American International University-Bangladesh (AIUB)

Department of Computer Science

Faculty of Science & Technology (FST)

PROJECT TITLE

Semester: Fall 25-26

Group:		***Section:***
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1. PROJECT PROPOSAL

1.1 Background to the Problem

Background to the Problem Farmers in many regions face ongoing challenges due to unreliable electricity and the rising cost of fuel. To solve these problems, a new initiative called Famonergy Link encourages each farmer to install a solar power system on their land. This system allows them to generate their own electricity using sunlight for irrigation, farm machinery, and household needs.

By depending less on diesel generators and other fossil-fuel-based sources, farmers can cut costs and reduce pollution. Any unused electricity can also be stored for later use, ensuring a steady supply even during low-sunlight periods. If the solar panels produce more electricity than the farmer needs, the extra energy can be sent to the national power grid. By selling this surplus electricity, farmers can earn additional income, improving their financial stability while also supporting the nation's renewable energy production.

Famonergy Link not only promotes efficient energy use but also helps the country reduce its dependence on fossil fuels and move toward sustainable development. To manage the process easily, Famonergy Link provides an online platform where farmers can track how much electricity they have produced, consumed, stored, or sent to the grid. With their approval, the system can automatically transfer extra electricity to the national grid. Government authorities also benefit from this platform, as it provides real-time data for planning and monitoring national renewable energy progress. To encourage more participation, Famonergy Link includes a leaderboard highlighting top energy-producing farmers. National and personal production targets are set periodically, and farmers who meet or exceed these goals receive recognition and rewards.

This creates motivation, healthy competition, and supports a cleaner, more sustainable environment for future generations by lowering fossil fuel use and expanding renewable energy adoption.

1.2 Selection of Process Model

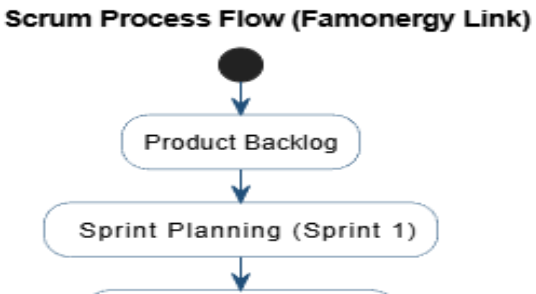
For the **Famonergy Link** project, which involves developing a platform for solar energy production and grid integration**,** Scrum has been selected as the most suitable Agile Process Model. In this section, I will explain the Scrum Process Model, its core components, and why it is the best choice for this project.

Scrum Process Model Explanation

Scrum is based on short, fixed-length iterations called Sprints, which typically last 2 to 4 weeks. Each sprint focuses on delivering **working software**, and at the end of each sprint, stakeholders review the progress, provide feedback, and adjust priorities.

Key Components of the Scrum Model:

1. **Roles in Scrum:**
    - **Product Owner**: Responsible for defining the product backlog (list of features and tasks) and ensuring the development team works on the most valuable features.
    - **Scrum Master**: Ensures the Scrum process is followed, facilitates meetings, and removes any blockers the team faces.
    - **Development Team**: The group of developers who work on building and delivering the features, including front-end and back-end development.
2. **Artifacts in Scrum:**
    - **Product Backlog**: A list of all desired features, enhancements, and bug fixes for the platform, prioritized by the Product Owner.
    - **Sprint Backlog**: A list of tasks to be completed within a specific sprint, selected from the Product Backlog.
    - **Increment**: The potentially shippable product or functionality delivered at the end of each sprint.
3. **Events in Scrum:**
    - **Sprint Planning**: A meeting where the team plans what will be done during the sprint, including selecting items from the Product Backlog to work on.
    - **Daily Scrum**: A short meeting where the team discusses progress, identifies any blockers, and plans for the next 24 hours.
    - **Sprint Review**: A meeting at the end of each sprint where the team presents the increment to stakeholders for feedback.
    - **Sprint Retrospective**: A meeting held after the Sprint Review to reflect on the sprint, identify improvements, and adjust processes for the next sprint.
4. **Process Flow**:
    - Scrum focuses on delivering **incremental progress** in each sprint. The product is delivered in **small, functional pieces** with each sprint focusing on **specific features** (e.g., energy tracking for farmers, loan management for financial institutions).
    - At the end of each sprint, **feedback from stakeholders** is used to adjust and prioritize the Product Backlog for the next sprint.



Scrum Cycle for "Famonergy Link":

1. **Product Backlog**: The project begins with a list of features, functionalities, and tasks that need to be developed. Examples for **Famonergy Link** include features such as:
    - **Farmer Dashboard** (energy production tracking)
    - **Energy Transfer Approval**
    - **Loan Tracking for Farmers**
    - **Government Reports on National Energy Production**

2. **Sprint Planning**: In each sprint, the team selects items from the Product Backlog to work on. These items are added to the **Sprint Backlog**.
3. **Development**: The development team works on implementing the selected features. These features are built incrementally and are tested as they are developed.
4. **Daily Scrums**: The team holds daily meetings to discuss progress, blockers, and tasks for the next 24 hours.
5. **Sprint Review**: At the end of the sprint, the team presents the developed features to stakeholders (farmers, grid operators, government authorities). Feedback is collected to refine the next iteration.
6. **Sprint Retrospective**: The team reflects on the sprint and identifies areas for improvement in processes, team collaboration, or technology.
7. **Repeat**: The cycle continues, with each sprint adding more functionality to the platform and incorporating stakeholder feedback.

Why Did We Choose Scrum for the "Famonergy Link" Project?

1. **Frequent Stakeholder Involvement**:
    - The project involves multiple stakeholders (farmers, government authorities, grid operators, financial institutions) whose feedback is essential. Scrum allows for continuous involvement of stakeholders, ensuring the platform meets their needs.
2. **Flexibility and Adaptability**:
    - The renewable energy sector is evolving, with changing regulations, technologies, and business requirements. Scrum's iterative nature allows for flexibility in adapting to these changes, making it an ideal choice for a project like **Famonergy Link**.
3. **Incremental Delivery**:
    - The **Famonergy Link** platform will be built in phases, with each sprint delivering functional components (e.g., **Farmer Dashboard**, **Loan Management**, **Energy Transfer Monitoring**). This incremental approach helps deliver working software early and regularly, allowing for faster user feedback.
4. **Continuous Improvement**:
    - Scrum emphasizes continuous improvement, which aligns well with the goal of constantly enhancing the **Famonergy Link** platform. With Scrum's **retrospectives**, the development team can identify areas for improvement and refine processes after each sprint.
5. **Risk Management**:
    - Scrum reduces risk by delivering incremental and functional pieces of the software early in the project. Frequent reviews and the ability to adapt after each sprint ensure that the project stays aligned with stakeholder expectations and any changes in requirements.
6. **Collaboration and Transparency**:
    - Scrum encourages collaboration and transparency within the team and with stakeholders. This is especially important in a cross-functional project like **Famonergy Link**, where different teams (developers, testers, business analysts) need to work together effectively.

2. SOFTWARE REQUIREMENTS SPECIFICATIONS (SRS) / PRODUCT REQUIREMENTS DOCUMENT (PRD)

2.1 Scopes and Features

Scope 1: Solar Energy Generation and Management

This scope allows farmers to not only generate solar power but also to manage the power effectively. The platform provides real-time monitoring, allowing farmers to see how much energy their solar panels are generating and how much they are consuming. By comparing these values, farmers can optimize their energy usage, ensuring that they are maximizing the efficiency of their solar panels.

