue is traditional agriculture's excessive reliance on fossil fuels, which not only seriously degrades the environment but also presents risks due to their limited supply and unstable geopolitical environment. Fossil fuels are becoming less viable as long-term energy sources due to rising extraction and production costs and depleting global reserves. Furthermore, agricultural communities' energy security and economic stability are threatened by their reliance on imported fossil fuels, which exposes them to market volatility and geopolitical risks.

By using sunlight, a plentiful and limitless resource, switching to solar energy allays these worries. In place of fossil fuels, solar energy provides a dependable and environmentally friendly way to power agricultural operations. Farmers can produce electricity on-site and lessen their reliance on outside energy sources by utilizing photovoltaic technology to harness sunlight. This also helps to mitigate the risks associated with fuel scarcity and supply disruptions. This shift supports environmental sustainability, economic resilience, and long-term energy security for agriculture.

1.2 Solution to the Problem for Software Development:

- The software aims to facilitate the seamless integration of solar energy into agricultural practices, addressing challenges associated with traditional fossil fuel reliance. The primary objective is to provide a user-friendly platform that empowers farmers to transition to sustainable and cost-effective solar-powered agriculture.

- The solutions to be implemented for the root problems found are the following: 1. Solar Energy Management System, 2. Energy Storage Optimization, 3. Financial Planning and Subsidy Integration, 4. Regulatory Compliance and Advocacy. A comprehensive solar

energy management system for farmers is designed to offer an intuitive interface, providing real-time insights into energy production, consumption patterns, and system performance. Algorithms for energy storage optimization ensure continuous power supply during low sunlight periods, with smart scheduling aligned with agricultural activities and weather forecasts. Integrated financial planning tools aid in assessing feasibility and accessing subsidies, grants, and financing options, while features guide users through regulatory compliance and provide advocacy resources to navigate legal frameworks seamlessly.

The software solution is highly appropriate as it aligns with the project's objective of promoting sustainable agriculture through solar energy. It is feasible due to its user-friendly design, integration of advanced algorithms, and focus on financial planning to make the transition accessible to a wide range of users.

- The proposed software embodies a holistic and innovative solution to the pressing challenge of integrating solar energy into agriculture. By adopting a multifaceted approach, it addresses various aspects of the transition, including energy management, financial planning, regulatory compliance, and advocacy. This comprehensive strategy ensures that farmers receive comprehensive support to navigate the complexities of transitioning to solar energy seamlessly. Moreover, the software's user-friendly interface caters to users with diverse technical expertise, enabling easy access to its functionalities without extensive training. Through real-time monitoring and optimization capabilities, farmers can make data-driven decisions to optimize energy usage according to their agricultural needs, supported by smart algorithms for energy storage optimization. The inclusion of financial planning tools, integrated with subsidy databases, alleviates the upfront costs associated with solar adoption, making the transition more feasible. Simultaneously, the software simplifies regulatory compliance by offering step-by-step guidance and advocacy resources, empowering farmers to navigate legal frameworks effortlessly. Tailored specifically for the agriculture sector, the software fills a crucial gap by providing customization and features that address the unique challenges faced by farmers transitioning to solar energy, such as smart scheduling aligned with weather forecasts. Furthermore, by contributing valuable data for ongoing scientific research, the software enriches our understanding of the impacts and benefits of renewable energy in agriculture. In summary, the proposed software represents a pioneering solution that not only facilitates the transition to sustainable energy practices but also empowers farmers to overcome barriers and embrace solar energy for a more resilient and environmentally friendly agricultural sector.

- The primary users include farmers, agricultural cooperatives, and solar energy consultants. The software benefits users by simplifying the transition to solar-powered agriculture, offering financial insights, and ensuring compliance with regulatory frameworks.

- The software contributes to scientific development by providing a tech-driven solution to the real-world problem of integrating solar energy into agriculture. It serves as a practical tool for farmers while contributing data for ongoing research on the impact of renewable energy in agriculture.

- Existing software solutions primarily focus on general energy management. However, the proposed software extends these solutions by catering specifically to the agriculture sector, addressing the unique challenges faced by farmers transitioning to solar energy.

- While general energy management software exists, there is a gap in solutions tailored for solar-powered agriculture. The proposed software extends existing approaches by integrating agriculture-specific functionalities and providing a holistic solution for farmers in the transition to sustainable energy practices.

- The proposed software's focus on user-friendly interfaces and accessibility ensures that farmers, agricultural cooperatives, and solar energy consultants can easily navigate and leverage its features. By addressing the specific needs of the agriculture sector and facilitating the transition to sustainable energy practices, the proposed solution aims to offer significant benefits in terms of improved efficiency, cost savings, and environmental sustainability for users.

Impact of social, health, safety and cultural issues

Analyzing the impact of societal, health, safety, legal, and cultural issues is crucial for understanding the broader implications of the agricultural software project, SunlitHarvest. The project's success can contribute positively to society by promoting sustainable cultivation practices, aligning with the global emphasis on environmentally friendly technologies. SunlitHarvest's potential to enhance agricultural efficiency addresses societal concerns related to food security. In terms of health impact, the adoption of technology may contribute to producing healthier crops and minimizing health risks associated with strenuous agricultural work. The safety-focused nature of the project emphasizes the need to ensure the reliability and security of the software, considering issues related to data security, system reliability, and the integration of AI components. Legally, compliance with agricultural, technological, and data privacy regulations is crucial, including considerations of intellectual property rights, environmental regulations, and safety standards. Understanding and respecting diverse cultural practices in agriculture is essential for successful software implementation, requiring culturally sensitive user interfaces and functionalities to ensure widespread acceptance and adoption.

2. SOFTWARE DEVELOPMENT LIFE CYCLE

2.1 Process Model: Scrum

Why we are selecting Scrum:

Our project name is SunlitHarvest: Sustainable Cultivation Enhanced by Solar Solutions. Scrum has been selected as the process model for our agricultural software project due to its adaptability to change, iterative development approach, emphasis on stakeholder

engagement, effective risk management strategies, and its commitment to ensuring high product quality. The inherent flexibility of Scrum aligns well with the dynamic nature of our project, enabling continuous adjustments to changing requirements and technological advancements. The iterative development process and regular feedback loops in Scrum are essential for refining our AI-based system, ensuring it remains aligned with stakeholder expectations. Scrum's emphasis on stakeholder collaboration is crucial for a customer-centric agricultural software product, where user experience holds significant importance. Additionally, Scrum's risk management practices, delivering work in small increments and allowing for regular reassessment, minimize potential risks associated with project delays and budget overruns. The incremental release of functionalities within Scrum ensures a focus on product quality at every stage, differentiating it from traditional models like Waterfall.

Why we are not selecting other models:

Waterfall model was not chosen due to its inherent inflexibility in accommodating changes once the project has started. Unlike Scrum, where requirements can be adjusted throughout the development process, Waterfall demands upfront and accurate requirement definitions, making it unsuitable for our dynamic agricultural software project. The V-model, while emphasizing early testing, lacks the continuous adaptability feature of Scrum, and its expensive nature makes it less cost-effective. Prototyping model, not adopted, is time-consuming and does not prioritize risk analysis, a critical aspect for our safety-focused project. Evolutionary and incremental development models, though providing adaptability, fall short in the frequency of reassessment that Scrum offers. RAD, requiring extensive user involvement, may pose challenges in the agricultural context. Component-based development models, while modular, may not align seamlessly with our integrated software needs. Agile models like XP, DSDM, and FDD were not chosen for specific reasons. XP's emphasis on pair programming and constant user presence may not align with the project's requirements. DSDM's prototyping focus might not be essential for our initial development phase, and FDD's resource-intensive nature, requiring 50 persons for the project, makes it costlier compared to the efficiency of Scrum in managing our project's complexities. Additionally, other Agile models might introduce unnecessary complexities or resource requirements that Scrum's flexible and iterative approach effectively addresses in our context.

2.2 Project Role Identification and Responsibilities

- **Product Owner:** Product Owner is officially responsible for the project, managing, controlling, and making visible the Product Backlog list. He makes the final decisions of the tasks related to product Backlog.

- **Scrum Master:** Scrum Master interacts with the project team as well as with the customer and the management during the project.

- **Scrum Team:** The scrum team is involved, for example, in effort estimation, creating the Sprint Backlog, reviewing the product Backlog list and suggesting impediments that need to be removed from the project.

- **Stakeholders/Clients:** While not directly part of the Scrum team, stakeholders, including clients and end-users, play a vital role. Their input is essential during sprint reviews and backlog refinement sessions. Regular collaboration with stakeholders ensures that the product aligns with business needs and user expectations.

- **Customer**

  Customer participates in the tasks related to product Backlog items for the system being developed or enhanced.

- **Management**

  Management is in charge of final decision making, along with the agreements, standards, and conventions to be followed in the project.

  What is the impact of choosing SCRUM model for our project?

  Choosing the Scrum model for our agricultural software project, SunlitHarvest, has a significant positive impact. This model's flexibility, iterative development, stakeholder involvement, risk management, and focus on product quality perfectly match the dynamic nature of our project. Scrum's adaptability allows us to adjust to changing requirements and technological advancements in agriculture. The iterative approach and stakeholder engagement are crucial for refining our AI-based system and ensuring it meets user expectations. Scrum's effective risk management minimizes potential delays and budget issues, making it ideal for our safety-focused project. Continuous testing guarantees that our software meets high standards. Other models were not chosen due to their limitations. Scrum's roles, including Product Owner, Scrum Master, and others, enhance collaboration and decision-making.

3. REQUIREMENT ANALYSIS

1. Users Authentication:

- The users can log in to the system using their username and password if user got no account, they can create new account and verification code will sent by email or phone number.
- The login information provided on this page will be verified by IT.
- If the username or password is wrong, the system will generate and send verification code again and again.

- If the number of unsuccessful attempts exceeds the limit 3 times in a row, the system will lock the account.

2. **Account Recovery:**
   - If the user forgets his password or his account gets locked they will get additional verification process from the login page.
   - If the user can provide the necessary information, the account will be fully functional, and the user can change his password.
   - Also, by contacting IT, users can solve the problem with some additional verification information.

3. **Solar Panel Monitoring:**
   - This feature allows users to monitor the performance of their solar panels in real-time, giving those insights into how efficiently their panels are converting sunlight into electricity.
   - Users can track metrics such as current energy production levels, energy consumption within their systems, and overall efficiency.
   - Access to real-time data empowers users to make informed decisions about energy usage, potentially optimizing their consumption patterns to maximize the benefits of their solar panel system.
   - When the system detects abnormalities or deviations from expected performance levels, it sends alerts and notifications to users via email, SMS, or mobile app notifications.
   - By understanding historical performance data, users can make informed decisions about maintenance schedules, system upgrades, or optimizations to maximize the lifespan and efficiency of their solar panel installations.

4. **Smart Energy Storage Management:**
   - The software optimizes energy storage systems based on current solar energy production and anticipated usage patterns.
   - Users can set preferences within the software to prioritize certain appliances or operations during low sunlight periods.
   - During times when solar energy production is insufficient, the system prioritizes supplying power to these critical loads to ensure uninterrupted operation.
   - The software incorporates automated alerting mechanisms to notify users of any potential issues with energy storage systems.

- Alerts are triggered by anomalies in energy storage performance, such as battery degradation, inefficient charging, or system malfunctions.

5. **Crop Energy Demand Forecast:**
   - The system collects and analyses both historical and real-time data related to energy usage, crop types, and growth stages.
   - This forecasting capability enables farmers to anticipate and plan for the energy needs of their agricultural operations with greater accuracy and efficiency.
   - Based on the forecasted energy demands for different crops, the system generates automated recommendations to optimize energy usage.
   - The forecast tool helps users plan energy consumption for irrigation, lighting, and other agricultural activities, minimizing waste.

6. **Financial Planning and Subsidy Integration:**
   - The system provides a financial planning module that estimates the cost and potential savings of transitioning to solar energy.
   - Users can explore available subsidies, grants, and financing options through an integrated database.
   - The software offers automated assistance in filling out subsidy applications, simplifying the financial planning process.

7. **Regulatory Compliance Guidance:**
   - The system guides users through step-by-step processes to ensure compliance with local and national regulations for solar-powered agriculture.
   - Automated updates inform users of any changes in regulations and provide necessary actions to maintain compliance.
   - The software generates reports to showcase adherence to regulatory standards for audits or verification.

8. **Weather Integration:**
   - The software integrates real-time weather data to enhance energy production and consumption forecasts.
   - Users receive automated weather alerts directly through the software whenever meteorological conditions are forecasted to impact solar energy generation.
   - These alerts notify users of events such as approaching clouds, inclement weather, or changes in sunlight intensity that may affect solar panel performance.

- The software analyzes historical weather data spanning weeks, months, or even years to identify long-term weather patterns and trends.
- By examining historical weather data, the software can detect recurring weather phenomena, seasonal variations, and climate trends that impact energy production and consumption.

9. Mobile Application Integration:

- Users can access the software through a mobile application for on-the-go monitoring and control.
- The mobile app provides push notifications for critical alerts, ensuring users stay informed even when away from the farm.
- Remote control features enable users to adjust energy settings and monitor farm operations from anywhere.

10. Automated Maintenance Scheduling:

- The system analyzes historical performance data to predict maintenance requirements for 10.2 solar panels and energy storage systems.
- Users receive automated maintenance schedules, optimizing the lifespan and efficiency of the equipment.
- Maintenance alerts prompt users to schedule or perform necessary repairs, reducing downtime.

11. Integration with Agricultural Equipment:

- The software integrates with existing agricultural equipment, enabling automated control based on energy availability.
- Users can remotely operate compatible equipment, such as irrigation systems, through the software interface.
- Energy usage data from equipment is captured and incorporated into overall farm analytics.
- The software monitors equipment health, generating alerts and enabling users to schedule proactive maintenance for enhanced reliability.
- The software interfaces with sensors, providing real-time crop status updates and utilizing predictive models for accurate yield estimations.

12. Community Collaboration Platform:

- Users can connect with neighboring farms through a collaborative platform within the software.
- The platform facilitates resource sharing, such as surplus energy, equipment, or expertise, fostering community resilience.
- Automated notifications inform users of collaboration opportunities and community events.
- The platform serves as a marketplace, allowing users to list and access available resources like machinery or labor for optimized farm operations.
- Users can engage in crop swap initiatives through the platform, promoting localized exchanges of produce for diverse and sustainable farming practices.

13. Energy Market Integration:

- Users can participate in local or regional energy markets through the software.
- Automated algorithms optimize energy selling strategies based on market conditions, maximizing revenue.
- Real-time market updates and transaction history are accessible within the software.
- The software enables users to engage in demand response programs, allowing them to adjust energy usage in response to market signals for increased efficiency.
- Users can participate in peer-to-peer energy trading, facilitating direct energy transactions between neighboring farms through the integrated marketplace.

14. Automated Emergency Response System:

- The system provides a user-friendly interface for configuring and managing emergency response protocols.
- The system continuously monitors energy usage and availability across different farm operations.
- Users can define and customize protocols based on specific triggers, thresholds, and desired actions.
- Users set their preferences for energy usage, security settings, and automation schedules based on their lifestyle and needs.

15. Pest and Disease Monitoring:

- The software integrates with sensors and imaging technologies to monitor for signs of pests and diseases in crops.

- Users receive real-time alerts and notifications when potential pest or disease outbreaks are detected, enabling prompt action to mitigate risks.
- Automated analysis of pest and disease data provides insights into trends and patterns, facilitating proactive pest management strategies.
- Historical data on pest and disease occurrences are utilized to forecast and anticipate future outbreaks, aiding in preventive measures.
- The system offers recommendations for pest control methods and disease management practices tailored to specific crops, promoting crop health and yield optimization.

16. Solar-Powered Egg Incubation:

- Solar energy is used to power the heating elements inside the incubator, maintaining a consistent temperature for optimal egg incubation.
- Users can monitor the incubator's temperature and humidity levels remotely through a mobile app or web interface, powered by solar energy.
- The app sends instant alerts if conditions stray from the desired settings, enabling quick corrective actions by users..

17. Automatic Irrigation:

- The system is equipped with soil moisture sensors placed in the farm's soil.
- These sensors continuously monitor the moisture levels of the soil in real-time.
- When the soil moisture levels drop below a predefined threshold, indicating dehydration, the system detects this condition.
- Upon detecting soil dehydration, the system triggers the automatic start of the irrigation system.
- The irrigation system is powered by solar panels, ensuring sustainable and eco-friendly operation.

