OPTIMIZING THE USE OF SOLAR ENERGY IN THE OPERATION OF INTELLIGENT WATER PUMPS FOR AGRICULTURE

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Abstract

Technological progress is very rapid in the field of new and renewable energy. One of the renewable energy sources whose implementation and diversification has been very much is the Solar Power Plant (PLTS). There are many benefits of PLTS in various sectors, one of which is in agriculture. Nabil Aziz View Farm is a farm located in Cimanggu whose plant care is still conventional. One of the problems that exist on this farm is the provision of irrigation for the purposes of watering plants that require a lot of labor or high electricity costs.

In the process of designing the system using the RAD (Rapid Application Development) method. The results obtained by making a prototype of a water pump using solar panels by utilizing solar energy for the purposes of watering plants on the Nabil Aziz View Farm can already be implemented and tested by the farm manager.

Keywords: Solar Power Plant, Agriculture, RAD Method.

Introduction

At this time technology is increasingly sophisticated given that the times have developed rapidly. Many technological factors have affected society and the surrounding environment with the passage of time and other things that can help social activities. Very rapid technological advances in the field of new and renewable energy are expected to improve the welfare of mankind. One of the renewable energy sources whose implementation and diversification have been very much is the Solar Power Plant (PLTS). (Hermanu et al., 2019). This technology is often used by the community to achieve practical goals.

Solar energy is a renewable and environmentally friendly energy that can be utilized in various fields, solar energy is an active element that converts sunlight into electrical energy. Solar energy is widely used in various fields, one of which is in agriculture. To increase the production of the agricultural sector can be done by utilizing smart and efficient technology, for example solar energy-based technology.

In agriculture, water is used to irrigate agricultural land because if plants lack water or the irrigation is not good, agricultural yields cannot be maximized. So the availability of water is an important component in agriculture.

Nabil Aziz View Farm is an agricultural sector with a large area of land available and the land is potentially dry because it is planted with fruit trees which are higher in elevation than ordinary rice fields. Therefore, this farm requires sufficient water for the needs of existing plants. However, Nabil Aziz View Farm for the process of providing water for irrigation still uses conventional methods that are not efficient because at certain times the water is not well controlled by the guard so that in this process the Nabil Aziz View Farm is very wasteful in spending money on electricity bills because the electricity consumption for water collection is very high and the price of electricity is now quite expensive. For sufficient irrigation, it requires a lot of energy and regular checking of the toren so that the water stored is always available and sufficient to water the plants. With this intelligent solar water pump that can be controlled remotely, it is very easy for farm guards to maintain the consistency of plant watering and the availability of water stock in the farm.

Literature Review and Hypothesis Development

Muhammad Syahid, et al. (Syahid et al., 2022) with the title Utilization of Solar Water Pumps for Agricultural Irrigation Systems, the method used Achievement Targets, Activity Implementation and Achievement Measurement Methods The research results of solar water pumps for agricultural irrigation systems can run smoothly. Zian Iqtimal, Ira Devi Sara and Syahrizal (Iqtimal & Devi, 2018) title Solar Power System Application as a Source of Electricity for Water Pumps method Literature Study research results The design of a solar power system for water pump electrical energy using solar panels takes 32 minutes to fill 1750 liters of water to the reservoir according to water needs. The fundamental difference between the system created and the system that became the previous study is the integration of the Internet of Things (IoT) in the system created. In the previously studied system, IoT was not used or did not exist in its design. The presence of IoT in the system allows for real-time data collection, remote control, and more advanced analytics, which were not available in the previous system that relied solely on traditional methods. This results in increased efficiency, responsiveness, and system intelligence.

Research Methods

The implementation procedure in designing a water pump drive system through solar panels with solar energy uses the Rapid Application Development (RAD) method. The stages of the RAD method are shown in the following figure.

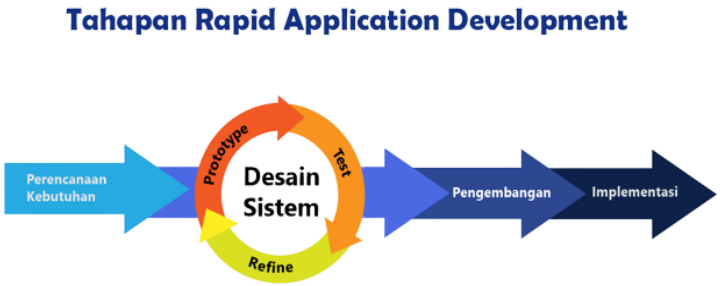


Image 1 RAD Stages

1. Requirements Planning.

This stage is the initial stage in a system design, collecting the data needed through interviews and observations to the Nabil Aziz View Farm, namely to Mr. Slamet Cahyo Edi Sahputro, M.Kom as the person in charge of the Nabil Aziz View Farm and Mr. Sangidun as the guard of the Nabil Aziz View Farm. The following are the questions asked to Mr. Slamet.