Additionally, the platform enables automatic energy storage management. When the solar panels generate more energy than is needed, the excess is stored in batteries. The platform will manage energy storage based on the farmer's consumption pattern and storage capacity, ensuring that energy is available when required, especially during cloudy or rainy days when solar production is low.

Another feature is the surplus energy transfer: the platform automatically sends the surplus energy to the national grid with the farmer’s approval. This not only contributes to the national renewable energy goal but also provides the farmer with compensation for the energy supplied to the grid.

Scope 2: Real-Time Data Monitoring and Rewards System

The platform offers real-time monitoring of energy generation and consumption, but it also features **performance tracking** in the form of a leaderboard. The leaderboard ranks farmers based on the amount of energy they produce, offering **incentives** for the top producers. This creates a sense of community and healthy competition among farmers to maximize their energy production.

National energy targets will be set periodically to encourage participation. Farmers who meet or exceed these targets will be **recognized** on the platform and may receive rewards such as subsidies, grants, or recognition at national events. This feature promotes sustainability, motivates farmers to adopt solar energy, and supports the growth of renewable energy production in the country.

Scope 3: Data Analytics and Reporting

This new scope would focus on providing farmers and stakeholders with in-depth analysis of energy data:

- **Comprehensive Energy Reports**: Generate detailed monthly, quarterly, and annual reports on energy production, consumption, storage, and grid transfer. These reports can be used for personal record-keeping or government audits, providing insights into energy trends and overall efficiency.
- **Predictive Maintenance**: Using data analytics, the system can predict when maintenance is due on solar panels or energy storage systems. This can be based on usage patterns, system performance, and external conditions like weather, ensuring that equipment is maintained before it fails.
- **Impact Analysis**: Government authorities and stakeholders could access detailed analytics to evaluate the environmental impact of the project, such as the amount of CO2 emissions reduced by the transition to solar energy in farming.
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Scope 4: Financial Planning and Subsidy Integration

In addition to estimating the costs of transitioning to solar energy, here are new features for financial management:

- **Real-Time Loan Tracking**: Farmers can view real-time information about their solar energy loans, including loan repayment status, interest rates, and available subsidies. This feature could also send reminders for due payments or applications for financial assistance.
- **Insurance Integration**: Integrate a feature where farmers can purchase renewable energy-related insurance. This could cover risks like damage to solar panels or energy storage systems, providing financial security for farmers in case of system failures or natural disasters.
- **Financial Education and Tools**: Offer educational content, calculators, and financial planning tools to help farmers better understand the financial implications of switching to solar energy. This could include calculators for return on investment (ROI), payback periods, and savings from reduced electricity costs.
- **Incentive Programs for Adoption**: Integrate national and local government incentive programs that reward farmers for installing solar energy systems. The platform can automatically notify farmers of available subsidies, grants, and tax incentives based on their location and production.

2.2 User Story Table

User Type	Story
Farmer	As a farmer, I want to track my energy production, so I can see how much energy I am generating and determine if I have surplus to send to the grid.

Government Authority	As a government authority, I want to track the energy produced by farms in real-time so that I can make data-driven decisions on national energy policies.
Energy Grid Operator	As an energy grid operator, I want to validate and approve energy transfers from farms to the grid so that energy distribution is properly managed.
Financial Institution	As a financial institution, I want to track how much farmers earn from selling energy so I can manage subsidies and loan repayments effectively.

2.3 Requirements Traceability Matrix

Req ID	Requirement Description	Related Feature(s)	Actor
FR_01	The system shall allow farmers to register using personal details.	Farmer Signup	Farmer
FR_02	The system shall allow government authorities to register with their information.	Government Signup	Government Authority
FR_03	The system shall allow users to log in using role-based authentication.	User Login	All
FR_04	The system shall allow users to reset forgotten passwords securely.	Forgot Password	All
FR_05	The system shall allow users to update profile information.	Profile Update	All
FR_06	The system shall allow users to change their account password.	Change Password	All
FR_07	The system shall display a dashboard with energy production data for farmers.	Farmer Dashboard	Farmer
FR_08	The system shall allow farmers to search for energy data by time (daily/weekly/monthly).	Energy Data Search	Farmer
FR_09	The system shall recommend suitable solar systems based on farm size and location.	Recommended Solar Systems	Farmer
FR_10	The system shall show real-time energy production data on a map for farm monitoring.	Live Energy Tracking	Farmer
FR_11	The system shall calculate and display the estimated energy savings.	Energy Savings Calculation	System
FR_12	The system shall display energy production vs. consumption levels.	Energy Monitoring	Farmer
FR_13	The system shall allow farmers to follow selected energy production reports.	Follow Reports	Farmer

Req ID	Requirement Description	Related Feature(s)	Actor
FR_14	The system shall send notifications for energy production milestones or anomalies.	Push Notifications	System
FR_15	The system shall store and display farmers' energy production history.	Energy History	Farmer
FR_16	The system shall support Bangla and English language switching.	Language Toggle	All
FR_17	The system shall display assigned solar energy production goals for government authorities.	Government Dashboard	Government Authority
FR_18	The system shall allow government authorities to set national energy production targets.	Energy Goal Management	Government Authority
FR_19	The system shall allow government authorities to monitor active energy production data.	Real-Time Monitoring	Government Authority
FR_20	The system shall send periodic updates about energy production to government authorities.	Energy Updates	Government Authority
FR_21	The system shall allow energy data to be manually updated by grid operators.	Grid Data Update	Grid Operator
FR_22	The system shall display energy production data on a map during grid monitoring.	Energy Map	Grid Operator
FR_23	The system shall generate energy production reports including total output and trends.	Energy Report Generation	Grid Operator
FR_24	The system shall allow operators to view all active solar farms on a map.	Fleet Overview	Operator
FR_25	The system shall allow operators to monitor energy production status in real-time.	Energy Status Monitor	Operator
FR_26	The system shall allow operators to manage solar farm routes and energy generation locations.	Route Management	Operator
FR_27	The system shall display analytics related to energy efficiency and anomalies.	Energy Analytics	Operator
FR_28	The system shall allow exporting energy reports in CSV or PDF format.	Report Export	Operator
FR_29	The system shall allow farmers and operators to view energy data in offline mode.	Offline Data Access	System
FR_30	The system shall optimize GPS usage for tracking and reporting purposes.	Adaptive GPS	System
FR_31	The system shall handle GPS or network failures gracefully.	Error Handling	System
FR_32	The system shall restrict system access based on user roles (e.g., Farmer, Grid Operator).	Role-Based Access	System
FR_33	The system shall ensure secure authentication using tokens or sessions.	Secure Authentication	System
FR_34	The system shall provide localized Bangla and English content for users.	Localization	System

2.3.1 Functional Requirements

FARMERS:

• **Login/Logout**

Description: Farmers must be able to log into the system with their credentials (username and password) to access their account and use the platform. They should also be able to log out securely, terminating their session.

• **Monitor Production**

Description: Farmers can view real-time data on the solar power generated by their system. This includes metrics like energy produced in the current day, week, or month. They can also view trends and efficiency to optimize the system's

• **Monitor Consumption**

Description: Farmers can track how much energy their farm is using for various activities such as irrigation, machinery, and lighting. This helps in managing energy consumption and ensuring energy-efficient practices.

• **Manage Storage**

Description: The system allows farmers to monitor the battery storage levels of their solar-powered system. They can view how much energy is stored and manage the use of stored energy during times of low solar generation.

