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Software Requirement Specification [SRS] Document On

A Centralized Digital Solution for Farm Solar Energy Production and Grid Integration

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1. INTRODUCTION

1.1 PROJECT PROPOSAL

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 TARGET GROUP OF USERS:

Farmers (Primary Users):

Farmers are the main users of Famonery Link. They can monitor electricity production, consumption, and storage, approve the transfer of surplus electricity to the national grid, and view the income earned from selling extra electricity. Farmers can also track their performance on a daily, weekly, or monthly basis, check their ranking on the leaderboard, and review energy targets. The system provides guidance for installation, maintenance, and all necessary

paperwork, making it easier for farmers to adopt and manage the platform. **Government Authorities:**

Government authorities use a centralized dashboard to monitor nationwide energy production from participating farms, track energy distribution and contributions to the national grid, and approve or manage subsidies, grants, or other incentives. They can announce national energy targets for farmers, identify areas with high or low production, and make policy decisions using the real-time data provided by the system.

Energy Grid Operators:

Grid operators handle the connection between farms and the national power grid. They verify the energy supplied by farmers, approve surplus electricity transfers, track total input from solar farms, and generate energy purchase records for payments. **Financial Institutions:**

Banks or microfinance institutions supporting farmers can provide information on loans, subsidies, or financing options. They can also track repayments for solar system loans and coordinate with farmers through the system for financial matters. They can also track how much farmers earn and send money.

2. SCOPES & FEATURES

2.1 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.

2.2 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.

2.3 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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2.4 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.

3. USE CASE DIAGRAM

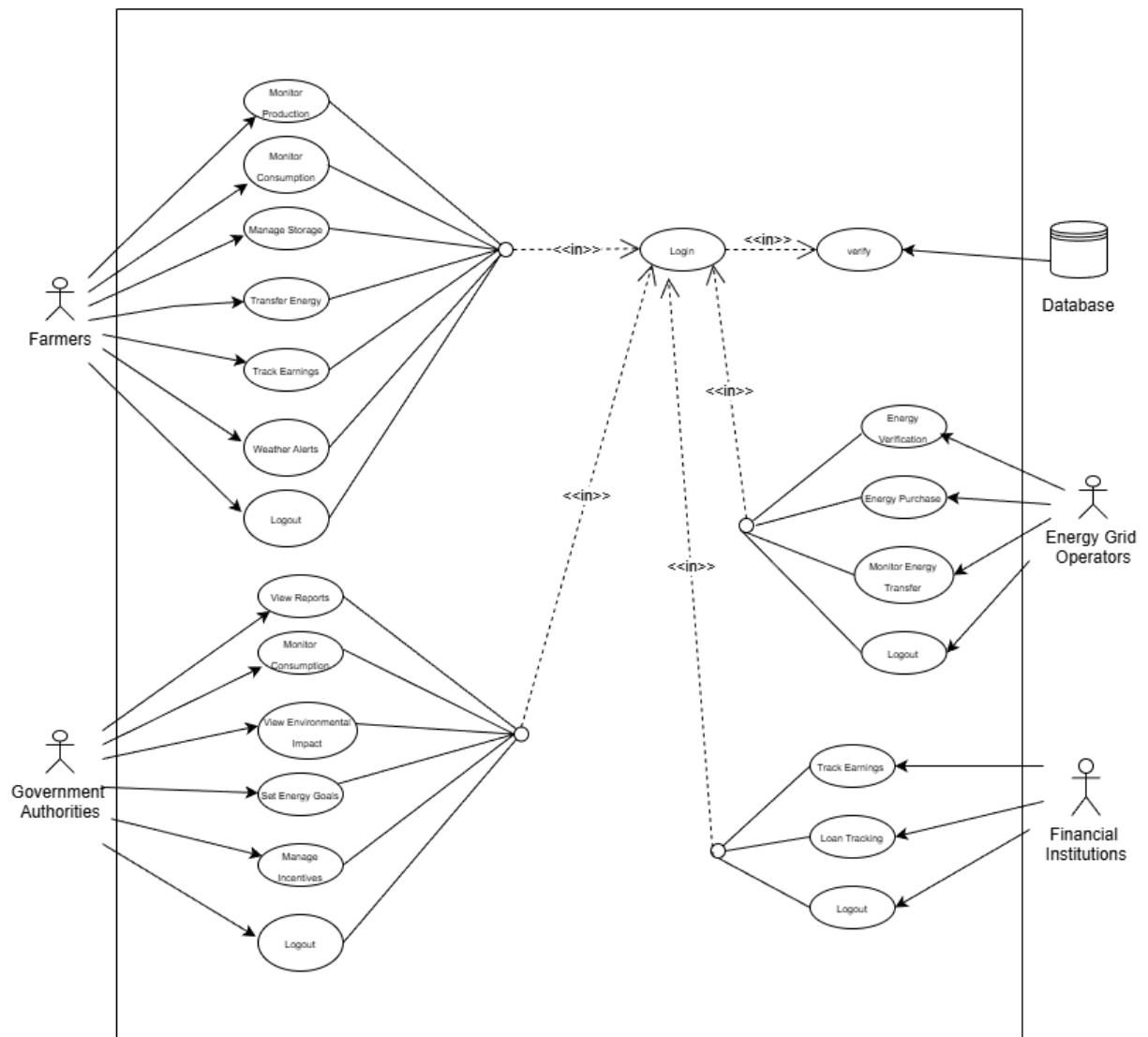


Fig: Use case diagram of Farmonergy Link

4. 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.

5.REQUIREMENT TRACEABILITY MATRIX

5.1 Functional Requirements

5.1.1 FARMERS

- Login**

Farmers must be able to log into the system using their valid credentials (username and password). Successful login will allow them to securely access their personal account and use all available features of the platform.

- Logout**

Farmers must be able to log out of the system securely at any time. Logging out will terminate the active session and prevent unauthorized access to their account.

- 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.

5.1.2 Government Authorities

- **Login**

Government authorities need to securely log into the system using their authorized credentials to access information related to energy production, grid contributions, and subsidies.

- **Logout**

Government authorities must be able to log out of the system after completing their tasks, ensuring that their session is securely terminated and data remains protected.

- **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.

5.1.3 Grid Operators

- **Login**

Grid operators need to securely log in to the system using their authorized credentials in order to access energy transfer functions and grid monitoring features.

- **Logout**

Grid operators must be able to log out of the system once their tasks are complete, ensuring that the active session is securely terminated.

- **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.

5.1.4 Financial Institutions

- **Login**

Financial institutions (such as banks and microfinance institutions) must securely log in to the system using authorized credentials to access farmers' financial records, loan information, and payment details.

- **Logout**

Financial institutions must be able to log out of the system after completing their tasks, ensuring secure termination of their session.

- **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

5.2 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 be loaded 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 will be available **24/7** with a minimum up time 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) requires more than **3 user actions**.
- The platform shall support both **English and Bangla**.

5. Scalability

- The system shall be scaled to support nationwide adoption without redesigning.
- 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 should run on all modern web browsers.
- The Farmer module should 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.