Table 1 Interviews with Managers

No	Question
1	Who Owns Nabil Aziz View Farm?
2	When was Nabil Aziz View Farm established?
3	What is the history of Nabil Aziz View Farm?
4	Why was Nabil Aziz View Farm established?
5	What is the organizational structure of Nabil Aziz View Farm?
6	What are the crops grown at Nabil Aziz View Farm?
7	How much is the land area of Nabil Aziz View Farm?

After interviewing Mr. Slamet, an interview was conducted with Mr. Sangidun, the caretaker of Nabil Aziz View Farm, and the following questions were asked.

Table 2 Interviews with Agriculture supervisors

No	Question
1	What are the trees planted at Nabil Aziz View Farm?
2	What is the irrigation system at Nabil Aziz View Farm?
3	How many times do you water the plants on Nabil Aziz View Farm?
4	How much electricity does it cost for one month?
5.	Is using conventional electricity to power pumps in irrigation a burden on expenses?
6.	How to fill the water reservoir?

2. System Design.

a. Prototype

In the system design stage, the design process is carried out and the design improvement process is repeatedly carried out if there is still a design mismatch with theuser needs that have been identified in the previous stage. The following is a prototype ofthe system design.

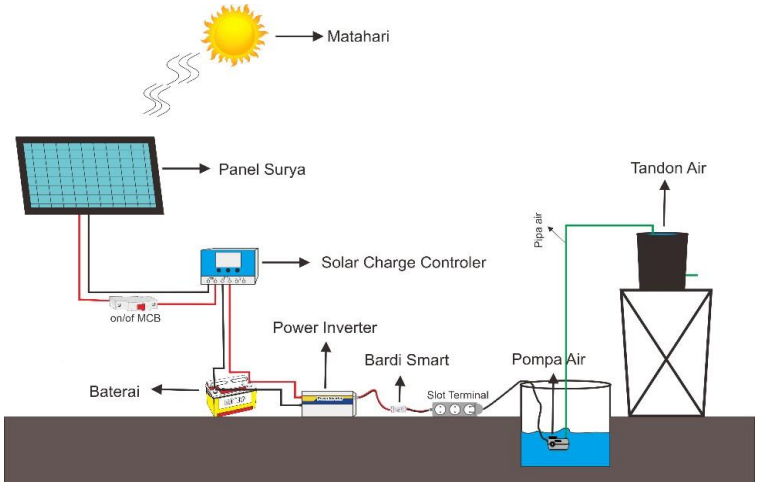


Image 2 Prototype System Design

b. Test

At this stage the system design that has been made and agreed upon is thoroughly tested both in terms of functional requirements and other functionalities. If the system has run according to its function, it will proceed to the next stage.

Table 3 Blackbox Testing Scenario

No	Scenario	Steps	Expected Results	Summary
1	Solar Panel Durability Testing	Power the water pump with solar energy.	Water Pump Turns On	○ Successful ○ No
2	Solar Charge Controller controls the incoming and outgoing electrical power	Connect the solarpanel with the solar charge controller	Knowing the wattage of electricity used	○ Successful ○ No
3	The battery stores the electrical energy from the solar panel through the solar charge controller	Connect the solar charge controller to the battery	Battery charged with electricalenergy	○ Successful ○ No
4	The inverter converts AC current to DC well	Installing the Converter	Electric WaterPump running	○ Successful ○ No
5.	Bardi smart breaker charging water pump on schedule	Bardi smart breaker sets the schedule for Pumping and maintenance.	Bandi smart breaker runs to according schedule	○ Successful ○ No

6.	Pump delivers water from the water source to the water reservoir	Put the water pump into the water source	Water reservoirfilled	○ Successful ○ No

c. Refine

At this stage, the system is tested repeatedly until everything runs correctly without any tools or materials that can be damaged.

3. Development

The process of developing a system that has been created and tested is applied again to things that are lacking to perfect the system so that the system is ready to be used for a long time.

4. Implementation.

The finalization process is carried out by applying the design of the system that has been approved at the previous stage to those who need the system.

Discussion

The result of the research that has been done is the formation of a Solar Smart Water Pump system.

1. Planning needs

The following is an explanation of the materials and tools needed to make a solar smart water pump.

a. Solar Panel 20/12 Volt WP

Solar panel is a device consisting of solar cells made of semi-conductor material to convert solar energy into electrical energy. Solar panels function to convert sunlight into a direct current or DC power source (Primawan, 2019). The solar panel used the research is a solar penel with a capacity of 20 Watt Poly/12 volts.