• **Transfer Energy**

Description: Farmers can approve the transfer of surplus energy from their solar systems to the national grid. The system will show the amount of surplus energy available for transfer and request the farmer's approval before sending it to the grid. • **Recalculation Based on Updated Production Data**

Description: If energy production data changes (e.g., due to panel maintenance or weather conditions), the system will recalculate the farmer's available surplus energy. This will trigger a new calculation for how much energy can be sent to the grid.

• **Track Earnings**

Description: Farmers can track the earnings generated from selling surplus energy to the national grid. The system will show detailed records of energy sold, the amount paid, and the balance remaining in their accounts.

• **Weather Alerts**

Description: The system will notify farmers of any weather conditions (like storms, heavy rain, or cloud cover) that could affect solar energy production. These alerts help farmers plan energy management, ensuring they're prepared for sudden weather changes.

Government Authorities:

•**Login/Logout**

Description: Government authorities need to securely log into the system to access data on energy production, grid contributions, and subsidies. They can log out after completing their tasks.

• **View Reports**

Description: Authorities can generate and view comprehensive reports on energy production, consumption, and grid transfers. This includes national energy statistics, trends, and farm-specific performance reports.

• **View Environmental Impact**

Description: Authorities can view the environmental impact of the project, including the total amount of carbon emissions reduced, the number of solar panels installed, and other sustainability metrics.

• **Set Energy Goals**

Description: Government authorities can set national or regional energy production targets for farmers. These targets motivate farmers and guide the policy direction for renewable energy initiatives.

• **Manage Incentives**

Description: Authorities can manage and distribute incentives such as subsidies, tax benefits, or grants to encourage more farmers to adopt solar energy. They can also track the effectiveness of these incentives.

Grid Operators

• **Login/Logout**

Description: Grid operators need to securely log in to the system to access energy transfer and grid monitoring features. They can log out once their tasks are complete.

• **Energy Verification**

Description: Grid operators verify the amount of energy transferred from farms to the national grid. This ensures the data is accurate and that farmers are credited correctly for their contributions.

• **Energy Purchase**

Description: Operators track the total energy purchased from farms and handle the financial transactions involved in paying farmers for the surplus energy supplied to the grid.

• **Monitor Energy Transfer**

Description: Grid operators monitor real-time energy transfers from farms to the grid. They ensure the process runs smoothly and track energy quantities to ensure the national grid is properly balanced.

Financial Institutions

• **Login/Logout**

Description: Financial institutions (banks, microfinance institutions) must log in to securely access farmers' financial records, loan data, and payment details. They can log out after completing their tasks.

• **Track Earnings**

Description: Financial institutions track the income farmers receive from selling energy. They can view detailed data on energy sales and verify earnings to assist with loan repayments or subsidy management.

• **Loan Tracking**

Description: Financial institutions track the status of solar system loans provided to farmers, including repayment schedules, outstanding balances, and disbursement details. They ensure that loan repayments are being made

2.3.2 Non-Functional Requirements

1. Performance Requirements

- The Farmer Dashboard shall display real-time production, consumption, and storage data within **3 seconds**.
- Daily, weekly, and monthly summaries shall load within **5 seconds**.
- Weather alerts shall be delivered within **1 minute** of receiving updates from external services.
- Government and Grid Operator dashboards shall refresh national and live grid data every **10 seconds**.
- Financial dashboards shall generate earnings and loan summaries within **5 seconds**.
- The system shall handle at least **100,000 farmers** and **10,000 institutional users** concurrently.

2. Reliability & Availability

- The system shall be available **24/7** with a minimum uptime of **99.5%**.
- Energy production, transfer, and financial data shall not be lost during failures.
- Automatic backups shall occur every **24 hours**.
- If a module fails (e.g., Reports), other modules (e.g., Farmer Dashboard, Grid Monitoring) shall continue functioning.

3. Security

- All users (Farmers, Authorities, Grid Operators, Financial Institutions) must log in using secure authentication.
- Role-based access control shall restrict features:
    - Farmers: production, consumption, storage, transfer approval
    - Government: reports, goals, incentives
    - Grid Operators: verification, monitoring, purchases
    - Financial Institutions: earnings and loans
- All financial and energy data shall be encrypted.
- Every energy transfer, approval, payment, and goal update shall be logged for audit.

4. Usability

- The system shall be simple enough for farmers with minimal technical knowledge.
- Each dashboard shall present key information in a single screen:
    - Farmer: production, consumption, storage, weather alerts
    - Government: national summary, targets, alerts
    - Grid Operator: live grid flow, incoming energy
    - Financial: earnings and loan overview
- No critical task (e.g., transfer approval, report generation) shall require more than **3 user actions**.
- The platform shall support both **English and Bangla**.

5. Scalability

- The system shall scale to support nationwide adoption without redesign.
- It shall allow the future addition of:
    - AI-based energy forecasting
    - Advanced weather analytics
    - New financial partners and banks
    - More IoT devices per farm

6. Maintainability

- Each module (Farmer, Government, Grid, Financial) shall be independently maintainable.
- Updates to one module shall not disrupt others.
- Bug fixes and upgrades shall be deployable without system downtime.

7. Portability

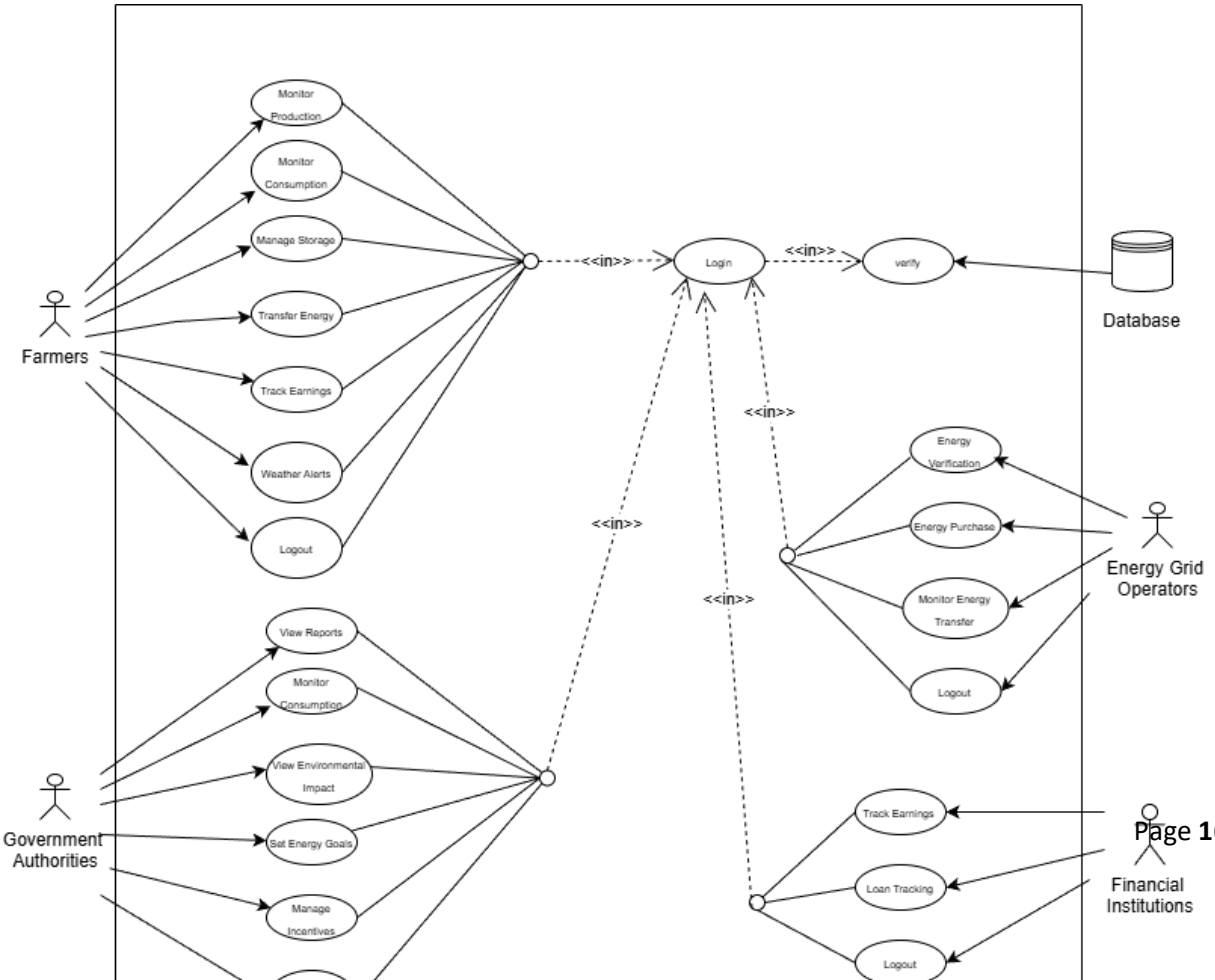
- The system shall run on all modern web browsers.
- The Farmer module shall be optimized for mobile devices.
- The backend shall be cloud-deployable for nationwide access.