18. Solar-Powered Tractor with Battery Storage:

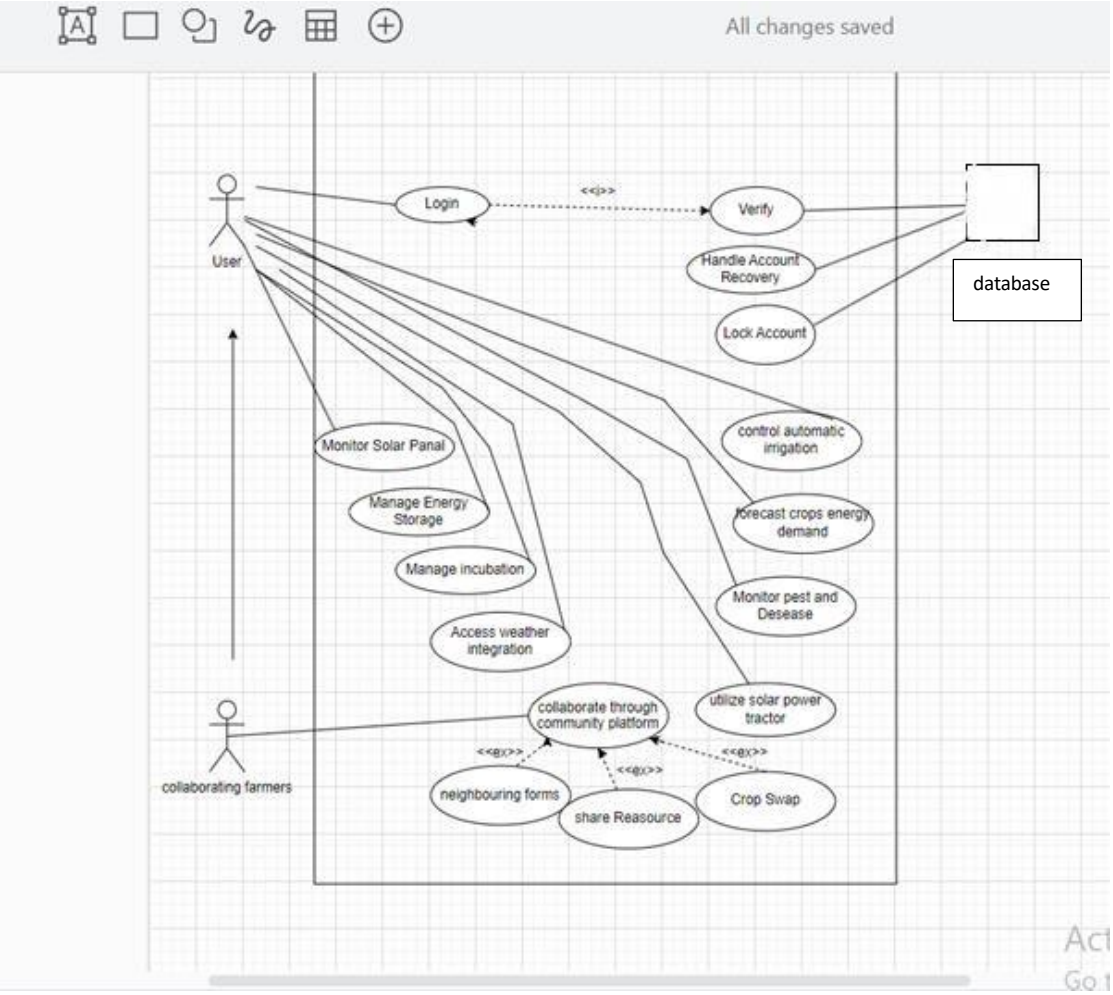
18.1 The tractor operates entirely on solar energy derived from onboard solar panels.

18.2 When the system detects that the crops have reached optimal maturity for harvesting through sensors and data analysis, it triggers the activation of the solar-powered tractor equipped with precision cutting implements.

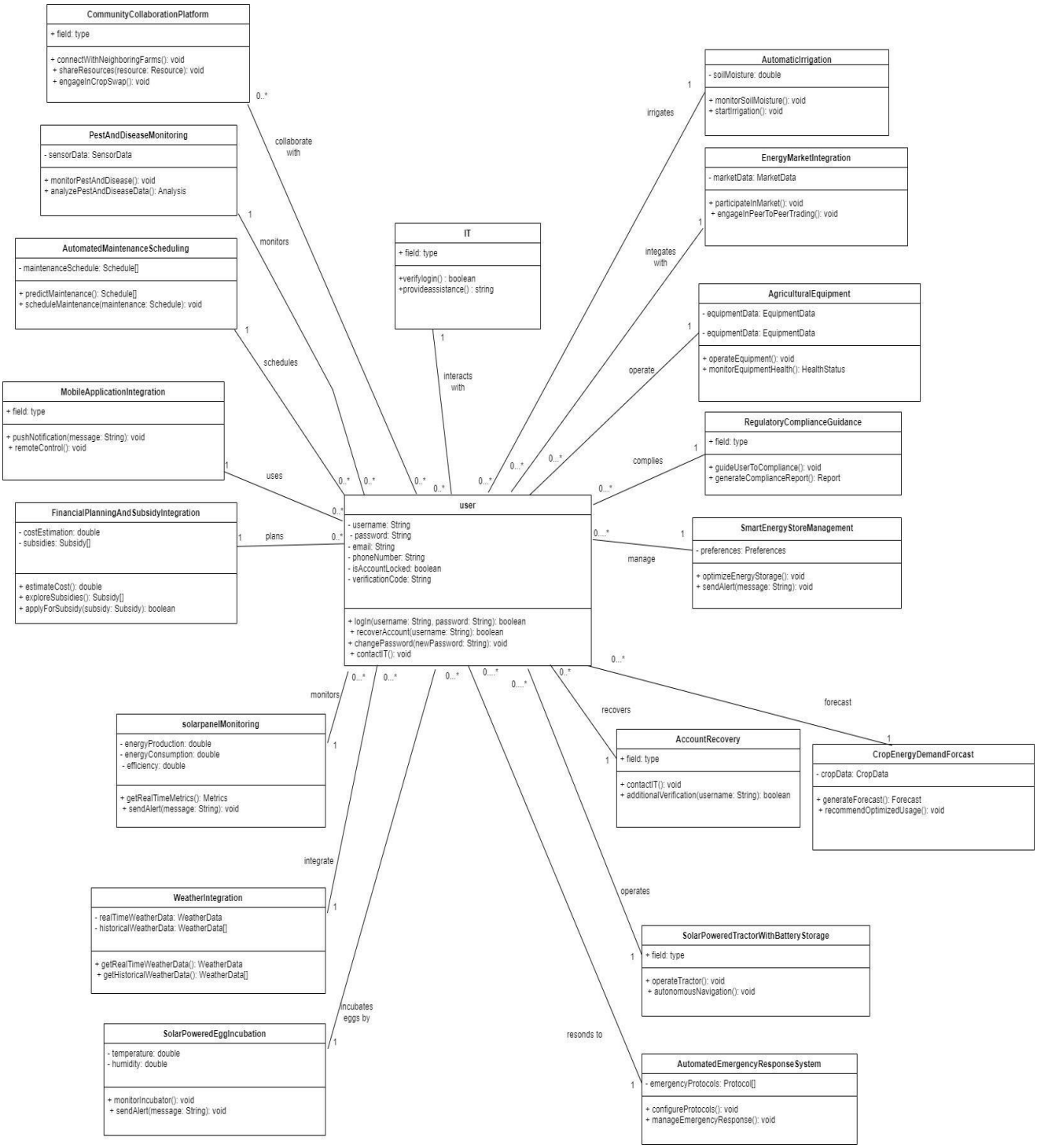
18.3 Utilizing field mapping data and GPS technology, the tractor autonomously navigates to the specific area within the field where the mature crops are located.

4. SESIGN SPECIFICATION

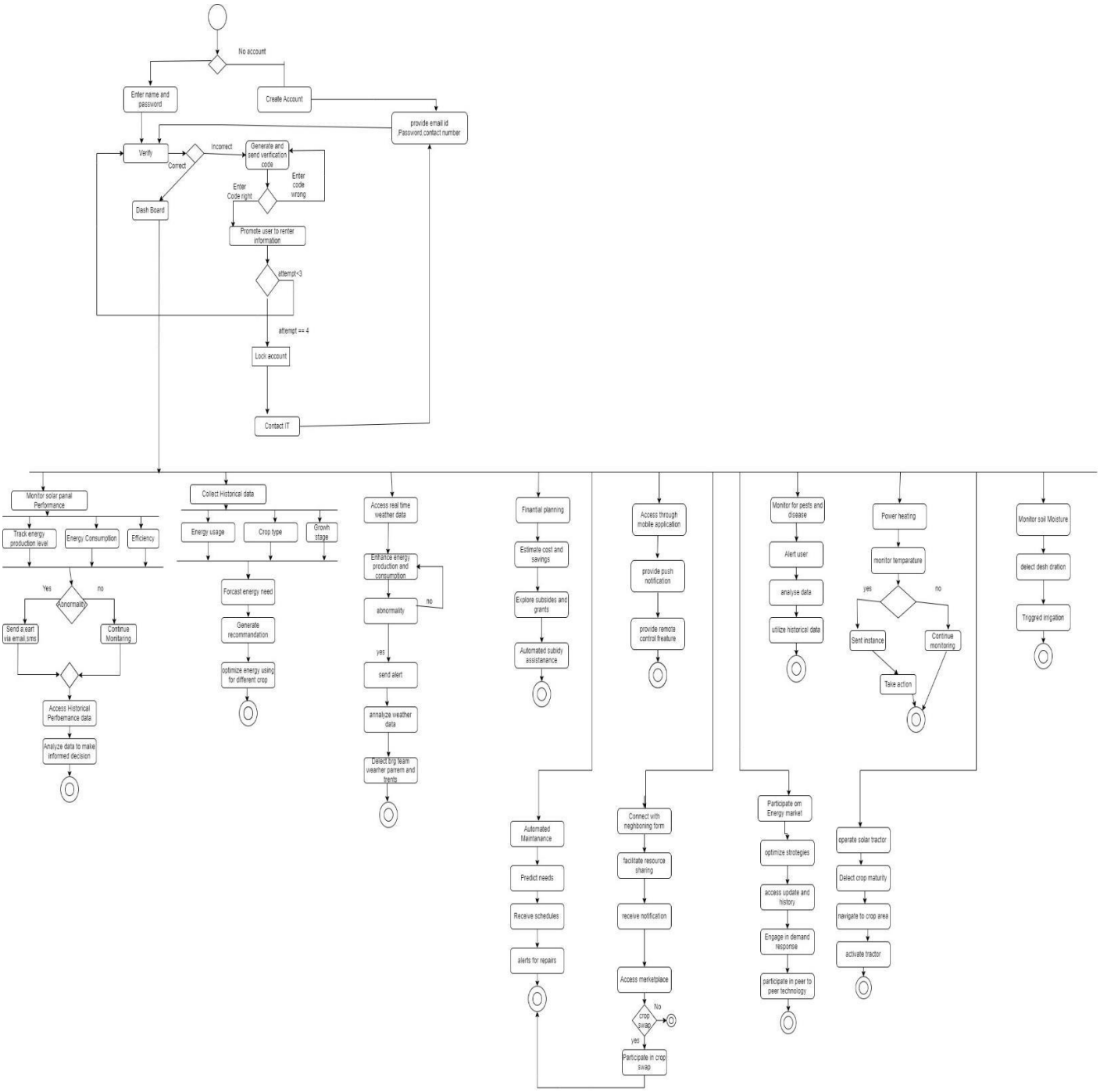
Use Case Diagram:



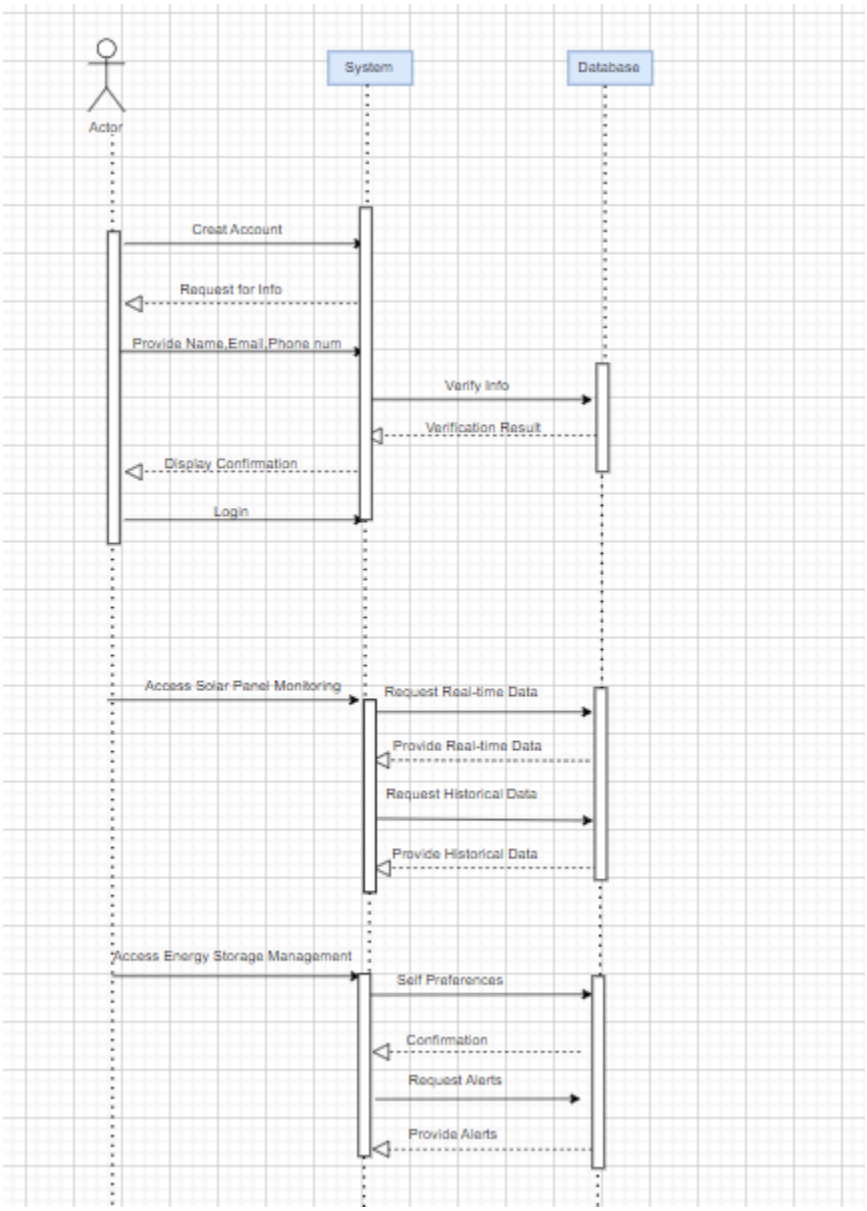
Class Diagram:

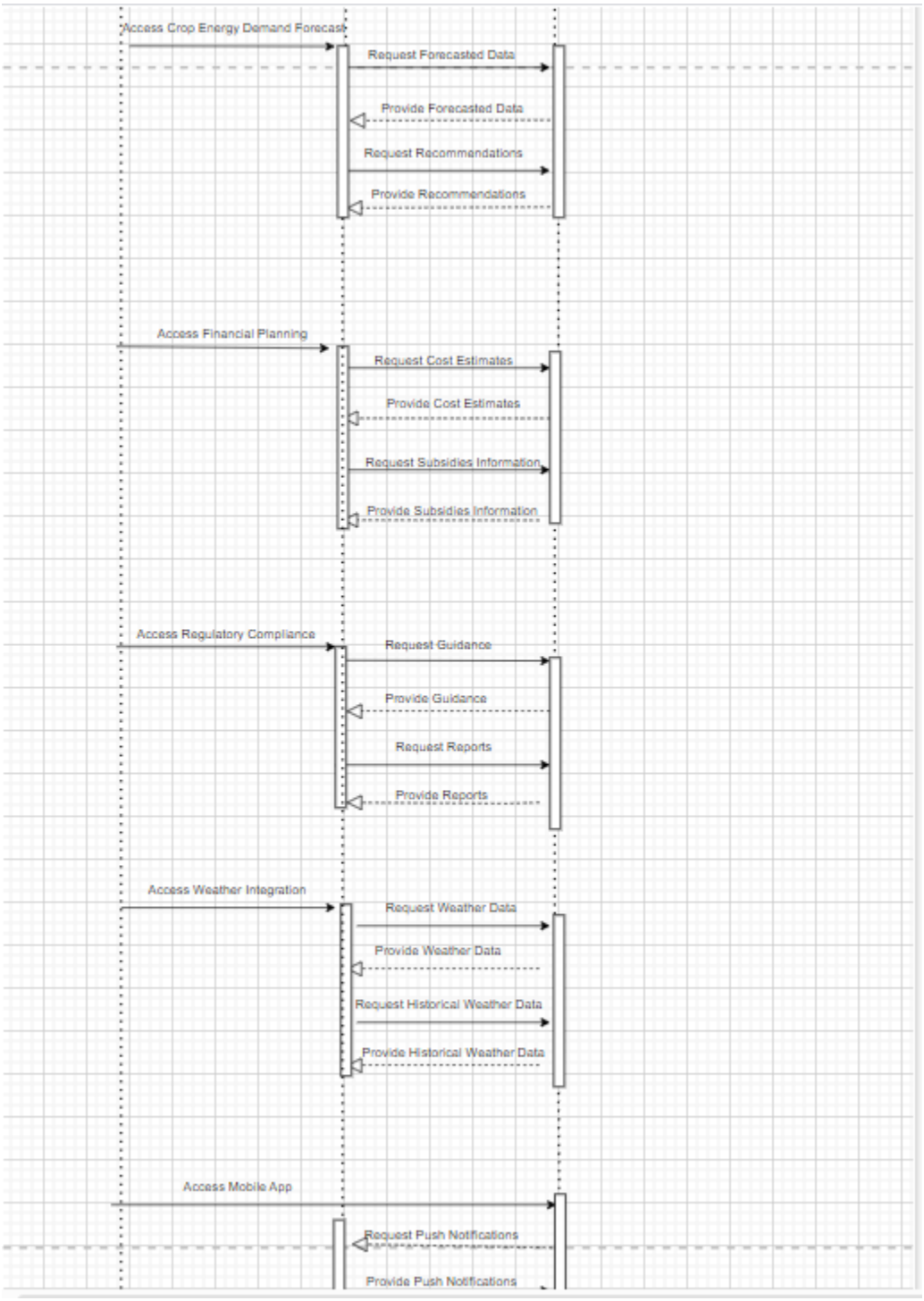


Activity diagram:



Sequence diagram:


Actor
System
Database
Creat Account
Request for Info
Provide Name,Email,Phone num
Verify Info
Verification Result
Display Confirmation
Login
Access Solar Panel Monitoring
Request Real-time Data
Provide Real-time Data
Request Historical Data
Provide Historical Data
Access Energy Storage Management
Self Preferences
Confirmation
Request Alerts
Provide Alerts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Request Recommendations
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Access Financial Planning
Request Cost Estimates
Provide Cost Estimates
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Provide Subsidies Information
Access Regulatory Compliance
Request Guidance
Provide Guidance
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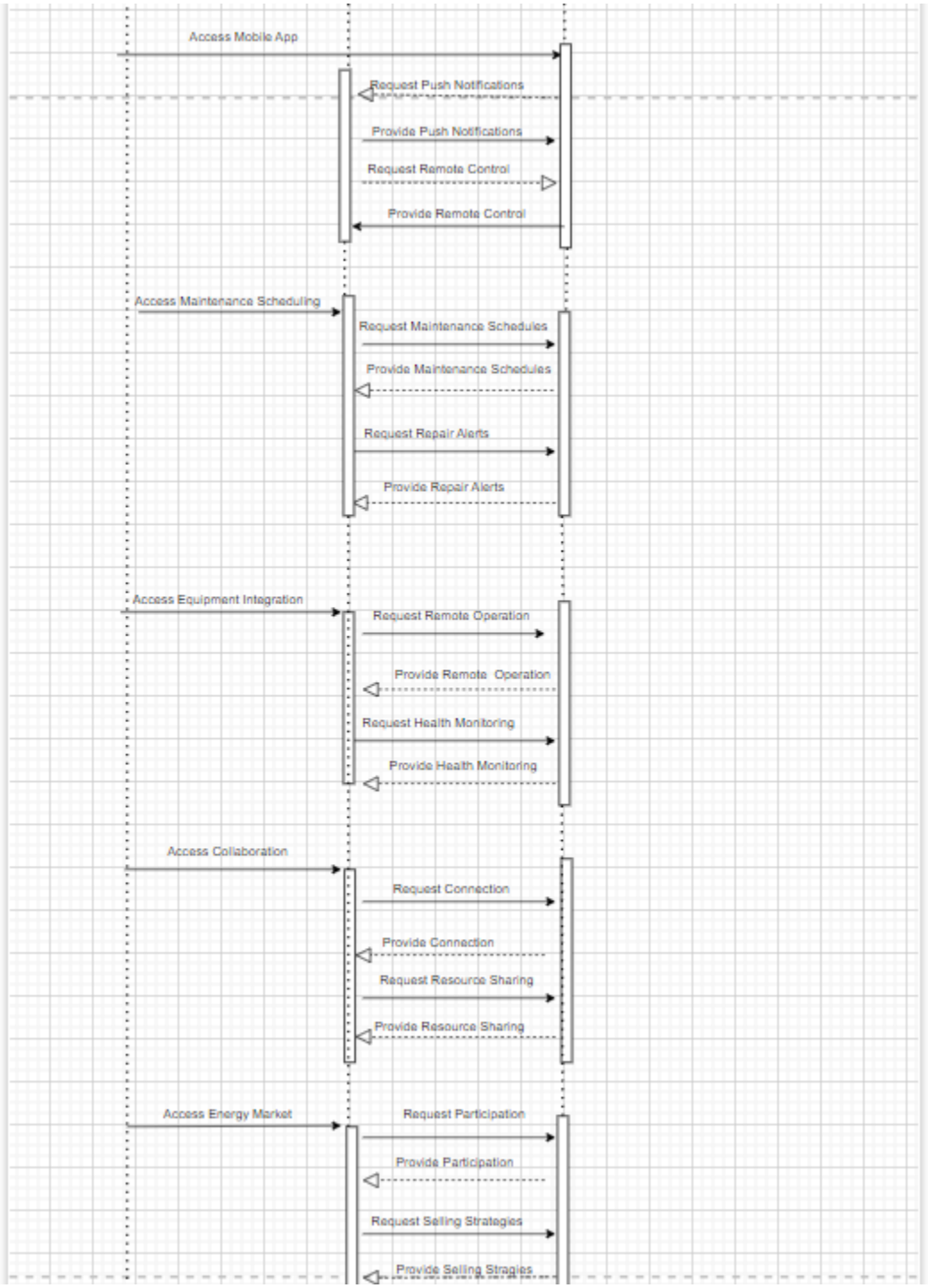
Provide Reports
Access Weather Integration
Request Weather Data
Provide Weather Data
Request Historical Weather Data
Provide Historical Weather Data
Access Mobile App
Request Push Notifications
Provide Push Notifications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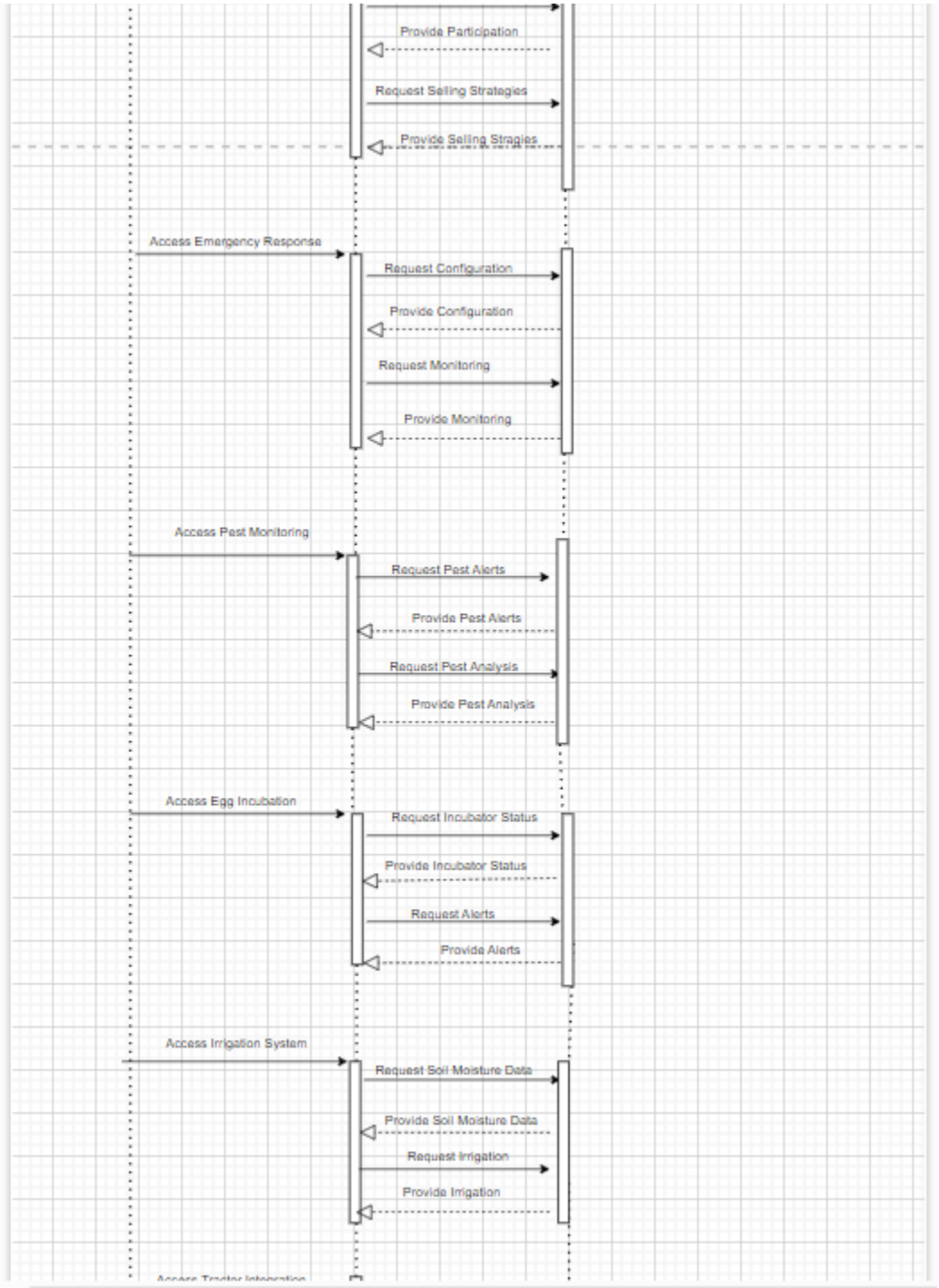
Provide Push Notifications
Request Remote Control
Provide Remote Control
Access Maintenance Scheduling
Request Maintenance Schedules
Provide Maintenance Schedules
Request Repair Alerts
Provide Repair Alerts
Access Equipment Integration
Request Remote Operation
Provide Remote Operation
Request Health Monitoring
Provide Health Monitoring
Access Collaboration
Request Connection
Provide Connection
Request Resource Sharing
Provide Resource Sharing
Access Energy Market
Request Participation
Provide Participation
Request Selling Strategies
Provide Selling Stragies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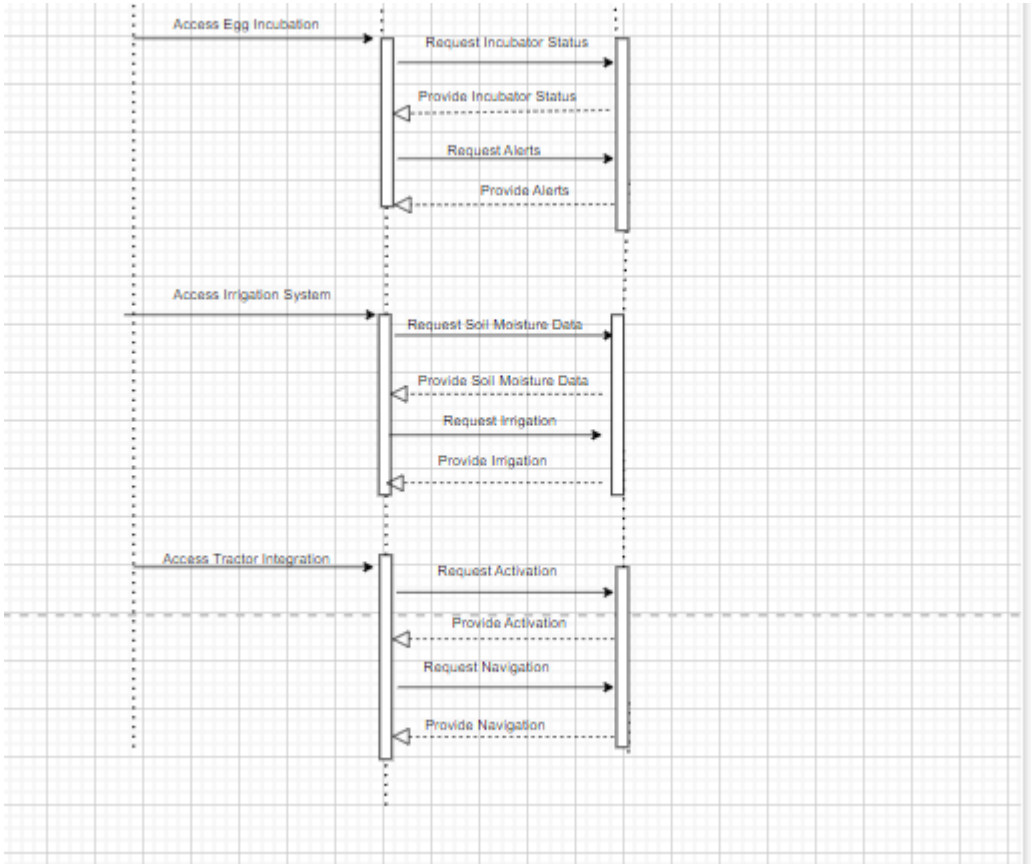
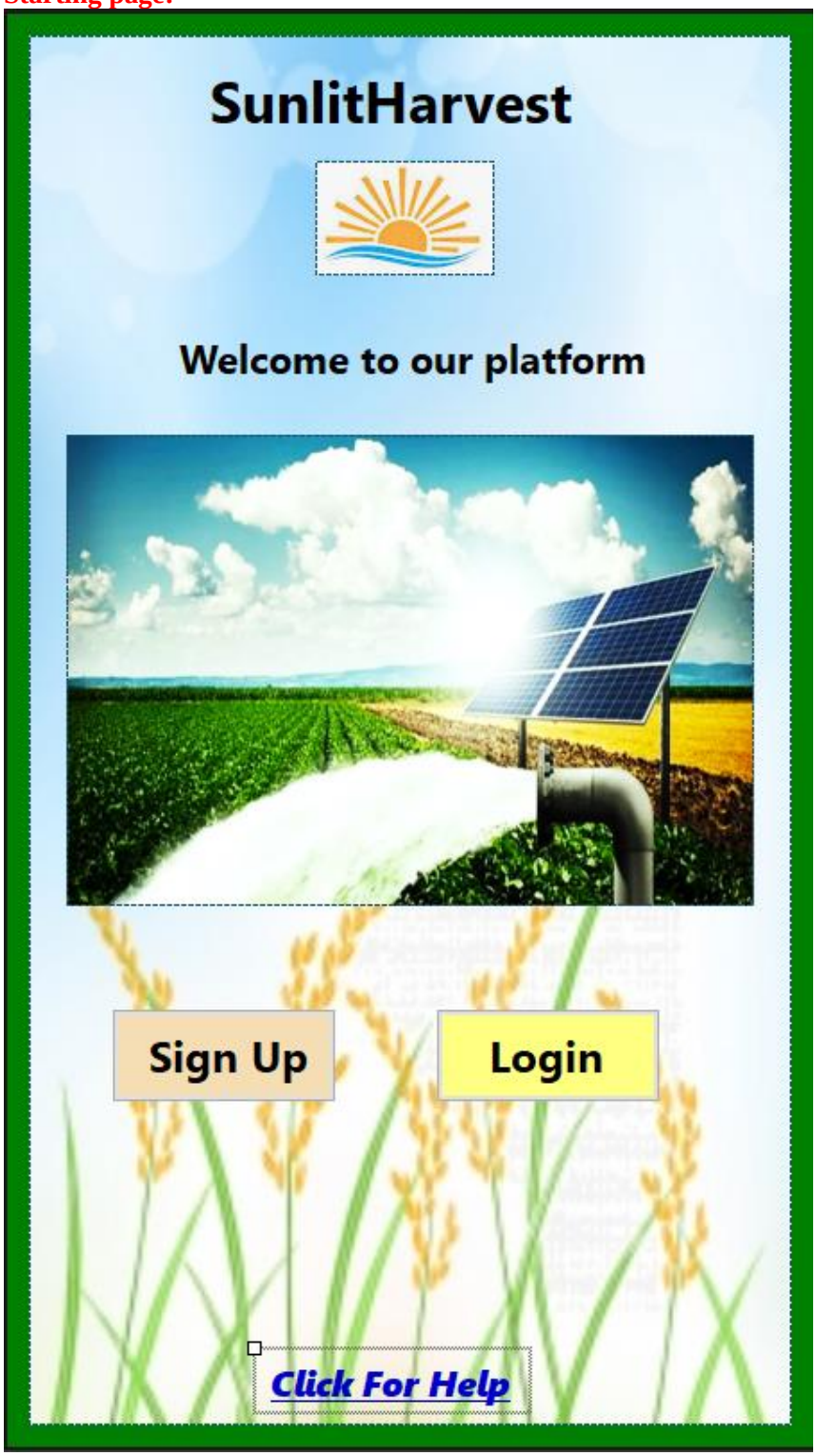
Request Configuration
Provide Configuration
Request Monitoring
Provide Monitoring
Access Pest Monitoring
Request Pest Alerts
Provide Pest Alerts
Request Pest Analysis
Provide Pest Analysis
Access Egg Incubation
Request Incubator Status
Provide Incubator Status
Request Alerts
Provide Alerts
Access Irrigation System
Request Soil Moisture Data
Provide Soil Moisture Data
Request Irrigation
Provide Irrigation

