



Advanced Solar Pump with Maximizing Efficiency and Performance

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Elevator Pitch & Problem Statement

The number of farmers who use solar pumps is almost negligible due to their ineffectiveness and the difficulty of dealing with them in agricultural areas. Imagine a solar-powered pump system that revolutionizes agriculture, empowering farmers with precise control and real-time insights. Our innovative solution combines the reliability of solar energy with advanced data acquisition technology, creating a game-changer for the farming industry.

Objectives

- 1. Integrated Energy Storage System:** Allows surplus energy generated during peak sunlight hours to be efficiently stored, ensuring uninterrupted operation during low sunlight or at night.
- 2. Seamless Integration with Data Acquisition (DAQ) System:** Integration with a DAQ system enhances intelligence and functionality, enabling real-time data collection, analysis, and precise control for optimization.
- 3. Comprehensive Monitoring & Control System:** Enables real-time tracking of performance and energy consumption, empowering users to make informed decisions and troubleshoot issues promptly, ensuring peak efficiency throughout the system's lifecycle.

Constraints

- 1. Technological Limitations:** Solar panel and battery efficiency constrained by current technology, limiting improvements in system performance.
- 2. Budgetary Constraints:** Project must operate within specific financial limitations, balancing high efficiency with available budget.
- 3. Regulatory Compliance:** System design and operation must adhere to government regulations, obtaining necessary approvals or certifications.
- 4. Material Selection:** High corrosion resistance materials may be necessary, posing constraints on options and increasing costs.
- 5. Environmental Conditions:** Weather patterns, cloud cover, and shading affect solar panel efficiency, requiring design considerations for reliable operation.
- 6. Time:** Project completion within a given timeframe necessitates efficient management and coordination.

Prototype Design

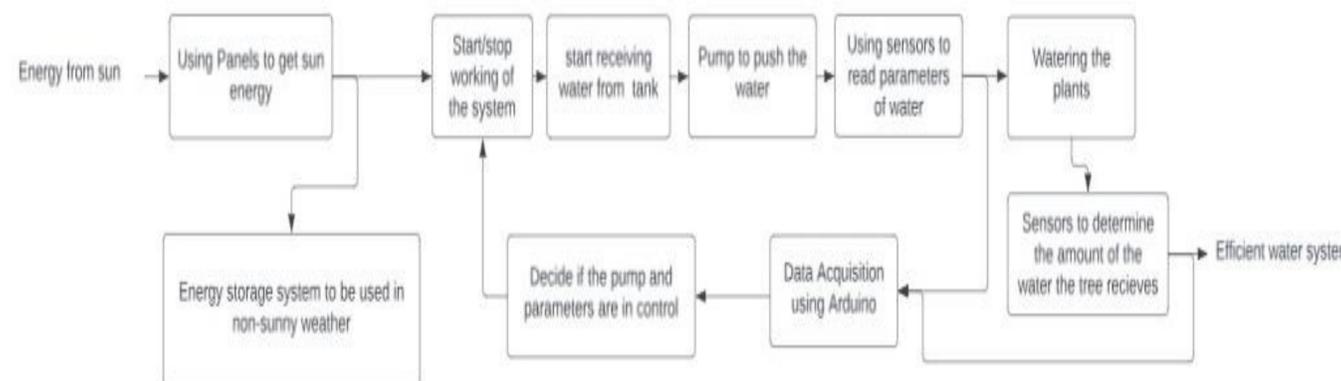
The prototype consists of a solar-powered pump system integrated with an energy storage system based on batteries for night operation and an Arduino based data acquisition, monitoring and control system.

The main components include:

- Solar panels: Mono/Poly-crystalline solar panels to harness solar energy.
- Pump: Efficient water pump capable of operating on variable solar power.
- Energy storage system: Lithium-ion batteries with appropriate capacity for storing excess solar energy.
- Data acquisition, monitoring, and control system: Arduino microcontroller connected to sensors for monitoring various parameters like solar irradiance, battery voltage, pump status, etc.



Concept Design for The Prototype



Block Diagram for The Prototype

Target Specifications

1. Pump Specifications:

- Size: 1x1 inches
- Horsepower: 0.15 HP
- Flowrate: 25 L/min
- Pressure Head: 20 m

2. Energy Storage System Specifications:

- Individual Solar Panel Power: 200 W
- Solar Panels Quantity: 2 Pieces
- Solar Panel Dimensions: 1490 x 710 x 35 mm
- Battery Capacity: 100 Ah
- Battery Voltage: 12V
- Charge Controller Ratings: 12V, 30A

Target & Validations

- 1. Battery Capacity:** 12V * 100Ah = 1200Wh
- 2. Charging Requirements:** Considering a 20% loss, total energy needed = 1440Wh
- 3. Solar Pump Power Consumption:** 150W
- 4. Daily Operation:** Approx. 8 hours, consuming 1200Wh
- 5. Solar Panel Output:** Two panels combined at 400W
- 6. Daily Solar Energy Production:** Assuming 5 hours of effective sunlight = 2000Wh

This setup ensures that the solar pump is powered during the day and for approximately 4 hours at night, promoting efficient and sustainable energy use.

Project Impact

1. Economic Impact:

Cost Savings & Job Creation: Solar pumps save money by eliminating fuel costs and create local jobs, especially in rural areas.

2. Societal Impact:

Improved Water Access & Health: Reliable water supply improves health and sanitation, benefiting communities.

3. Environmental Impact:

Carbon Footprint Reduction & Sustainable Water Management: Solar pumps reduce emissions and conserve water resources, promoting environmental sustainability.

Conclusion

The project successfully developed an advanced solar-powered pump system that enhances energy efficiency and ensures reliable operation in remote areas. By integrating innovative energy storage and monitoring technologies, continuous operation and high performance were achieved, supporting sustainable water management and energy use. This system sets a new standard for renewable energy applications in fluid distribution.