8. Data Integrity & Consistency

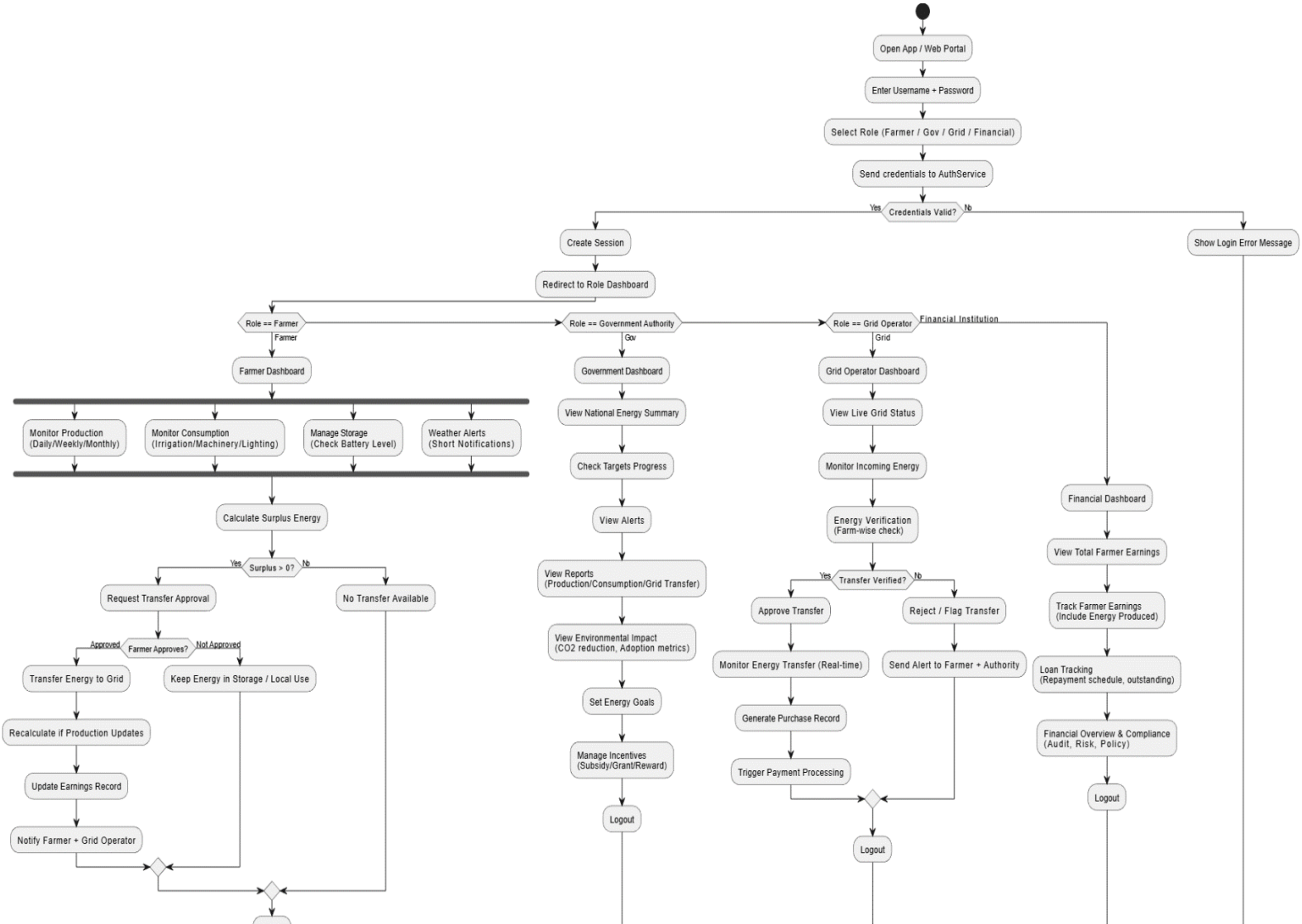
- Any change in production data shall automatically:
    - Update surplus energy
    - Trigger recalculation notices
    - Update earnings and reports
- Data shown across dashboards (Farmer, Government, Grid, Financial) shall remain consistent.
- Duplicate or conflicting energy records shall be prevented.