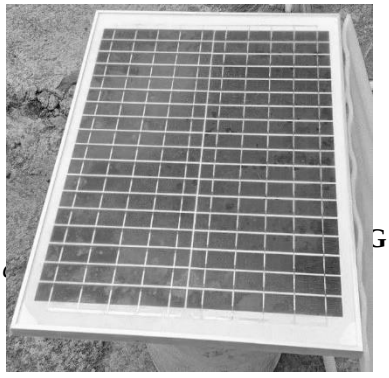


Image 3 Solar panel

b. Solar Charge Controller

Solar Charge Controller is a device that functions as a voltage and current control that comes from the output of solar cells to go to the battery and to the load. (Subandi & Hani, 2015).

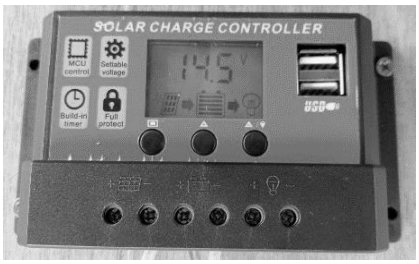


Image 4 Solar charge controller

c. Inverter

An inverter is a device needed to convert direct current (DC) into alternating current (AC). (Girikarto et al., 2019). An inverter is a device for converting DC current intoAC, this is done because the current stored in the battery is DC current while the load current or the pump motor is AC current. (Hartono, n.d.) The inverter used the research is an inverter with a capacity of 500 Watt.



Image 5 Power inverter

d. Battery

A battery is a device that stores power generated by solar panels that is not immediately used by the load. The stored power can be used during periods of low solar radiation or at night. Battery components are sometimes called accumulators. (Darma, 2017).



Image 6 Battery

e. Water Pump

A water pump is a device that functions to drain water from the ground to another higher place by increasing the water pressure. the water pump used the research is an aquarium water pump.



Image 7 Water pump

f. Bardi Smart BREAKER ON OF

This tool is a power to turn pumps on and off automatically through the Internet of Things with artificial intelligence.



Image 8 Bardi Smart

g. Water Reservoir

A water reservoir is a device used to collect water. The water reservoir used bythe author has a capacity of 60 liters.



Image 9 Water reservoir

h. Pipes

Pipes are flexible vessels designed to carry liquids from one place to another. In research the pipe is used as a place for water traffic to enter the water reservoir from the well.



Image 10 Pipes

2. System Design.

a. Solar panel prototype



Image 11 Solar intelligent water pump prototype

Solar panels capture sunlight and convert solar energy into electrical energy with a DC (direct) electric current flow, through the cable flowed to the solar panel slot in the solar charge controller, connect the battery / battery cable to the existing charge controller slot, the solar charge controller serves to regulate the flow of AC electricity from solar panels, there are 3 slots in the solar charge controller, the first for solar panels, the second for batteries, the third for loads where

in the slot for this load changes the AC flow to DC so it can be directly used but the resulting voltage is small, then the AC flow from the solar charge controller is accommodated to the battery, from the battery connect the inverter cable where the inverter functions to convert DC current into AC with a voltage according to the capacity of the battery used. Then connect the input cable with the plug and then the terminalcable to the output. Install the smart life application on the cellphone, after it has been installed, open it and enter the add device menu then select electrical. After turning on, press the reset button for 5 seconds until the indicator light flashes quickly. Don't forget to turn on WI-FI to connect the on/of breaker to the cellphone device. After the device is connected to the cellphone, enter the timer menu to set the time the pump turns on and the pump turns off automatically, the water pump turns on and fills the water reservoir to the brim.

b. Test

Table 4 Testing Results

No	Scenario	Step	Expected results		Summary
1	Solar Panel Durability Testing	Power the water pump with solar energy.	Water Pump Turns On	✓	Successful No
2	Solar Charge Controller controls the incoming and outgoing electrical power	Connect the solar panel with the solar charge controller	Knowing the wattage of electricity used	✓	Successful No
3	The battery stores the electrical energy from the solar panel through the solar charge controller	Connect the solar charge controller to the battery	Battery charged with electrical energy	✓	Successful No
4	The inverter converts AC current to DC well	Installing the Converter	Electric Water Pump running	✓	Successful No
5	Bardi smart breaker charging water pump on schedule	Bardi smart breaker sets the schedule for pumping and maintenance.	Bandi smart breaker runs according to schedule	✓	Successful No
6	Pump delivers water from the water source to the water reservoir	Put the water pump into the water source	Water reservoir filled	✓	Successful No

c. Refine

The solar intelligent water pump system is tested repeatedly and after repeated tests the results are all tools running well. The water pump can pump 60 liters of water into the water

reservoir in 19.07.81 minutes. With the height of the water reservoir datri ground level is 1.5 meters. And the distance between the pump and the water reservoir is 1 meter.