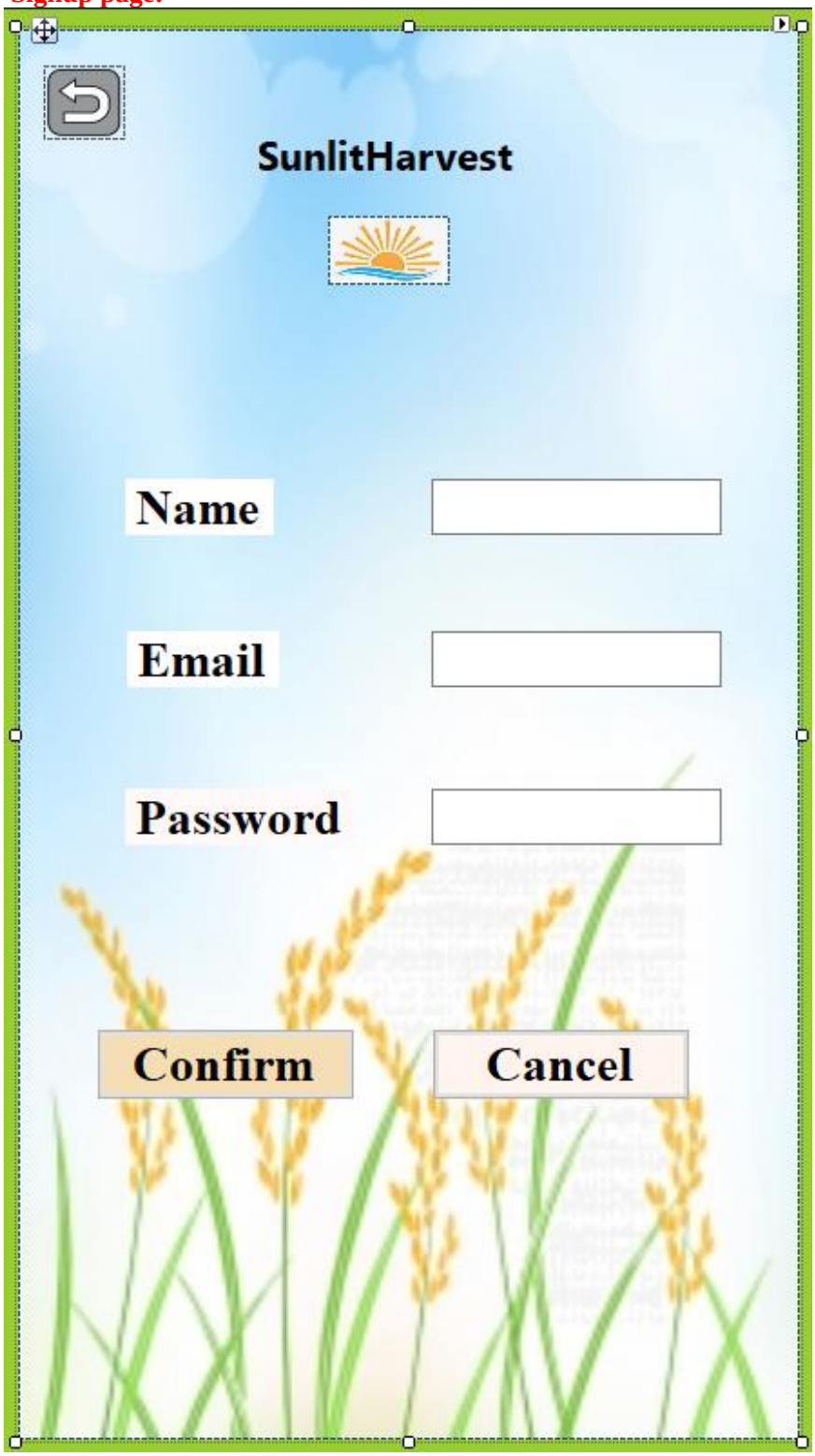

Access Egg Incubation
Request Incubator Status
Provide Incubator Status
Request Alerts
Provide Alerts
Access Irrigation System
Request Soil Moisture Data
Provide Soil Moisture Data
Request Irrigation
Provide Irrigation
Access Tractor Integration
Request Activation
Provide Activation
Request Navigation
Provide Navigation

Ui design

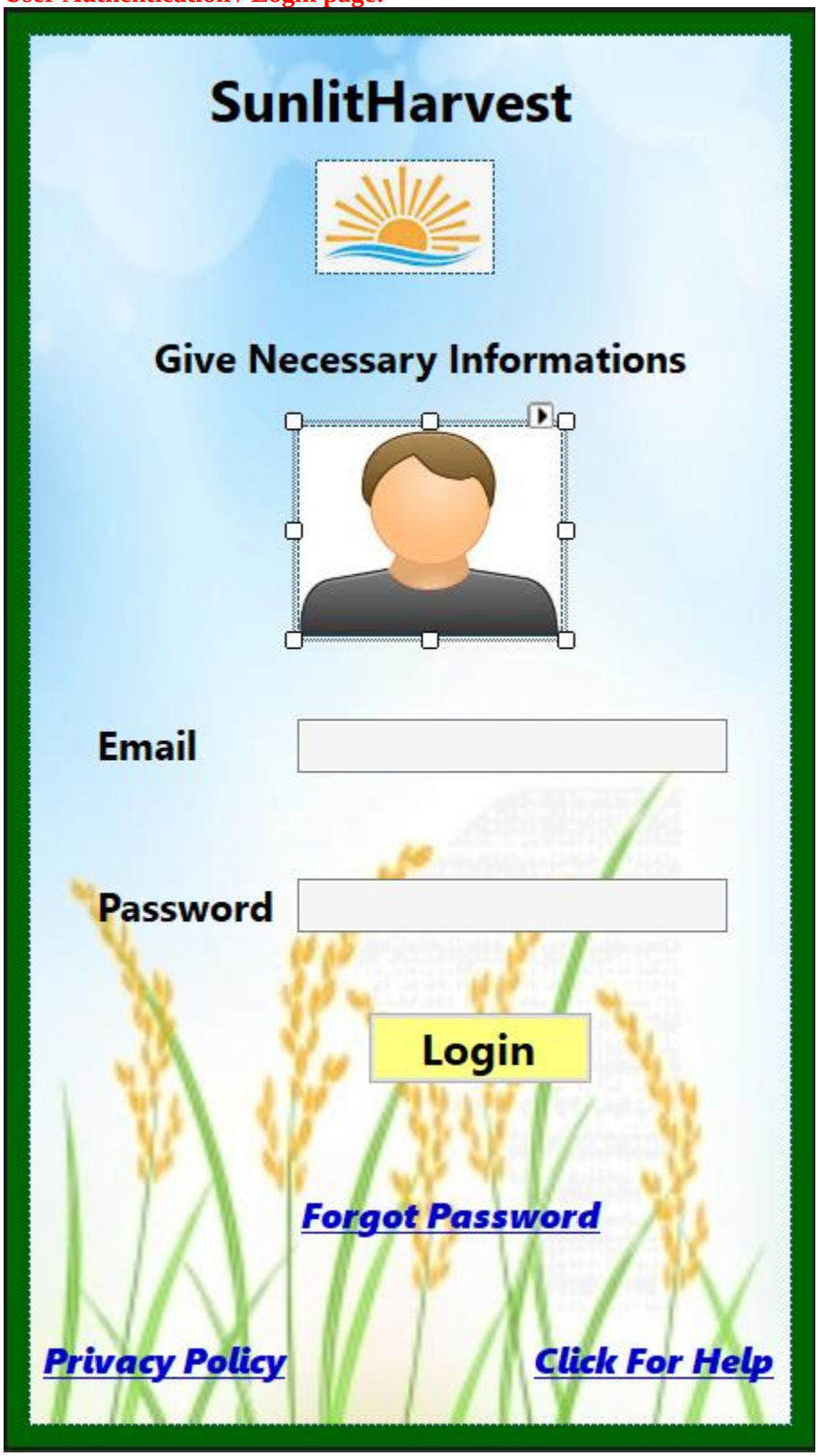
Starting page:



Signup page:

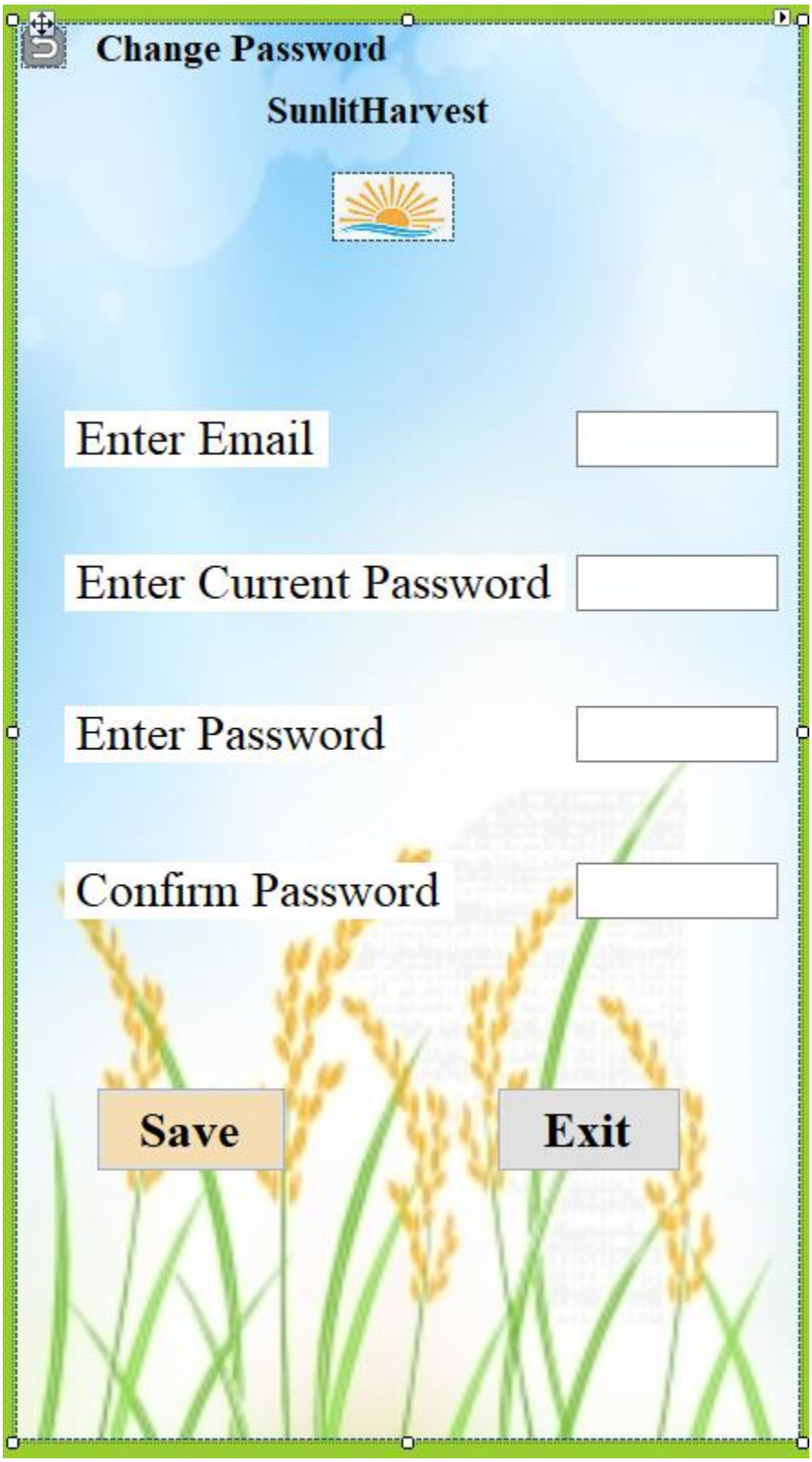


User Authentication / Login page:

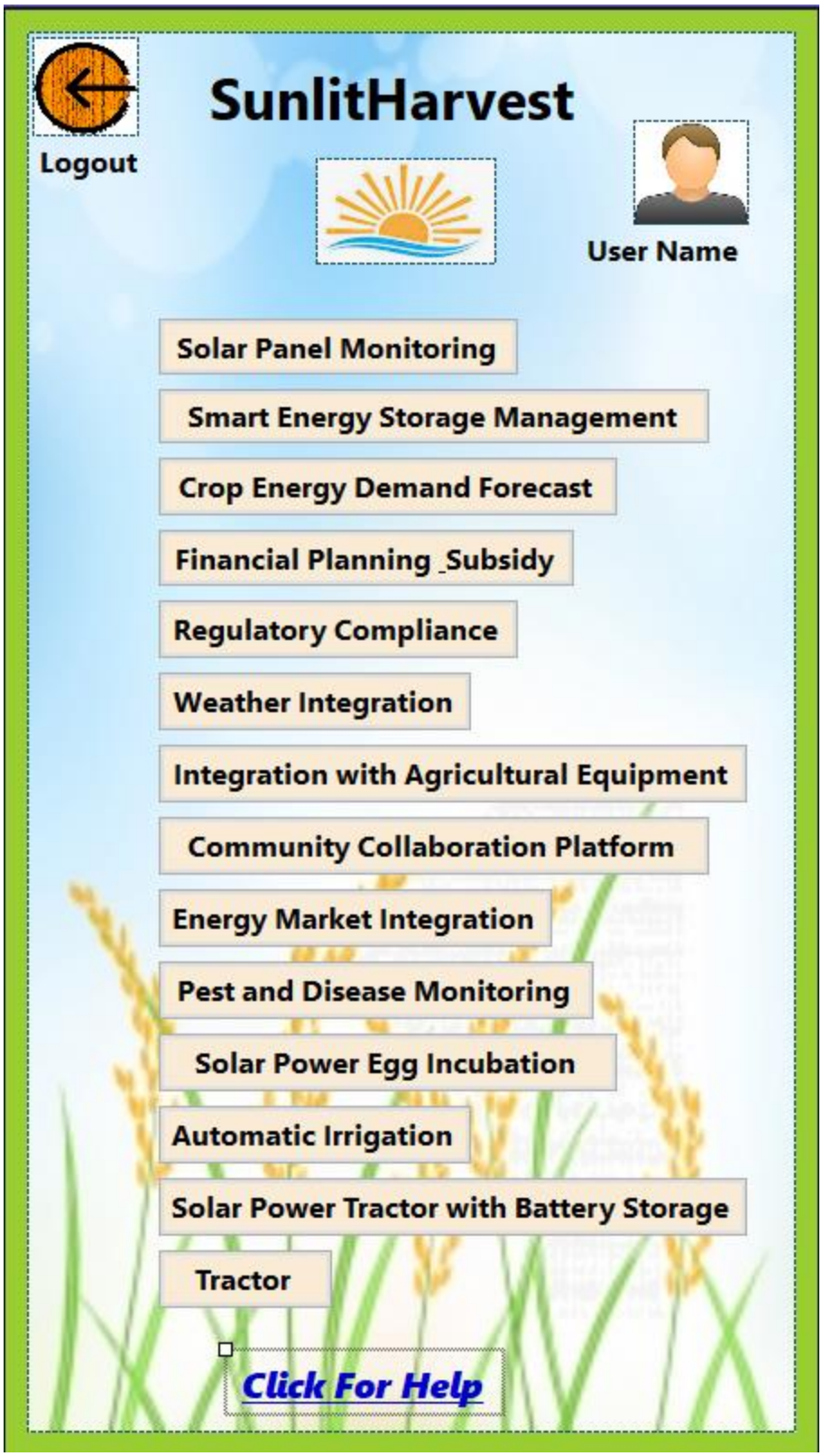


Forgot password page:

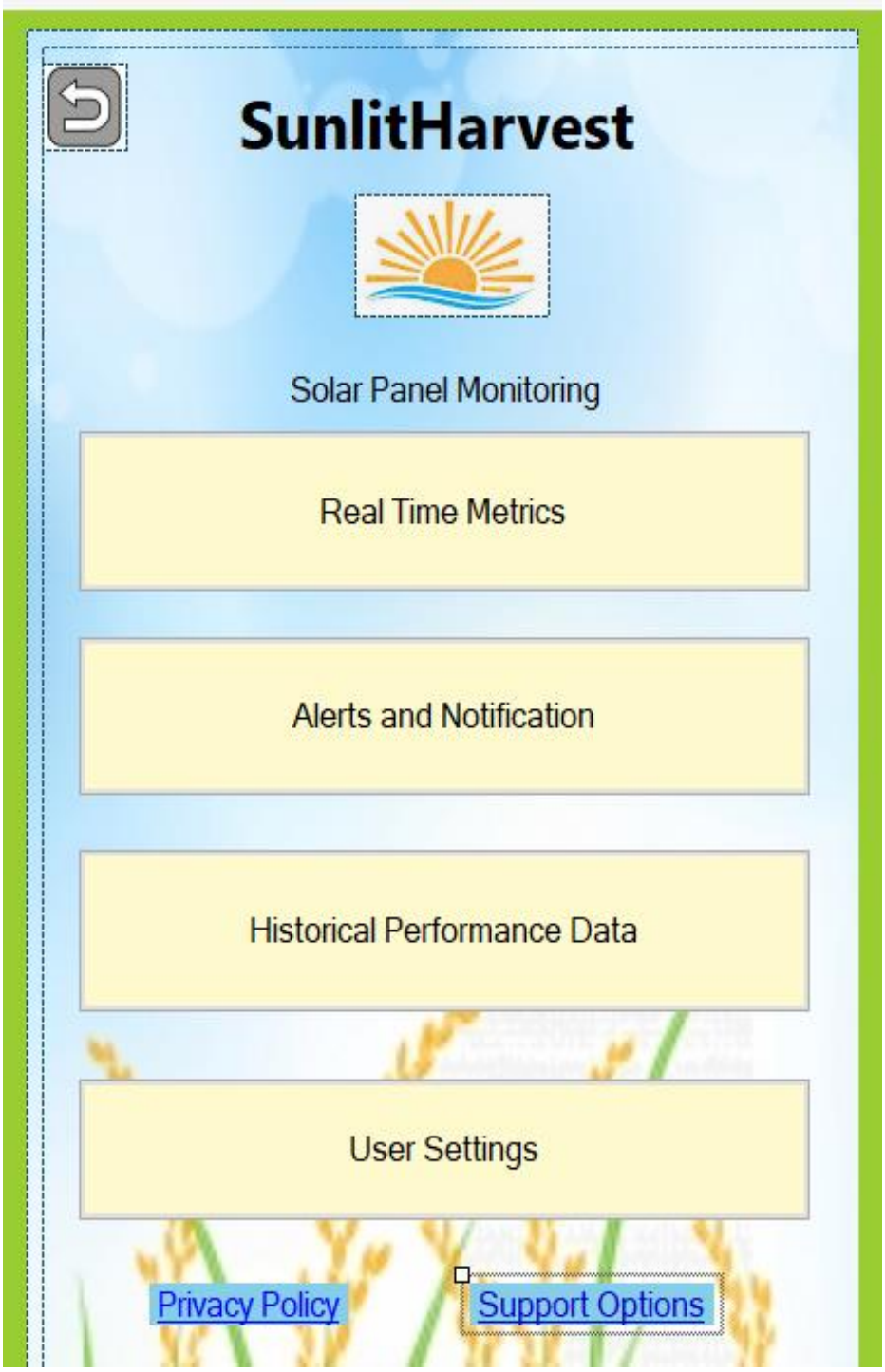
Change password page:


Change Password
SunlitHarvest
Enter Email
Enter Current Password
Enter Password
Confirm Password
Save
Exit

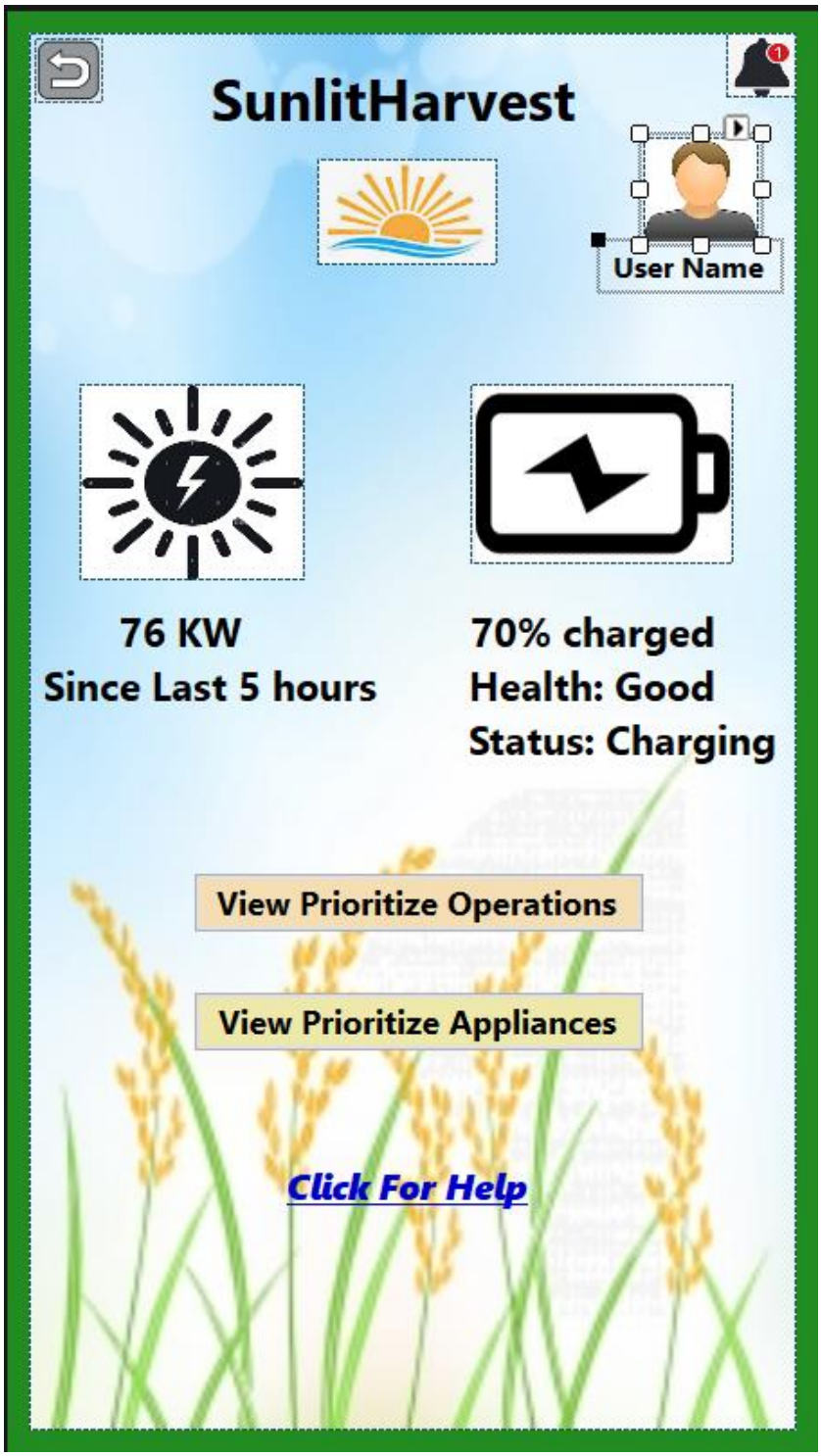
Home page:



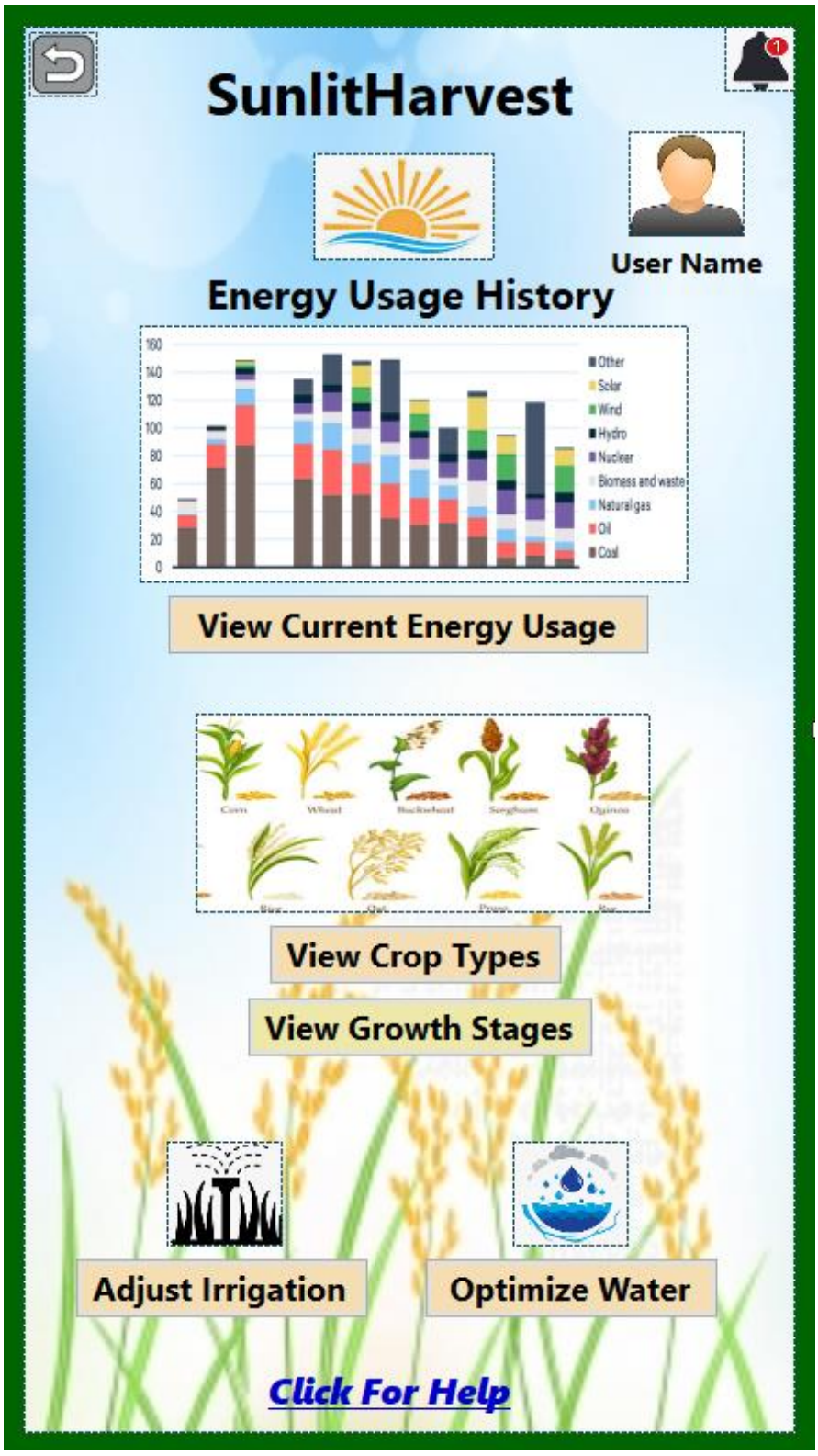
Solar Panel Monitoring:



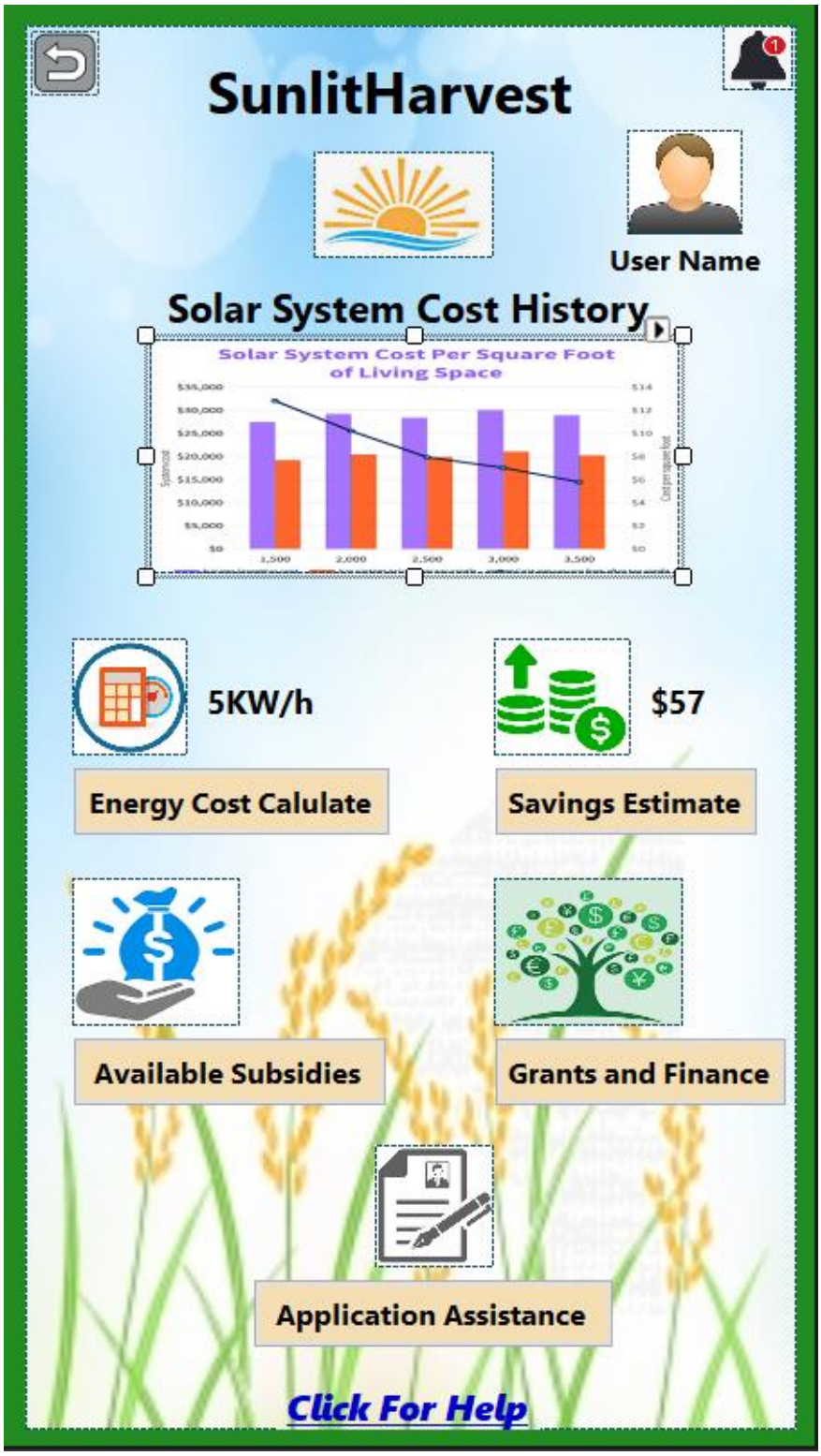
Smart Energy Storage Management:



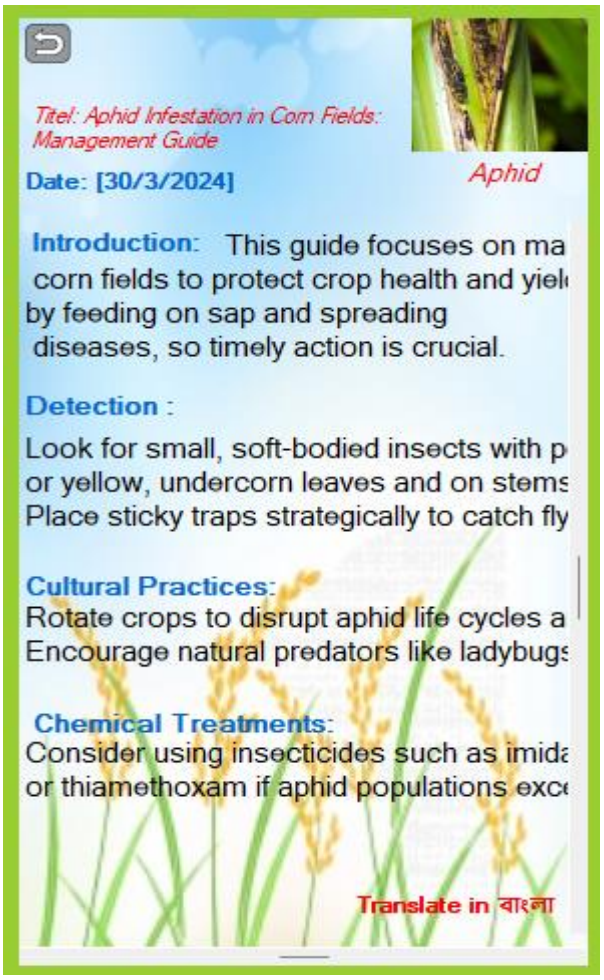
Crop Energy Demand Forecast:



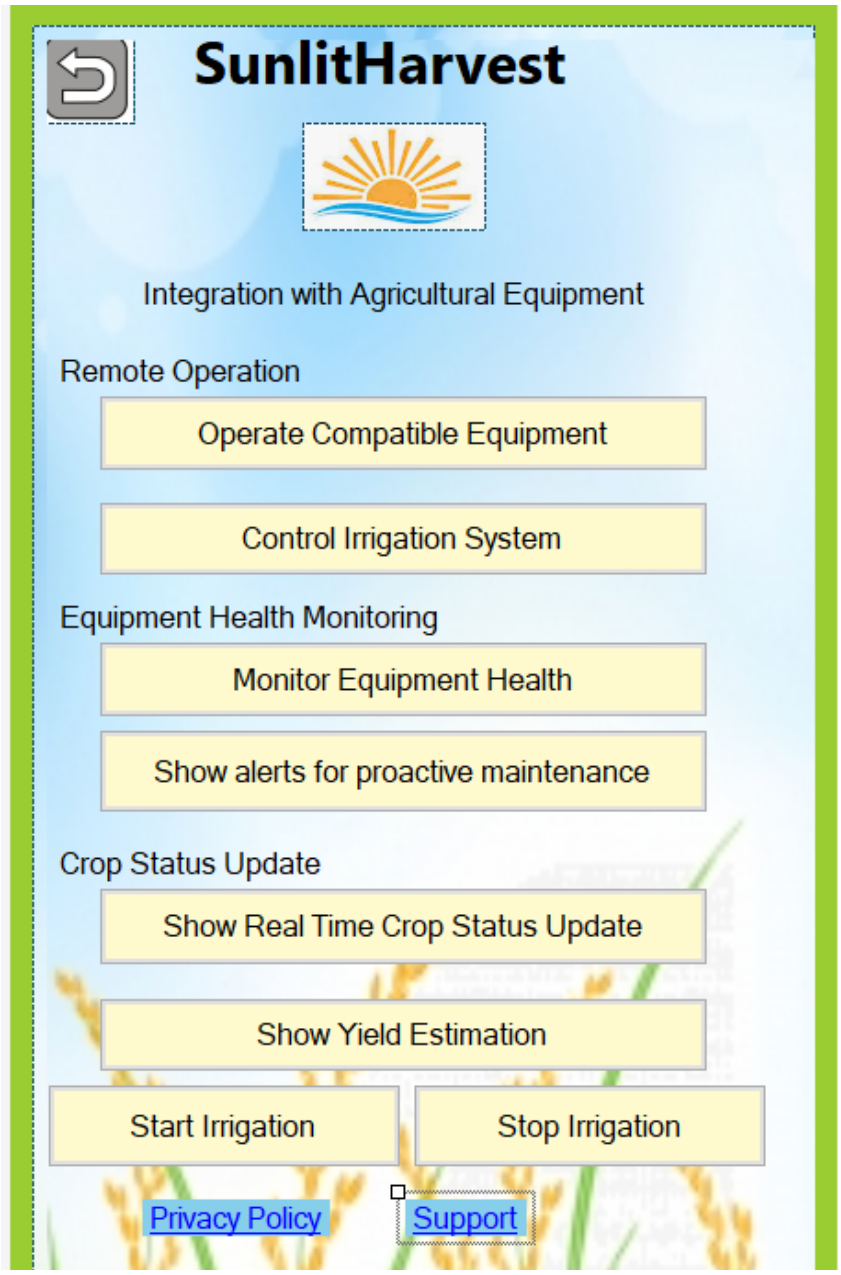
Financial planning & subsidy integration:



Weather Integration:



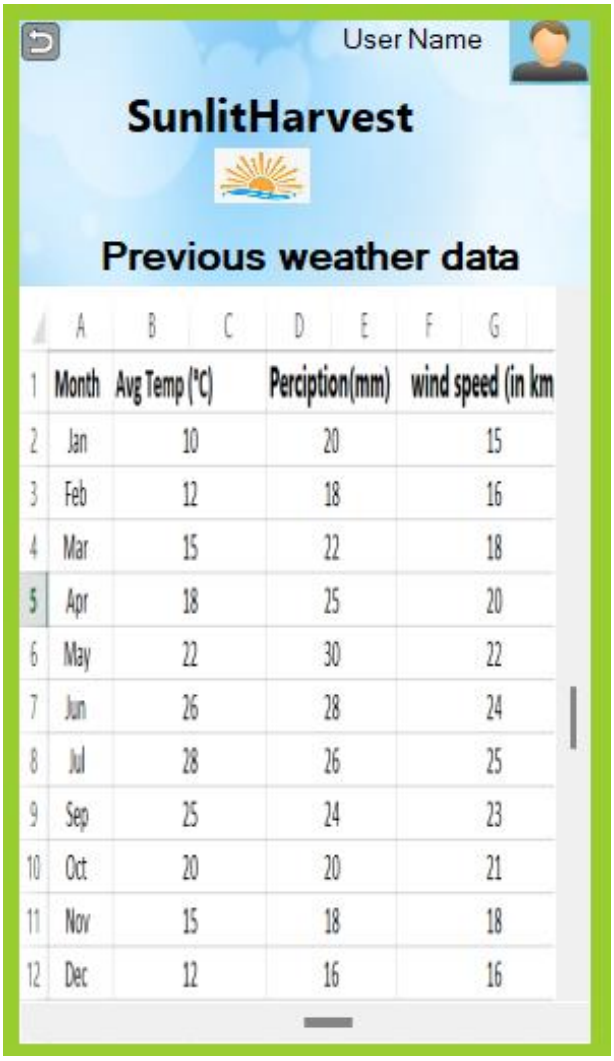
Integration with Agricultural Equipment:



Community Collaboration Platform page:

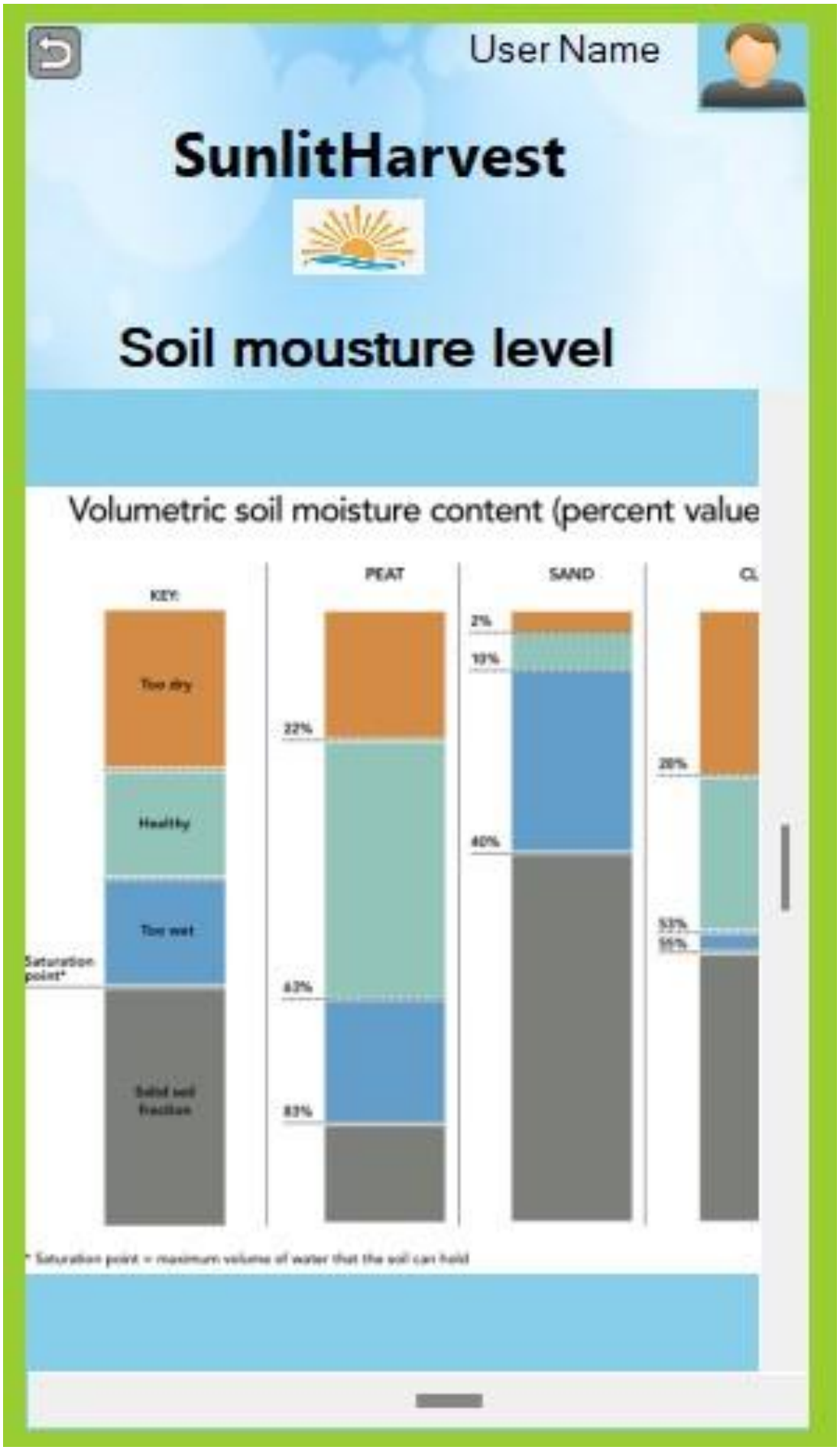

SunlitHarvest
Collaborating Farmers
Rakib Mia
Wasif
Safwan molla
Romjan mia

Pest and Disease Monitoring:



	A	B	C	D	E	F	G
1	Month	Avg Temp (°C)		Perciption(mm)		wind speed (in km	
2	Jan	10		20		15	
3	Feb	12		18		16	
4	Mar	15		22		18	
5	Apr	18		25		20	
6	May	22		30		22	
7	Jun	26		28		24	
8	Jul	28		26		25	
9	Sep	25		24		23	
10	Oct	20		20		21	
11	Nov	15		18		18	
12	Dec	12		16		16	

Automatic Irrigation:


User Name
SunlitHarvest
Soil mousture level
Volumetric soil moisture content (percent value
KEY:
Too dry
Healthy
Too wet
Saturation point*
Solid soil fraction
PEAT
22%
63%
83%
SAND
2%
10%
40%
CL
28%
33%
35%
* Saturation point = maximum volume of water that the soil can hold

Test Planning for SunlitHarvest: Sustainable Cultivation Enhanced by Solar Solutions

The test planning for the SunlitHarvest project aims to ensure the quality and reliability of the agricultural software solution. Given the complexity and critical nature of the project, a comprehensive testing approach is essential to validate its functionality, performance, security, and user experience.

1. **Types of Tests Required:**
    - Unit Testing:
        - **Reason:** To verify the functionality of individual software components such as modules, classes, and functions.
    - Integration Testing:
        - **Reason:** To test the interactions and interfaces between integrated software modules to ensure they function correctly as a whole.
    - System Testing:
        - **Reason:** To validate the entire system's compliance with specified requirements and its behavior under various conditions.
    - Acceptance Testing:
        - **Reason:** To confirm whether the software meets the acceptance criteria and fulfills stakeholders' expectations.
    - Regression Testing:
        - **Reason:** To ensure that recent code changes have not adversely affected existing functionalities.
    - Validation Testing:
        - **Reason:** To validate whether the software meets the user's needs and requirements.
    - White-box Testing:
        - **Reason:** To assess the internal structures and workings of the software, focusing on code paths, logic, and structure.
    - Black-box Testing:
        - **Reason:** To evaluate the software's functionality without considering its internal code structure, focusing on input-output behavior.
2. **Roles for Testing:**
    - **Business Analyst (Jon):**
        - **Responsibility:** Perform system testing to ensure the software meets business requirements and user needs.
    - **Software Developer (Siri):**
        - **Responsibility:** Conduct unit testing to verify the correctness of individual code units.
    - **Quality Assurance Engineer (Alexa):**
        - **Responsibility:** Oversee integration testing, system testing, acceptance testing, and regression testing to ensure the software's quality and reliability.
    - **End Users:**
        - **Responsibility:** Participate in acceptance testing to validate whether the software meets their expectations and requirements.

By adhering to this test planning framework, we aim to ensure the SunlitHarvest project's success by delivering a high-quality, reliable, and user-friendly agricultural software solution.

Project Name: SunlitHarvest: Sustainable Cultivation Enhanced by Solar Solutions	Test Designed by: Md Sabbir Hossain
Test Case ID: SH-01	Test Designed date: 20/4/2024
Test Priority (Low, Medium, High): High.	Test Executed by:
Module Name: Users Authentication	Test Execution date:
Test Title: Users User Authentication and Account Lockout	
Description: To verify the user authentication process and account lockout functionality in the Users Authentication system.	
Precondition (If any): The Users Authentication system is accessible and operational and Users have access to valid login credentials or can create a new account if necessary	

Test Steps	Test Data	Expected Results	Actual Results	Status
1.Attempt to log in to the system using valid username and password credentials. 2.Verify that the login information provided is validated by IT . 3.If the login information is incorrect : a. Verify that the system generates and sends a verification code to the user's email or phone number. b. Attempt to log in again using the verification code. 4.Repeat step 3 until successful login or until the maximum number of unsuccessful attempts is reached.	1.Valid User Login: Username: rakib Password: 1234 * 2.Invalid User Login : Username: rony Incorrect Password: 2542 3.Invalid User Login: Incorrect Username: Rony Password: 2542 3.Verification Code: Code: 123456 4.Maximum Number of Unsuccessful Attempts: 3 5.Locked Account: Username: rakib Password: locked password 2542	Users are able to log in to the system using valid username and password credentials. The login information provided is successfully validated by IT. If login information is incorrect, the system generates and sends a verification code to the user for authentication.		

Post Condition: For successful login The user gains access to the system and can proceed with using its functionalities.

Project Name: SunlitHarvest: Sustainable Cultivation Enhanced by Solar Solutions	Test Designed by: Md Sabbir Hossain
Test Case ID: SH-02	Test Designed date: 20/4/2024
Test Priority (Low, Medium, High): Medium	Test Executed by:
Module Name: Account Recovery	Test Execution date:
Test Title : Account Recovery Process Verification	
Description: To verify the account recovery process in the Account Recovery system.	
Precondition (If any): The user has forgotten their password or their account has been locked and The user has access to contact IT support or access an additional verification process from the login page.	

Test Steps	Test Data	Expected Results	Actual Results	Status
1.If the user forgets their password or encounters a locked account, navigate to the account recovery option. 2.Follow the instructions provided for account recovery, either by contacting IT support or accessing an additional verification process. 3.Provide the necessary information or complete the additional verification process as instructed. 4.Once the account recovery process is completed successfully, attempt to log in	1.Forgotten Password: Username: Sabbir Email Address Associated with Account: sabbir@gmail.com 2.Locked Account: Username: Sabbir 3.Additional Verification Information: User's Date of Birth: January 24, 2000 Security Question: "What is your mother's maiden name?": rony Contact Phone Number: 01753172069	The account recovery process provides clear instructions for users to follow, either by contacting IT support or accessing an additional verification process. Users are able to provide the necessary information or complete the additional verification process to recover their account..		

again. 5Verify that the user gains access to the system and can proceed with changing their password.				
Post Condition: the Account Recovery Process in SunlitHarvest is validated to be effective, reliable, and compliant with established security protocols and user expectations.				

Project Name: SunlitHarvest: Sustainable Cultivation Enhanced by Solar Solutions		Test Designed by: Md Sabbir Hossain		
Test Case ID: SH-03		Test Designed date: 20/4/2024		
Test Priority (Low, Medium, High): High.		Test Executed by:		
Module Name: Solar Panel Monitoring		Test Execution date:		
Test Title : Solar Panel Monitoring Functionality Validation				
Description: To verify the functionality of real-time monitoring for solar panel performance in the Solar Panel Monitoring system				
Precondition (If any): The user has valid login credentials for the Solar Panel Monitoring system. The solar panel system is properly installed and configured to transmit real-time performance data to the monitoring system..				
Test Steps	Test Data	Expected Results	Actual Results	Status

1.Login to the Solar Panel Monitoring system using valid credentials. 2.Navigate to the real-time monitoring section of the system. 3.Verify that the system displays current energy production levels for the user's solar panels. 4.Verify that the system provides metrics such as energy consumption within the solar panel system and overall efficiency.	1.Real-time Energy Production Levels 2.Peak energy production 3.Energy Consumption Metrics 4.Solar Panel Efficiency 5.Simulated abnormality	accurate real-time data collection, prompt alerting for critical issues, seamless remote access, scalability without performance degradation, secure integration with external systems, robust backup and redundancy mechanisms, and a user-friendly interface.		
Post Condition: Users receive alerts and notifications promptly in case of abnormal performance detected by the system.				

Project Name: SunlitHarvest: Sustainable Cultivation Enhanced by Solar Solutions	Test Designed by: Waliul Hasnat Wasif
Test Case ID: SH-04	Test Designed date: 22/4/2024
Test Priority (Low, Medium, High): High.	Test Executed by:
Module Name: Smart Energy Storage Management	Test Execution date:
Test Title : Energy Storage Optimization and Alerting Mechanisms	
Description: This test case verifies the functionality of the Smart Energy Storage Management system, including energy optimization based on solar production and user preferences, as well as automated alerting mechanisms for system issues.	
Precondition (If any): The software is properly installed and configured, and the energy storage system is operational.	

Test Steps	Test Data	Expected Results	Actual Results	Status
1. Verify Optimization Based on Solar Production. 2. Test User Preferences. 3. Validate Prioritization During Insufficient Solar Energy. 4. Test Automated Alerting Mechanisms.	1. Current solar energy production data. 2. User-defined preferences for energy usage. 3. Simulated data for insufficient solar energy production. 4. Anomalies in energy storage performance	1. The software optimizes energy storage effectively based on solar production and usage patterns. 2. User preferences are accurately reflected in the system's energy prioritization. 3. During insufficient solar energy, critical loads are prioritized for uninterrupted operation. 4. Automated alerts are triggered and notify users of energy storage system issues.		
Post Condition: The software continues to monitor and manage energy storage effectively, with automated alerting mechanisms in place for ongoing system monitoring.				