3. SOFTWARE DESIGN

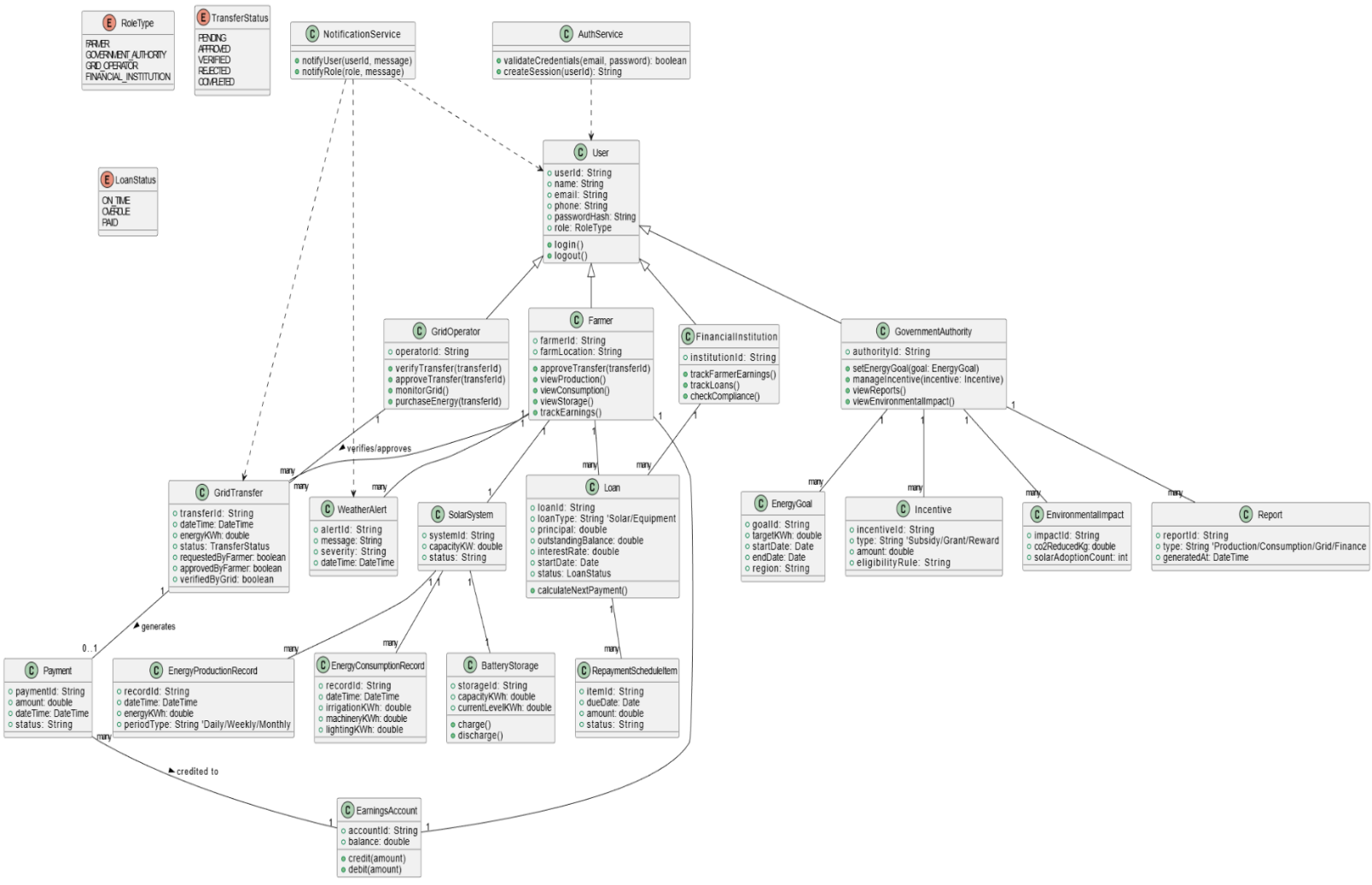
USE CASE:



Activity Diagram



Class Diagram

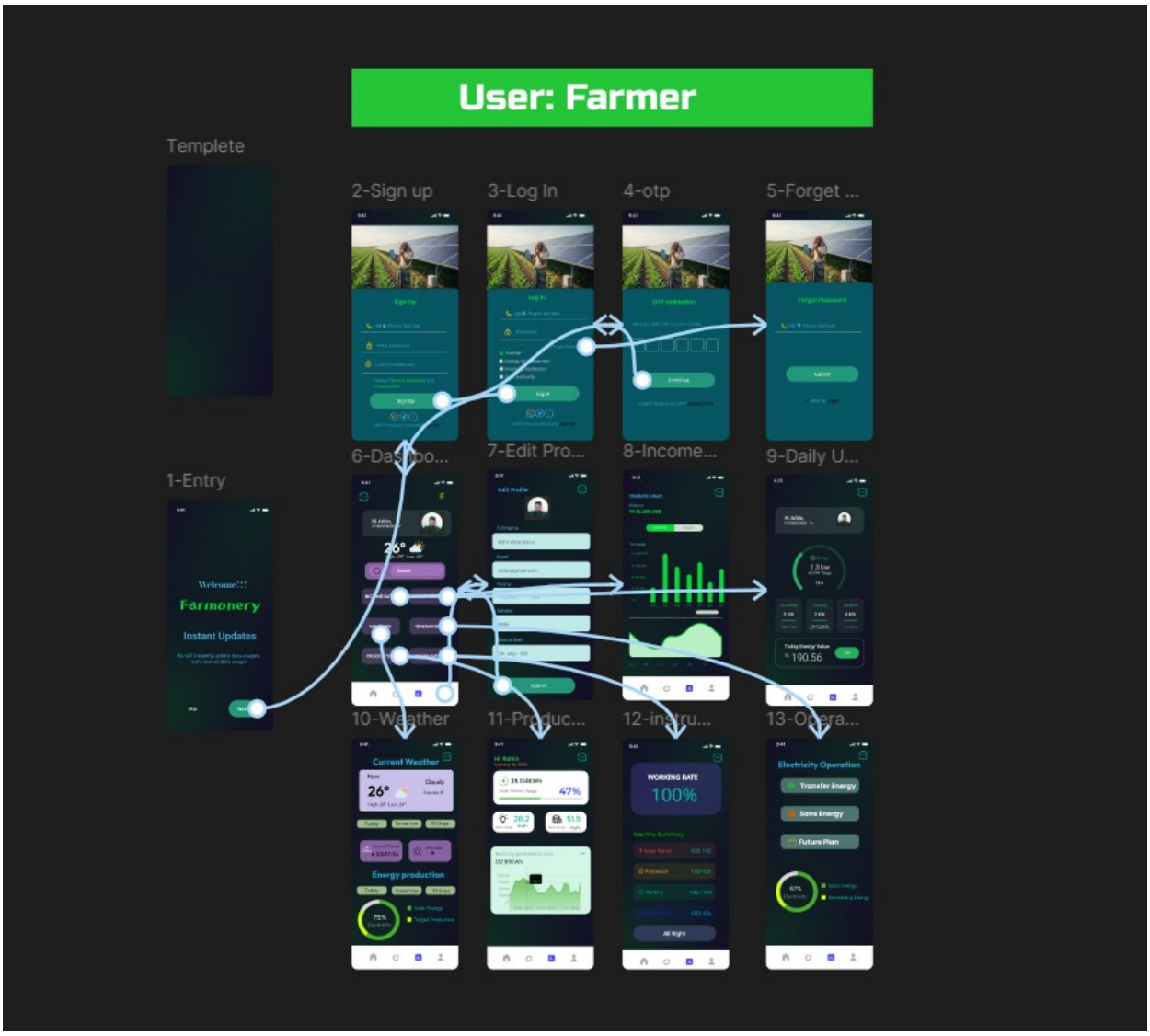


3.2 UI / Wireframe Design using Figma

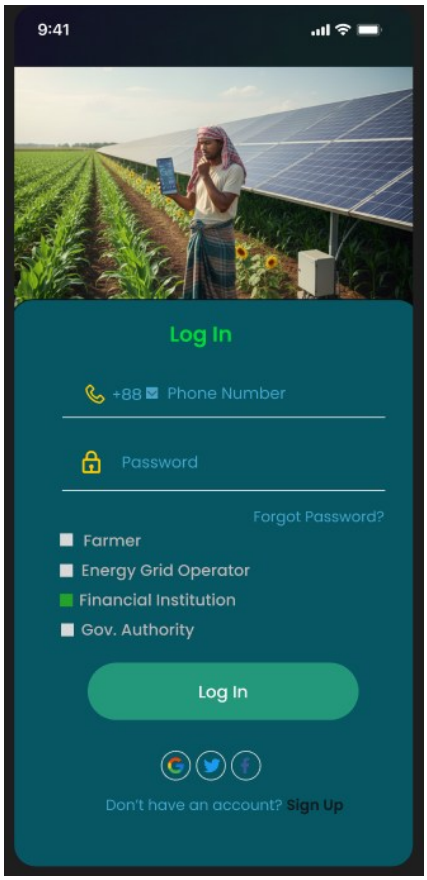
FARMAR

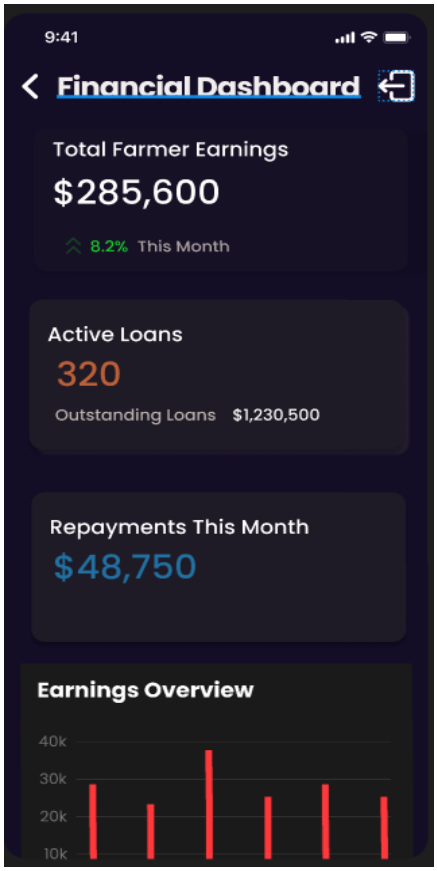

User: Farmer
Templete
2-Sign up
3-Log In
4-otp
5-Forge...
1-Entry
6-Dash...
7-Edit P...
8-Incom...
9-Daily ...
10-Wea...
11-Prod...
12-instr...
13-Elect...
Welcome!!
Farmonery
Instant Updates
26°
Current Weather
Energy production
WORKING RATE
100%
Electricity Operation

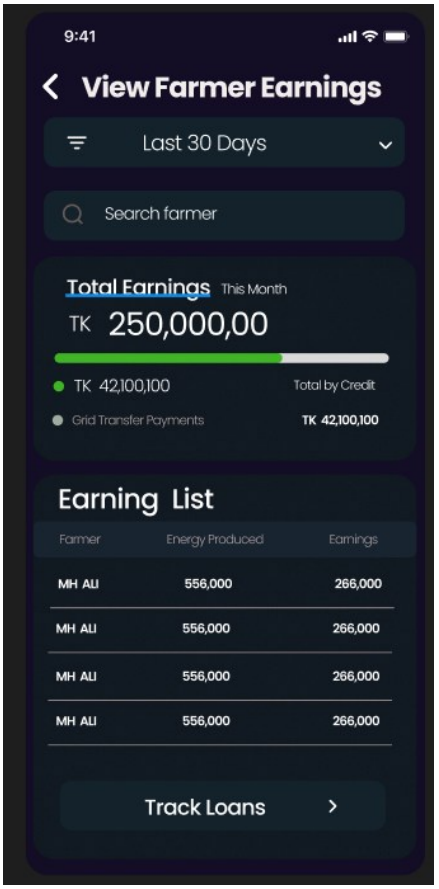
Farmar App Interaction

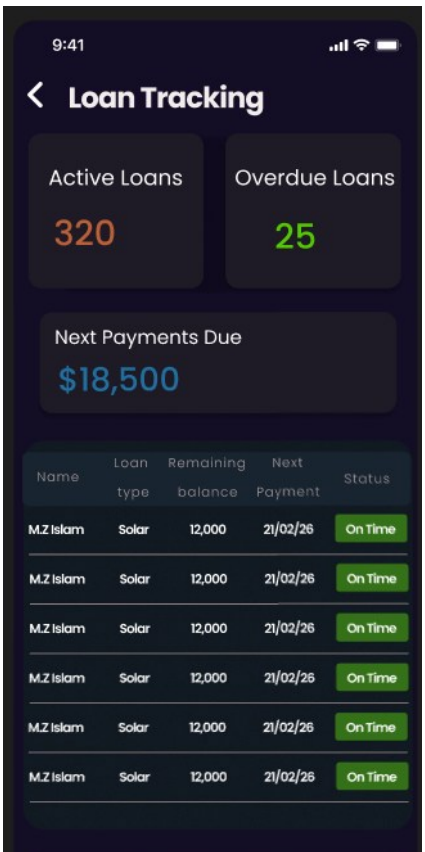


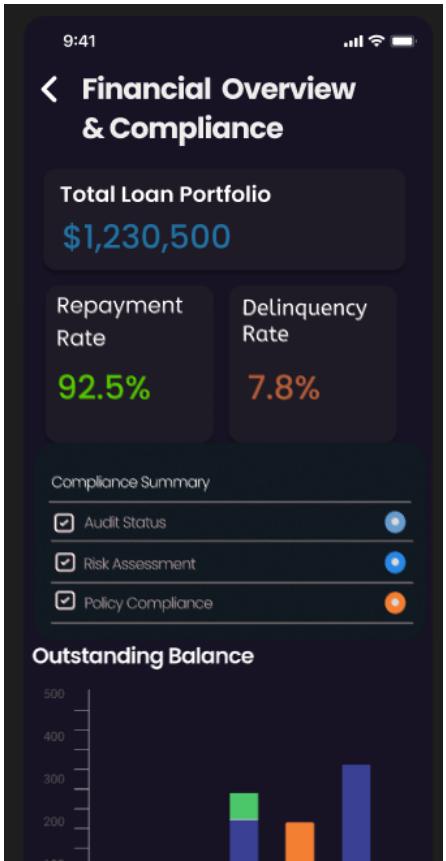
Financial Institutions

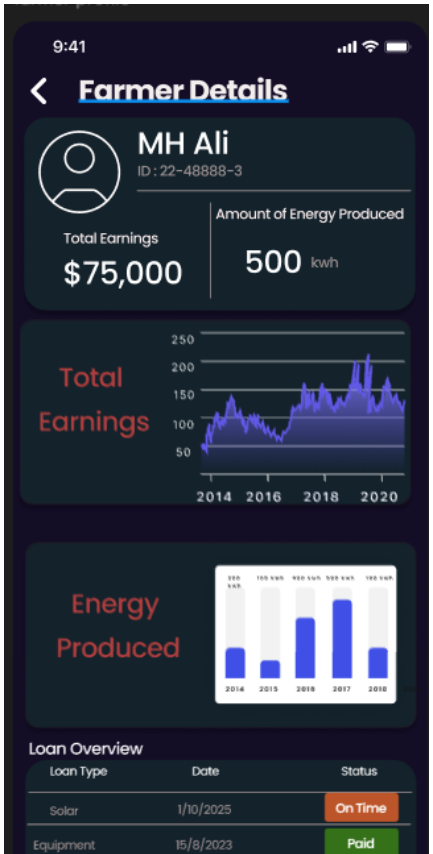












Interaction Flow

4. GIT WORKFLOW

- Create a central repository for the project on GitHub and set the master (or main) branch as the primary branch for integration.
- Each member should clone the repository and create their own feature branches for assigned tasks. Work on new features or fixes within these branches.
- Add files, stage them and commit changes with clear messages that describe the purpose of each update.
- Push commits from the feature branches to the remote repository so other members can see progress.
- Use pull to fetch and integrate changes from the remote repository into local copies, ensuring everyone stays updated.
- Merge feature branches into the master/main branch only after the work is tested and reviewed, resolving any conflicts that occur.
- Show evidence of collaboration by maintaining a clear commit history (using logs) with multiple commits, merges and contributions from all group members.
- Keep the repository organized with a clean history that tracks the project workflow from initialization to completion.

5. SOFTWARE TESTING

5.1 Functional Testing

Functional testing ensures that the system behaves according to the specified requirements. The following key modules were tested for functionality:

- **Farmer Module**:
  - **Login/Logout**: Verify that farmers can securely log in and log out of their accounts using the credentials.
  - **Monitor Production**: Test that farmers can view real-time data on solar power generation, track energy efficiency, and trends (daily, weekly, monthly).
  - **Monitor Consumption**: Ensure that farmers can accurately track energy usage for irrigation, machinery, and lighting.
  - **Energy Transfer**: Test that farmers can approve surplus energy transfer to the grid and receive notifications if recalculations are required.
- **Government Authority Module**:
  - **Login/Logout**: Verify that government authorities can access the platform securely.
  - **View Reports**: Ensure that government authorities can generate and view energy production, consumption, and grid transfer reports.
  - **Set National Energy Goals**: Test that authorities can set energy goals and track the progress of these goals.
- **Grid Operator Module**:
  - **Energy Verification**: Ensure that grid operators can verify energy supplied by farmers.
  - **Energy Transfer Monitoring**: Test real-time monitoring of energy transfers from farms to the national grid.
  - **Energy Purchase & Payment Processing**: Verify that grid operators can manage energy purchases and handle payment processing for farmers.
- **Financial Institution Module**:
  - **Track Farmer Earnings**: Test if financial institutions can view detailed earnings of farmers from energy production and track loan repayments.
  - **Loan Tracking**: Ensure financial institutions can monitor loan repayment statuses and outstanding balances.

5.2 Non-Functional Testing

Non-functional testing focuses on how the system performs under various conditions, including security, usability, and scalability.

- **Usability Testing**:
  - Test the ease of use of the platform, ensuring that users can navigate through the dashboards without confusion.
  - Verify that the platform's layout is responsive and works well on mobile devices and desktops.
- **Performance Testing**:

    - **Load Testing**: Test the platform's ability to handle multiple users (farmers, grid operators, etc.) simultaneously without degradation in performance.
    - **Stress Testing**: Push the system to its limits (e.g., simulating a high number of simultaneous transactions) to see if the platform can recover gracefully.
    - **Scalability Testing**: Ensure the system can scale up as more farmers and users join the platform.
- **Security Testing**:
    - **Authentication & Authorization**: Ensure that each user role has the correct access permissions, and no unauthorized access is allowed.
    - **Data Protection**: Test encryption methods to protect user data and financial transactions, ensuring compliance with data privacy regulations.
    - **Vulnerability Testing**: Run vulnerability scans to detect and fix potential security holes (e.g., SQL injection, cross-site scripting).

5.3 Integration Testing

Integration testing ensures that the different modules of the platform work together seamlessly. Specific tests include:

- **Farmer Data Integration**: Ensure that the data entered by farmers, such as energy production, consumption, and earnings, integrates correctly with the financial and reporting modules.
- **Grid and Energy Data Integration**: Verify that grid operators can view energy data in real-time and that energy transfers from farms to the national grid are tracked properly.
- **Loan and Payment Integration**: Ensure that financial institutions can view and process loan payments correctly based on the earnings data from the platform.

5.4 System Testing

System testing verifies that the integrated system performs as expected. Tests include:

- **End-to-End Functionality**: Ensure that all workflows, from energy production to loan payments, are seamless from a user's perspective.
- **Data Accuracy**: Verify that energy production and consumption data, as well as loan repayment statuses, are accurately tracked and updated in real-time.
- **User Interface Testing**: Test the user interface to ensure that all elements (buttons, graphs, tables) function as expected and display accurate data.

5.5 Regression Testing

Regression testing ensures that updates or new changes to the platform do not negatively affect existing functionalities. The following areas are specifically tested during regression:

- **Farmer Module Regression**: Verify that any changes to the Farmer Module, such as new features (e.g., energy transfer approval, energy monitoring), do not disrupt core functionality like monitoring energy production, tracking consumption, or approving energy transfer to the grid.

- **Government Authority Module Regression**: Ensure that any new changes or updates, such as the addition of national energy goals or report generation enhancements, do not break existing features like viewing energy production data or setting goals for farmers.
- **Grid Operator Module Regression**: Test that updates to the grid operator functionality, such as the introduction of new real-time monitoring features or approval processes for energy transfers, do not interfere with previously functioning features like energy verification and purchase tracking.
- **Financial Institution Module Regression**: Ensure that modifications to the loan tracking, earnings calculation, or payment processing features do not affect the platform's ability to track farmer earnings, manage loans, or process payments accurately.
- **Cross-Module Regression**: Verify that changes to one module (e.g., Financial Institution) do not negatively affect related modules (e.g., Farmer or Grid Operator modules) by ensuring seamless data flow between energy production, loan processing, and financial reporting.

Test Cases:

Farmer

TEST CASE 01

Project Name: Farmonergy			Test Designed by: Rahin Ibne Harun	
Test Case ID: TF_01			Test Designed date: 01/12/2025	
Test Priority (Low, Medium, High): High			Test Executed by: Nahid	
Module Name: **Farmer Login**			Test Execution date: 01/01/2026	
Test Title: Verify farmer login with valid credentials				
Description: Check if farmers can log in using valid username and password				
Precondition: Farmer is registered				
Dependencies: Authentication server				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
1.Open login page 2. Enter credentials 3.Click Ok	farmer01 / 12345	1.Login page opens 2.Dashboard loads	As expected	Pass

TEST CASE 02

Project Name: Farmonergy	Test Designed by: Rahin Ibne Harun
Test Case ID: TF_02	Test Designed date: 01/12/2025
Test Priority (Low, Medium, High): High	Test Executed by: Nahid
Module Name**: Monitor Production**	Test Execution date: 01/01/2026
Test Title: Verify real-time solar production data	

Description: Farmers can view current day, week, and month solar energy production				
Precondition: Farmer is logged in and system is connected to solar panel sensors				
Dependences: Solar panel monitoring API				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
1. Open Production tab 2. Select time frame	Today / This Week / This Month	Energy data displayed for selected time frame	As expected	Pass

TEST CASE 03

Project Name: Farmonergy			Test Designed by: Rahin Ibne Harun	
Test Case ID: TF_03			Test Designed date: 01/12/2025	
Test Priority (Low, Medium, High): Medium			Test Executed by: Nahid	
Module Name: **Manage Storage**			Test Execution date: 01/01/2026	
Test Title: Check battery storage levels display				
Description: Ensure farmers can view current battery storage and manage usage				
Precondition: Farmer logged in, battery connected				
Dependences: Battery monitoring module				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
1.Open app 2. Tap on Storage tab	Battery data	Battery level shown, energy usage options available	As expected	Pass

TEST CASE 04

Project Name: Farmonergy	Test Designed by: Rahin Ibne Harun
Test Case ID: TF_04	Test Designed date: 01/12/2025
Test Priority (Low, Medium, High): High	Test Executed by: Nahid
Module Name**: Transfer Energy**	Test Execution date: 01/01/2026
Test Title: Approve transfer of surplus energy	

Description: Verify farmer can approve surplus energy transfer to the national grid				
Precondition: Farmer logged in, surplus energy available				
Dependences: Grid API				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
. Open Transfer App 2. Check surplus 3. Click Approve	Surplus: 50 kWh	Surplus energy transferred to grid	As expected	Pass

TEST CASE 05

Project Name: Farmonergy			Test Designed by: Rahin Ibne Harun	
Test Case ID: TF_05			Test Designed date: 01/12/2025	
Test Priority (Low, Medium, High): Medium			Test Executed by: Nahid	
Module Name: **Weather Alerts**			Test Execution date: 01/01/2026	
Test Title: Receive weather notifications affecting solar production				
Description: System alerts farmer of storms, heavy rain, or cloud cover				
Precondition: Farmer logged in, surplus energy available				
Dependences: Grid API				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
. Open Transfer App 2. Check surplus 3. Click Approve	Surplus: 50 kWh	Surplus energy transferred to grid	As expected	Pass