Project Name: SunlitHarvest: Sustainable Cultivation Enhanced by Solar Solutions	Test Designed by: Waliul Hasnat Wasif
Test Case ID: SH-05	Test Designed date: 22/4/2024

Test Priority (Low, Medium, High): High.		Test Executed by:		
Module Name: Crop Energy Demand Forecast		Test Execution date:		
Test Title : Energy Demand Forecast and Optimization				
Description: This test case verifies the functionality of the Crop Energy Demand Forecast system, including data collection, analysis, forecasting, and recommendation generation for optimizing energy usage in agricultural operations.				
Precondition (If any): The software is properly installed and configured, and historical and real-time data related to energy usage, crop types, and growth stages are available for analysis.				
Test Steps	Test Data	Expected Results	Actual Results	Status
1. Verify Data Collection and Analysis 2. Test Forecasting Capability 3. Validate Automated Recommendations 4. Test Planning for Energy Consumption	1. Historical and real-time data related to energy usage, crop types, and growth stages. 2. Simulated data for energy demand forecasting 3. Forecasted energy demands for different crops 4. User inputs for planning energy consumption	1. The system accurately collects and analyzes the data to forecast energy demands with precision. 2. The system effectively forecasts energy needs for agricultural operations, enabling farmers to plan with accuracy and efficiency. 3. Automated recommendations are generated to optimize energy usage based on forecasted demands. 4. The forecast tool assists users in planning energy consumption for		

		irrigation, lighting, and other agricultural activities, minimizing waste.		
Post Condition: The software continues to provide accurate energy demand forecasts and recommendations for optimizing energy usage in agricultural operations, helping users plan efficiently and minimize waste.				

Project Name: SunlitHarvest: Sustainable Cultivation Enhanced by Solar Solutions		Test Designed by: Waliul Hasnat Wasif		
Test Case ID: SH-06		Test Designed date: 22/4/2024		
Test Priority (Low, Medium, High): High.		Test Executed by:		
Module Name: Financial Planning and Subsidy Integration		Test Execution date:		
Test Title : Financial Planning and Subsidy Integration				
Description: This test case verifies the functionality of the Financial Planning and Subsidy Integration module, including cost estimation, subsidy exploration, and automated assistance in filling out subsidy applications for transitioning to solar energy.				
Precondition (If any): The software is properly installed and configured, and relevant financial and subsidy data are available in the integrated database.				
Test Steps	Test Data	Expected Results	Actual Results	Status

1. Verify Cost Estimation 2. Test Subsidy Exploration 3. Validate Automated Assistance	1. Inputs for estimating the cost and potential savings of transitioning to solar energy 2. Simulated user inputs for exploring subsidies, grants, and financing options 3. Simulated subsidy application data	1. The system accurately estimates the cost and potential savings, providing users with valuable financial insights. 2. Users can successfully explore available subsidies, grants, and financing options through the integrated database. 3. The software provides automated assistance in filling out subsidy applications, simplifying the financial planning process for users.		
Post Condition: The software continues to provide accurate financial planning estimates and subsidy exploration options, simplifying the transition to solar energy for users.				

Project Name: SunlitHarvest: Sustainable Cultivation Enhanced by Solar Solutions	Test Designed by: Md Safwan Bhuiyan
Test Case ID: SH-07	Test Designed date: 20/4/2024
Test Priority (Low, Medium, High): Medium.	Test Executed by:
Module Name: Regulatory Compliance Guidance	Test Execution date:
Test Title : Compliance Guidance Process Verification	
Description: o verify that the "Regulatory Compliance Guidance" system accurately guides users through step-by-step processes to ensure compliance with local and national regulations for solar-powered	

agriculture.				
Precondition (If any): Users must have access to the system with valid login credentials.				
Test Steps	Test Data	Expected Results	Actual Results	Status
1.Login to the "Regulatory Compliance Guidance" system using valid credentials. 2.Select a specific regulation or compliance requirement related to solar-powered agriculture. 3.Follow the step-by-step guidance provided by the system to ensure compliance. 4.Verify that each step of the compliance process is clearly explained and easy to understand.	1. Automated Update 2. Compliance Report 3. Regulation: "Solar Panel Installation Guidelines	The Regulatory Compliance Guidance system successfully guides users through compliance processes for local and national regulations related to solar-powered agriculture.		
Post Condition: Users successfully complete the compliance processes guided by the system for the selected regulations.				

Project Name: SunlitHarvest: Sustainable Cultivation Enhanced by Solar Solutions	Test Designed by: Sadik Saleh
Test Case ID: SH-08	Test Designed date: 20/4/2024
Test Priority (Low, Medium, High): High.	Test Executed by:
Module Name: Weather integration	Test Execution date:

Test Title : Weather Integration Functionality Validation				
Description: This test case verifies the functionality of the Solar Panel Monitoring in that the system accurately measures and reports data, provides timely alerts for issues, allows remote access, scales effectively, integrates with other systems securely, and maintains usability. This validation guarantees reliable performance, efficient maintenance, and optimized energy production for solar installations.				
Precondition (If any): Ensure that the solar panel monitoring system is fully installed and operational, including sensors, data acquisition hardware, and software.				
Test Steps	Test Data	Expected Results	Actual Results	Status
1. Energy Measurement Accuracy Test: Simulate energy production data for different times of the day and varying weather conditions. Measure voltage for each solar panel or string. Measure current for each solar panel or string. Measure the temperature for each solar panel or string.	1. Simulated energy production data, voltage readings, current readings, and temperature readings.	1.The monitoring system accurately measures and reports energy production, voltage, current, and temperature for each solar panel.		
2.Real-time Performance validation test: Observe the system's performance to ensure it provides real-time updates on solar panel performance.	2. No specific test data required.	2. The system provides real-time updates on solar panel performance		
3.Fault detection and alerting test: Simulate various fault scenarios such as low energy production or high temperature. Verify that the alerting system promptly notifies relevant stakeholders about any detected faults.	3. Simulated fault scenarios.	3. The alerting system promptly notifies relevant stakeholders about detected faults.		
Post Condition: The weather integration module ensures seamless and accurate integration of weather data with the solar panel monitoring system, enhancing its functionality, and providing users with real-time weather updates to optimize energy production and system performance.				

Project Name: SunlitHarvest: Sustainable Cultivation Enhanced by Solar Solutions	Test Designed by: Sadik Saleh
Test Case ID: SH-09	Test Designed date: 20/4/2024
Test Priority (Low, Medium, High): High.	Test Executed by:
Module Name: Integration with Agricultural Equipment	Test Execution date:

Test Title : Integration with Agricultural Equipment Functionality Validation

Description: This test case verifies that the software integrates seamlessly with existing agricultural equipment, enabling automated control based on energy availability, remote operation of compatible equipment, capturing energy usage data, monitoring equipment health, and interfacing with sensors for real-time crop status updates and yield estimations.

Precondition (If any): Ensure that the software is fully installed and operational, with all required agricultural equipment properly connected and configured.

Test Steps	Test Data	Expected Results	Actual Results	Status
1. Integration Verification: Verify that the software integrates with existing agricultural equipment.	1. Equipment compatibility data.	1.The software should seamlessly integrate with existing agricultural equipment.		
2. Remote Operation Testing: Test the remote operation functionality of compatible equipment through the software interface.	2.Simulated energy usage data from equipment.	2.Users should be able to remotely operate compatible equipment through the software interface.		
3. Energy Usage Data Validation: Ensure that energy usage data from equipment is captured and incorporated into overall farm analytics.	3.Fault scenarios for equipment testing.	3.Energy usage data from equipment should be captured and incorporated into overall farm analytics.		

4. Fault Scenario Testing: Trigger various fault scenarios in the equipment and verify that the software generates alerts. 5. Proactive Maintenance Validation: Validate that users can schedule proactive maintenance for equipment reliability enhancement.	4.Sensor data for crop status updates. 5.Predictive model output for yield estimations.	4.The software should generate alerts for equipment health issues and enable proactive maintenance scheduling. 5.The software interface with sensors should provide real-time crop status updates.		
Post Condition: Upon successful completion of the Integration with Agricultural Equipment Test, the software ensures seamless integration with existing agricultural equipment, allowing for automated control based on energy availability, remote operation of compatible equipment, capture of energy usage data, monitoring of equipment health, and interfacing with sensors for real-time crop status updates and yield estimations. Additionally, the software enables users to schedule proactive maintenance for equipment reliability enhancement and utilizes predictive models for accurate yield estimations.				

Project Name: SunlitHarvest: Sustainable Cultivation Enhanced by Solar Solutions	Test Designed by: Sadik Saleh
Test Case ID: SH-10	Test Designed date: 20/4/2024
Test Priority (Low, Medium, High): High.	Test Executed by:
Module Name: Community Collaboration Platform	Test Execution date:
Test Title : Community Collaboration Platform Functionality Validation	

Precondition (If any): Software is installed and operational, users and neighboring farms are registered, resources are available, and notifications are enabled.				
Test Steps	Test Data	Expected Results	Actual Results	Status
1.Platform Connectivity Test: Verify that users can search for neighboring farms. Test the functionality to send connection requests to neighboring farms. Validate that connection requests are successfully accepted by neighboring farms.	Neighboring farms' contact information.	Users should be able to connect with neighboring farms through the collaborative platform.		
2.Resource Sharing Test: Test the functionality to share surplus energy with neighboring farms. Verify the process of sharing equipment or expertise with other users.	Surplus energy availability, equipment listings, expertise listings.	The platform should successfully facilitate resource sharing among users.		
3.Marketplace Functionality Test: Verify the process of listing resources such as machinery or labor on the platform. Test the functionality to search for and access listed resources**.**	Resource listings (machinery, labor).	Users should be able to list and access available resources through the platform's marketplace.		
Post Condition: Upon successful completion of testing, the Community Collaboration Platform seamlessly integrates into the software, fostering connectivity between users and neighboring farms, facilitating resource sharing and collaboration, and promoting community resilience and sustainable farming practices.				

Project Name: SunlitHarvest: Sustainable Cultivation Enhanced by Solar Solutions	Test Designed by: Shraboni Biswas Naboni
Test Case ID: SH-11	Test Designed date: 20/4/2024
Test Priority (Low, Medium, High): High.	Test Executed by:
Module Name: Soil Moisture Sensors	Test Execution date:

Test Title : Sensor Functionality and Accuracy

Description: This test case ensures the proper functioning and accuracy of the soil moisture sensors used in the automatic irrigation system.

Precondition (If any): The soil moisture sensors are properly installed and connected to the irrigation system.The irrigation system is powered and operational.The soil in the farm is prepared and ready for testing.

Test Steps	Test Data	Expected Results	Actual Results	Status
1.System verify that soil moisture sensors are operational and correctly placed in the soil. 2. Verify that the system detects soil dehydration in real-time. 3. Confirm that upon detecting soil dehydration, the system triggers the automatic start of the irrigation system	1.Controlled variations in soil moisture levels (example: watering or drying specific areas). 2.Expected sensor readings corresponding to different moisture levels. 3. Time intervals for monitoring sensor readings.	1. The sensors should provide consistent readings across different moisture levels. 2. The sensors should react to changes in soil moisture levels quickly enough to meet acceptable standards. 3. The sensors should react to changes in soil moisture levels quickly enough to meet acceptable		

		standards.		
Post Condition: Identified sensor issues are documented for review, followed by necessary calibration or replacement to ensure accurate readings.				

Project Name: SunlitHarvest: Sustainable Cultivation Enhanced by Solar Solutions		Test Designed by: Shraboni Biswas Naboni		
Test Case ID: SH-12		Test Designed date: 20/4/2024		
Test Priority (Low, Medium, High): High.		Test Executed by:		
Module Name: Automatic Irrigation System		Test Execution date:		
Test Title: Soil Moisture-Based Activation				
Description: To ensure that the irrigation system activates when soil moisture drops below a set level, as detected by soil moisture sensors.				
Precondition (If any): Soil moisture sensors are installed and functioning. Predefined threshold for soil moisture level is set.				
Test Steps	Test Data	Expected Results	Actual Results	Status

1.System verify that soil moisture sensors are operational and correctly placed in the soil. 2. Verify that the system detects soil dehydration in real-time. 3. Confirm that upon detecting soil dehydration, the system triggers the automatic start of the irrigation system. 4. Verify that the irrigation system remains active until the soil moisture levels reach the optimal range.	1.Soil moisture sensor readings indicating dehydration (below predefined threshold). 2.Solar panel power supply status.	1. The irrigation system should activate and deliver water to the dehydrated soil. 2. The irrigation system should remain active until the soil moisture levels reach the optimal range		
Post Condition: Irrigation system is active, ensuring soil moisture is maintained. System is powered sustainably by solar panels.				

Project Name: SunlitHarvest: Sustainable Cultivation Enhanced by Solar Solutions		Test Designed by: Shraboni Biswas Naboni		
Test Case ID: SH-13		Test Designed date: 20/4/2024		
Test Priority (Low, Medium, High): Medium.		Test Executed by:		
Module Name: Pest and Disease Monitoring System		Test Execution date:		
Test Title: Detection, Alerting, and Analysis				
Description: To ensure the functionality of the pest and disease monitoring system, including detection, alerting, analysis, and recommendation features.				
Precondition (If any): The software is properly installed and integrated with sensors and imaging technologies.				
Test Steps	Test Data	Expected Results	Actual Results	Status

1. User log in to the system 2. User click pest and Disease feature from the Home page . 3. Simulate the detection of a potential pest or disease outbreak in the monitored crops. 4. Upon login and accessing the Pest and Disease feature, confirm that the user receives a real-time notification/alert about the detected outbreak.. 5. Check if the notification/alert provides relevant information about the detected pest or disease, including affected crops and severity	1.Simulated data representing various pest and disease scenarios. 2.Historical data on pest and disease occurrences for analysis.	1. The system accurately detects signs of pests and diseases in crops. 2. Real-time alerts and notifications are promptly delivered to users upon detection of potential outbreaks. 3. Automated analysis provides meaningful insights into pest and disease trends and patterns. 4. The system effectively forecasts and anticipates future pest and disease outbreaks based on historical data		
Post Condition: Test outcomes and system responses are documented for analysis.User feedback on notification/alert functionality is gathered for potential improvements.				

Project Name: SunlitHarvest: Sustainable Cultivation Enhanced by Solar Solutions	Test Designed by: Safwan buyiyan
Test Case ID: SH-14	Test Designed date: 20/4/2024
Test Priority (Low, Medium, High): High.	Test Executed by:
Module Name: GPS Navigation	Test Execution date:
Test Title : Autonomous Navigation Accuracy	

Description: This test case ensures the accuracy and reliability of the GPS used by the solar-powered tractor for autonomous field navigation.				
Precondition (If any): Field mapping data and waypoints are accurately uploaded to the system.				
Test Steps	Test Data	Expected Results	Actual Results	Status
1.System activate the GPS and set a predefined destination within the field for the tractor to navigate to. 2. Ensure that the tractor maintains a safe distance from field boundaries and obstacles during navigation. 3. Validate the system's ability to recalculate routes and navigate around obstacles if necessary. 4. Measure the time taken for the tractor to reach the destination and compare it against expected time estimates.	Destination coordinates for the tractor to navigate to within the field.	1. Accurately guides the tractor along the planned route to the predefined destination. 2.Safe navigation practices are maintained, with the tractor avoiding collisions with field boundaries and obstacles..		
Post Condition: Any navigation errors or deviations identified during testing are documented and reported for further investigation..				

Project Name: SunlitHarvest: Sustainable Cultivation Enhanced by Solar Solutions	Test Designed by: Shraboni Biswas Naboni
Test Case ID: SH-15	Test Designed date: 20/4/2024
Test Priority (Low, Medium, High): High.	Test Executed by:

Module Name: Solar-Powered Tractor with Battery Storage		Test Execution date:		
Test Title : Autonomous Harvesting Activation				
Description: This test case verifies the functionality of the solar-powered tractor system in autonomously activating harvesting operations when crops reach optimal maturity and GPS technology..				
Precondition (If any): The solar-powered tractor system is properly installed and configured.				
Test Steps	Test Data	Expected Results	Actual Results	Status
1. Prepare test crops at various stages: Immature, optimal, and overripe. 2. Activate crop maturity detection system for analysis. 3. Verify accurate identification of optimal maturity. 4. Simulate GPS-guided navigation for cutting crops at identified mature land.	1. Simulated data indicating optimal crop maturity 2. GPS coordinates of the designated area within the field. 3.Field mapping data	Crops can be harvested within a proper area where the crops have matured		
Post Condition: The solar-powered tractor system is operational and ready for use.				

Effort Estimation:

COCOMO (Constructive Cost Model)

Software Project Type	Coefficient <Effort Factor>	P	T
Organic	2.4	1.05	0.38
Semi-detached	3.0	1.12	0.35
Embedded	3.6	1.20	0.32

We assume our SLOC (Source Line of Code) is 6000For

Organic,

Coefficient$_{<\text{Effort Factor}>}$=2.4

P= 1.05

T=0.38

So, Effort = PM= Coefficient* $(\frac{SLOC}{1000})^{P}$

=2.4* $(\frac{6000}{1000})^{1.05}$

= 15.75

Development Time = DM = 2.5* $(PM)^{T}$

= 2.5*$15.75^{0.38}$

=7.12

Requirement Number of People=ST = $\frac{PM}{DM}$

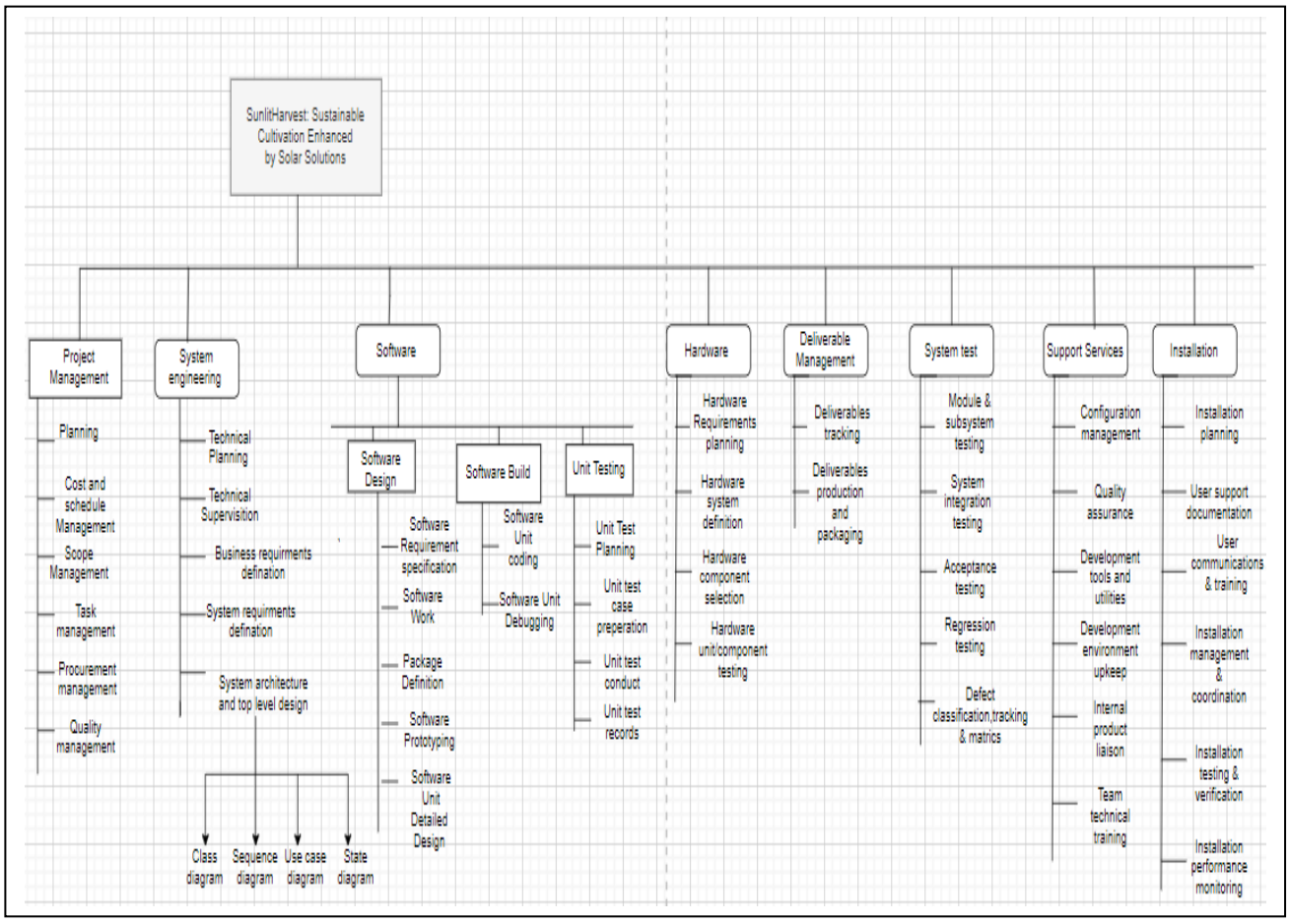
= $\frac{15.75}{7.12}$

= 2.212

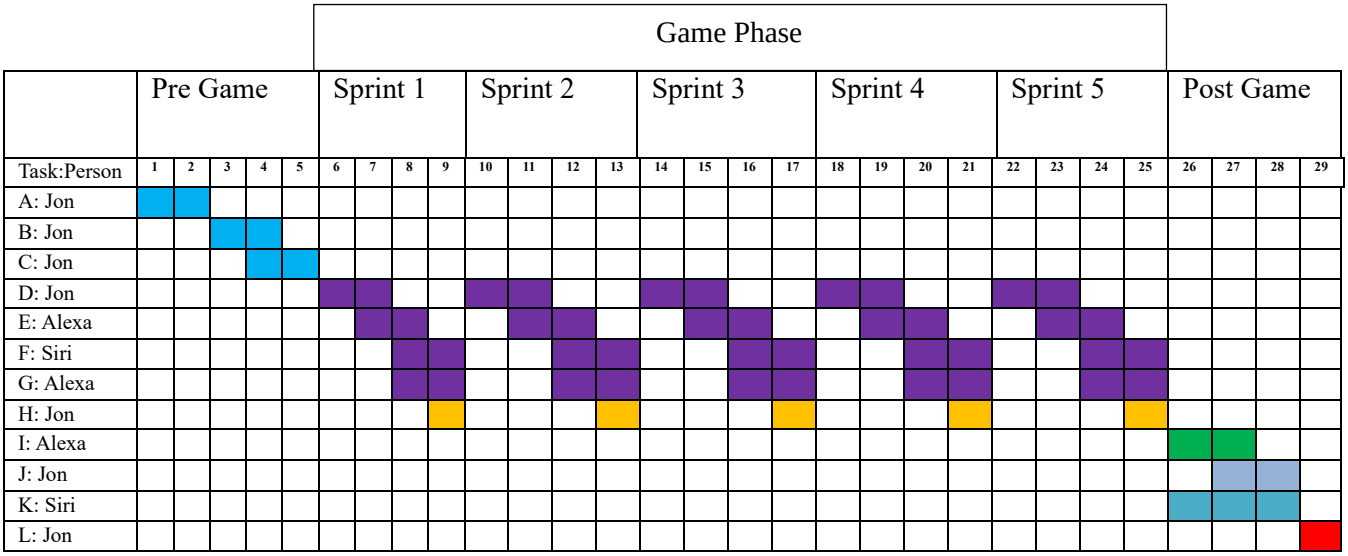
=3

Thus, the project development will take three persons and seven and a half months, or nearly 29 weeks, to complete

WBS: Work Breakdown Structure

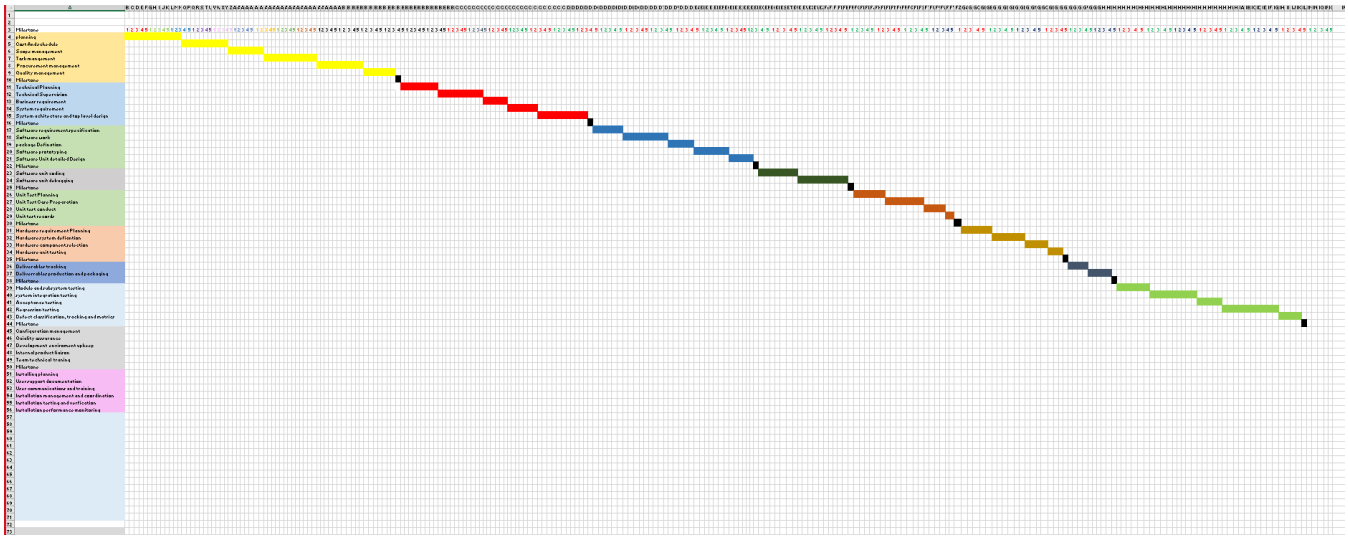


Timeline -1



A: Planning
B: Specification
C: High Level Architecture Design
D: Analysis
E: Design
F: Coding
G: Functional Testing
H: Product Backlog Update
I: Integration
J: System Testing
K: Documentation
L: Release

Timeline -2



Total Working days = PM*20 = 15.75*20 = 315

EVA Analysis :

Tasks	Planned effort	Actual effort
1	13	7
2	12	6
3	7	3
4	13	4
5	11	15
6	7	5
7	8	6
8	11	…
9	6	…
10	7	…
11	11	…
12		
13		

BCWP

BCWS

ACWP

Given ,
The total number of tasks = 40

Effort estimated, BAC = PM*20 = 315
BCWS = = (13+12+7+13+11+7+8+11+6+7+11)=106
BCWP = (13+12+7+13+11+7++8)=71
ACWP = 7+6+3+4+15+5+6=46

So, SPI = BCWP/BCWS = 71/106 = 0.6698
SV = BCWP – BCWS = 71-106 = -35 person-day

CPI = BCWP /ACWP = 71/46 = 1.54
CV = BCWP – ACWP = 71 – 46 = 25 person-day

%schedule for completion = BCWS/BAC = (106/315)*100% = 33.65%
%completed = BCWP/BAC = (71/315)*100% = 22.54%
Here,

BAC is the budgeted cost of work scheduled.
SPI is schedule performance index,
SV is schedule variance,

CPI is cost performance index,
CV is cost variance.
BCWP is the sum of BCWS for all work tasks that has been completed by a point of time. **BCWS** effort planned for each task.
ACWP is the actual cost of work performed.

Risk management

Risks	Category	Probability	Impact
Size estimate maty be significantly low	PS	50%	2
Larger Number of users than planned	PS	30%	3
Less reuse than planned	PS	40%	1
End-users resist system	BU	40%	1
Delivery deadline will be tightened	BU	50%	2
Funding will be lost	CU	30%	1
Customer will change requirements	PS	70%	2
Technology will not meet expectations	TE	30%	1
Lack of training on tools	DE	80%	3
Staff inexperienced	ST	40%	1
Staff turnover will be high	ST	50%	2
Technology Reliability and Dependency	DE	60%	2

Data Security and Privacy Breaches	CU	70%	2
Environmental Vulnerabilities	BU	50%	2
Lack of training	BE	60%	3
Improper data analysis	DE	15%	1
Wrong data collection	BE	10%	1

Risks	Risks Reduction technique
Size estimate maty be significantly low	To minimize the risk of significantly low size estimates, incorporate extra time or resources into the project plan as a buffer for potential underestimation.
Larger Number of users than planned	To minimize the risk of a larger number of users than planned, ensure scalability and robustness in the system architecture.
Less reuse than planned	To minimize the risk of less reuse than planned, consider diversifying resources across projects or components.
End-users resist system	To minimize end-users' resistance to the system, involve them early, address concerns promptly, and provide support throughout implementation.
Delivery deadline will be tightened	Focus on important tasks, streamline work, use resources well, talk clearly, be flexible with Agile, watch for risks, work together, check progress, and be ready for changes.
Funding will be lost	To reduce the risk of losing funding, teams can save money, seek additional funding sources, demonstrate project value, manage risks, maintain stakeholder engagement, and monitor project performance closely.
Customer will change requirements	To minimize the risk of changing customer requirements, maintain open communication, implement Agile methodologies, gather feedback regularly, document requirements clearly, and collaborate closely with stakeholders.
Technology will not meet expectations	To reduce the risk of technology not meeting expectations, ensure thorough assessment, stakeholder involvement, clear communication, realistic goal-setting, adequate training, rigorous testing, continuous improvement, and contingency planning.

Lack of training on tools	To reduce the risk of lack of training on tools, provide comprehensive training sessions, create easy-to-follow user guides, offer ongoing support, encourage hands-on practice, and establish a feedback loop for continuous improvement.
Staff inexperienced	To mitigate the risk of inexperienced staff, provide comprehensive training and support, foster a supportive team environment, and consider hiring experienced personnel for critical roles.
Staff turnover will be high	To lower the risk of high staff turnover, offer good pay, opportunities to grow, a positive work atmosphere, work-life balance, and listen to and act on employee feedback.
Technology Reliability and Dependency	To lessen the risk of technology problems and dependence, use different solutions, keep technology up-to-date, have backups, train employees, and make plans for when things go wrong.
Data Security and Privacy Breaches	To lower the risk of data security and privacy breaches, protect data with encryption, train staff, update systems regularly, conduct audits, use multi-factor authentication, and comply with regulations.
Environmental Vulnerabilities	To reduce the risk of environmental vulnerabilities, plan for disasters, assess and mitigate risks, use resilient infrastructure, and educate staff on emergency procedures.
Lack of training on tour	To prevent the risk of not enough training, offer thorough training sessions and ongoing support for learning.
Improper data analysis	To lower the risk of improper data analysis, ensure proper training, quality control, collaboration among analysts, validation of findings, and use of data visualization tools.
Wrong data collection	To mitigate the risk of wrong data collection, establish clear procedures, provide training, implement quality checks, review collected data regularly, and use standardized tools.

Rubric for Project Assessment (CO1)

Marking Criteria	Marks Distribution (Maximum 3X5=15)				Acquired Marks
	Inadequate (1-2)	Satisfactory (3)	Good (4)	Excellent (5)	
Background Analysis	No background information regarding the project is	Insufficient background information is given; project	Sufficient background information is given; the	Thorough and Relevant background information	
	given; project goals and benefits are missing.	goals and benefits are poorly stated	purpose and goals of the project are explained.	is given; project goals are clear and easy to identify.	
Analysis the impact of societal, health, safety, legal and cultural issues	Student vaguely discuss the impact of societal, health, safety, legal and cultural issues in their project	Student provided with partial relevance to the impact of societal, health, safety, legal and cultural issues in their project	Student fairly provided the analysis to the impact of societal, health, safety, legal and cultural issues in their project	Student comprehensively provided the analysis to the impact of societal, health, safety, legal and cultural issues in their project	
Existing Studies and Relevant Example	Ambiguous representative example.	Partially identify / indicate towards real-life example.	Real-life example is fairly connected towards the definition.	Comprehensively defend with real life example.	
				Acquired Marks:	
				CO Pass / Fail:	

Rubric for Project Assessment (CO2)

Criteria	Marks distribution (Max 3X5= 15)				Acquired Marks
	Inadequate (1-2)	**Satisfactory (3)**	**Good (4)**	**Excellent (5)**	
Argumentation of Model selection with Evidence of Argumentation	Does not articulate a position or argument of choosing appropriate model. Does not present any evidence to support the arguments for the choice of the model	Articulates a position or argument for choosing models that is unfocused or ambiguous. Presents incomplete/vague evidence to support argument for model choice	Articulates a position or argument of choosing models that is limited in scope. Does not present enough evidence to support the argument for the choice of the model	Clearly articulates a position or argument for the choosing software engineering models. Presents sufficient amount of evidence to support argument for the model selection	
Role identification and Responsibility Allocation	The project has poor project management plans for identifying roles and assigning the responsibilities	Identify few roles in the project management where some of the roles are left alone with any project responsibilities	Identify most of the roles in the project management and assign their responsibilities	Well planned project with proper role identification and responsibility allocation in the project management activities	
Submission, Completeness, Spelling, grammar and Organization of the Project report	Project report is not complete and Several errors in spelling and grammar. Present a Confusing organization of concepts, supporting arguments, and real-life example. Sentences rambling, and details are repeated.	Some errors in spelling and grammar. Some problems of organizing the answer in a logical order of defining, elaborating, and providing real-life examples.	Few errors in spelling and grammar. Presents most of the details in a logical flow of organization in definition, details, and example.	Project report is complete and No errors in spelling and grammar. Consistently presents a logical and effective organization of definition, details, and real-life example of the topic.	
				Acquired marks:	

CO Pass / Fail:	