TEST CASE 06

Project Name: Farmonergy	Test Designed by: Rahin Ibne Harun
Test Case ID: TF_06	Test Designed date: 01/12/2025
Test Priority (Low, Medium, High): Medium	Test Executed by: Nahid
Module Name: **Track Earnings (Farmers)**	Test Execution date: 01/01/2026
Test Title: Verify earnings from surplus energy sale	
Description: Check that farmers can see detailed energy sales and payments	Check that farmers can see detailed energy sales and payments

Precondition: Farmer logged in, surplus energy available				
Dependence: Payment system				
Test Steps	Test Data	Expected Results	Actual Results	Status (Pass/Fail)
. Open Earnings tab tab app , the go to the feature	All money transection	Sales and payment details displayed	As expected	Pass

Financial Institutions

Test Case 1: Verify Total Farmer Earnings Display

Project Name	**Farmonergy**	**Test Designed by**		**Nahid**
Test Case ID	FI_01	**Test Designed Date**		01/12/2026
Test Priority	High	**Test Executed by**		John Doe
Module Name	Financial Dashboard	**Test Execution Date**		05/01/2026
Test Title	Verify total farmer earnings display	**Description**		Ensure the total farmer earnings value is correctly displayed.
Precondition	User is logged into Financial Dashboard	**Dependencies**		Data from the financial records and database
Test Steps	**Test Data**	**Expected Results**	**Actual Results**	**Status (Pass/Fail)**
1. Open Financial Dashboard	-	The dashboard opens with total earnings displayed at the top.	The dashboard loaded successfully with total earnings displayed.	Pass
2. Verify Total Earnings field	$285,600	The total earnings should show the correct value of $285,600.	Correct earnings value displayed.	Pass

Test Case 2: Verify Loan Summary Display

Project Name	Farmonergy	Test Designed by		Nahid
Test Case ID	FI_02	**Test Designed Date**		01/12/2026
Test Priority	Medium	**Test Executed by**		John Doe
Module Name	Financial Dashboard	**Test Execution Date**		05/01/2026
Test Title	Verify loan summary details	**Description**		Check if the loan summary (Active Loans, Outstanding Amount) is displayed correctly.
Precondition	User is logged into Financial Dashboard with loan data available	**Dependencies**		Loan records in the database
Test Steps	**Test Data**	**Expected Results**	**Actual Results**	**Status (Pass/Fail)**
1. Open Financial Dashboard	-	Dashboard loads correctly with loan data.	Loaded successfully, showing loan data.	Pass
2. Check for Active Loans section	320 active loans	Active loans field shows the correct number of active loans (320).	Correct number of active loans displayed.	Pass
3. Check Outstanding Loans amount	$1,230,500	Outstanding loan amount (e.g., $1,230,500) displays correctly.	Correct outstanding loan value displayed.	Pass

Test Case 3: Track Farmer Earnings

Project Name	Farmonergy	Test Designed by	Nahid
Test Case ID	FI_03	**Test Designed Date**	01/12/2026
Test Priority	High	**Test Executed by**	John Doe
Module Name	Track Farmer Earnings	**Test Execution Date**	06/01/2026
Test Title	Verify tracking of farmer earnings	**Description**	Ensure the earnings of farmers from energy production are accurately tracked.

Project Name	Farmonergy	Test Designed by	Nahid	
Precondition	Farmer data available in the system	**Dependencies**	Energy data from farmer account	
Test Steps	**Test Data**	**Expected Results**	**Actual Results**	**Status (Pass/Fail)**
1. Open "Track Farmer Earnings" section	-	Earnings tab opens.	Earnings tab loaded successfully.	Pass
2. Select a farmer	MD Ziaul Islam	Farmer's earnings should be displayed correctly (e.g., $75,200).	Earnings displayed as $75,200.	Pass
3. Verify amount of energy produced	500 kWh	Total earnings for the farmer should match the energy production value (e.g., 500 kWh).	Energy production matches earnings.	Pass

Test Case 4: Loan Tracking

Project Name	Farmonergy	Test Designed by	Nahid	
Test Case ID	FI_04	**Test Designed Date**	01/12/2026	
Test Priority	High	**Test Executed by**	John Doe	
Module Name	Loan Tracking	**Test Execution Date**	06/01/2026	
Test Title	Verify loan tracking and repayment details	**Description**	Ensure that the loan status (remaining balance, next payment, etc.) is tracked and updated.	
Precondition	Loan data for farmers is available in the system	**Dependencies**	Loan API and payment system	
Test Steps	**Test Data**	**Expected Results**	**Actual Results**	**Status (Pass/Fail)**
1. Open "Loan Tracking" page	-	Loan tracking page opens with details on active loans.	Loaded successfully with loan details.	Pass
2. Select a loan entry	MD Ziaul Islam loan	Loan details appear with status (e.g., On Time).	Loan entry selected successfully.	Pass
3. Check next payment date and amount	$18,500 due on 15/04/2026	Next payment field shows the correct amount and due date.	Correct payment details shown.	Pass

Test Case 5: Verify Repayment Schedule

Project Name	Farmonergy	Test Designed by	Nahid	
Test Case ID	FI_05	**Test Designed Date**	01/12/2026	
Test Priority	High	**Test Executed by**	John Doe	
Module Name	Financial Overview & Compliance	**Test Execution Date**	07/01/2026	
Test Title	Verify repayment schedule	**Description**	Verify the schedule for loan repayments, including amounts and dates.	
Precondition	Loan records exist	**Dependencies**	Repayment system	
Test Steps	**Test Data**	**Expected Results**	**Actual Results**	**Status (Pass/Fail)**
1. Open "Repayment Schedule" section	-	Repayment schedule opens with upcoming due payments.	Repayment schedule opened successfully.	Pass
2. Check due dates and amounts	$8,500 due on 15/04/2026	Next payment date and amount are displayed accurately.	Correct payment due details shown.	Pass

6. CONCLUSION

The **Famonergy Link** project successfully addresses the challenges faced by farmers in managing energy production through solar power and integrating surplus energy into the national grid. By leveraging renewable energy, the platform not only contributes to environmental sustainability but also enhances the financial stability of farmers by enabling them to sell surplus energy. With functionalities like real-time energy monitoring, loan management, and performance tracking, the platform offers an all-in-one solution that benefits farmers, government authorities, grid operators, and financial institutions.

Throughout the project, the **Agile Scrum framework** was utilized, allowing for flexibility and constant feedback from stakeholders, ensuring the platform evolves in line with their needs. This approach has ensured that the product is delivered incrementally, providing opportunities for continuous improvement based on real-world testing and stakeholder input.

By implementing features such as **energy transfer approval**, **real-time energy monitoring**, and **financial tracking**, **Famonergy Link** not only empowers farmers but also encourages competition and collaboration within the energy sector. The platform is designed to scale, ensuring that it can support a growing number of users and future technological advancements.

In conclusion, the **Famonergy Link** project stands as a promising solution for integrating solar energy into farming while supporting the nation's renewable energy goals and providing financial opportunities for rural communities.

Instructions:

- Minimum of 3 members and Maximum of 5 members per group.
- Font: Times New Roman ; Size: 12; Justify the para [Ctrl + J].
- Delete the highlighted part after completing this project report.
- The completed report should be within the range of 40 to 50 pages.

- **Submission:** Bring a hard copy of this report [per group] on the project evaluation day. Also, you will need to upload the soft copy later.