3. Development

After the system design stage has been successfully carried out, further development is carried out regarding the designed solar intelligent water pump. In a day the farm needs 8,400 liters of water with the following details:

The number of plants watered was 84 plants

Each plant requires 50 liters one time flush

Water the plants twice a day

One day per plant 50 liters x 2 = 100 liters

For one flsush the pump works as follows:

The time for the pump to fully fill the water reservoir is 19 minutes

The requirement of the whole plant one flush is 4,200 liters

Water reservoir with a capacity of 60 liters

Calculation: $\frac{4,200}{60} = 70$ liters

70 liters x 19 minutes = 22 hours

In this case, to develop the system to be more perfect, it is necessary to enlarge the water reservoir, which can be increased to a toren with a capacity of 1000 liters so that more water is stored and replace the water pump with a sanyo so that the power to pump water is greater.

4. Implementation

In the implementation stage, a series of stages are carried out to ensure that all devices run as expected, including the following:

a. Solar Panel Installation: First, the solar panels will be installed at a location that is well exposed to sunlight to capture enough solar energy.
b. Water Pump Installation: The water pump will be installed at the back of the Nabil Aziz View farm base camp near the fish pond which is close to the water source.
c. Connection with Irrigation System: The water pump system will be integrated with the existing irrigation system at Nabil Aziz View Farm.
d. Remote Control Setup: A remote control system is set up so that the farm keeper can controlthe water pump, monitor its performance, and receive notifications through the Smart Life app with the Bardi Smart device.

e. Functionality Testing: Prior to active use, the system was tested through blackbox testing to ensure that the water pump operates according to specifications and responds well to emergencies.

f. Socialization to the farm: Nabil Aziz View farm was provided with training on how to operate the system, monitor its performance, and address common issues that may arise.

Conclusion

The prototype of a water pump using solar panels by utilizing solar energy for plant watering purposes at Nabil Aziz View Farm has been implemented.

With the solar power plant that has been designed, it can help Nabil Aziz View Farm to optimize existing renewable energy so that it can save electricity costs.

Designing an automatic water pump system using AI (Artificial Intelligence) with the Bardi Smart tool has been implemented and tested by the Nabil Aziz View Cikarag Farm.

Bibliography

Darma, S. (2017). Analysis Of The Estimated Power Capability Required For Planning Solar Power Plants (PLTS). AMPERE Journal Volume 2, Number 1, January - June 2017.

Girikarto, D., Panggang, K., Girikerto, D., & Panggang, K. (2019). Solar Water Pumping System: Utilization Of Solar Energy For Hamlet Clean Water Supply. 2(1), 38-43.

Gunoto, P., & Sofyan, S. (2020). Design Of A 100 Wp Solar Power Electricity Device For Lamp Lighting In The Basement Room. 3 (2), 96-106.

Hartono, B. (n.d.). Designing A Solar Water Pump To Transfer Clean Water To A Holding Tank. 9(1), 28-33.

Hasrul, R. (2021). Active Versus Passive Cooling System in Increasing Solar Panel Output. Journal of Science, Energy, Technology & Industry, 5(2), 79-87.

Hermanu, C., Apribowo, B., Arifin, Z., & Adriyanto, F. (2019). Mobile Solar Water Pump.1(1).

Hermanu, C., Apribowo, B., S, T. E., & Anwar, M. (2015). Solar Water Pump System Prototype To Increase Agricultural Productivity.

Hutabri, E. (2019). Application of Rapid Application Development (RAD) Method in the Design of Multimedia Learning Media. Innovation in Research of Informatics (INNOVATICS), 1(2), 57-62. https://doi.org/10.37058/innovatics.v1i2.932

Iqtimal, Z., & Devi, I. (2018). SOLAR POWER SYSTEM APPLICATION AS A WATER PUMP POWER SOURCE. 3(1), 1-8.

Purwoto, B. H., Jatmiko, J., Fadilah, M. A., & Huda, I. F. (2018). Efficiency of Solar Panel Usage as an Alternative Energy Source. Emitor: Journal of Electrical Engineering, 18(1), 10-14. https://doi.org/10.23917/emitor.v18i01.6251

Subandi, & Hani, S. (2015). Solar Energy Power Generation As A Water Pump Driver Using Solar Cell. 7(2), 157-163.

Suryaningsih, S., Hidayat, S., & Abid, F. (2016). Design of an internet-based household electrical energy usage monitoring tool. V, 87-90.

Syahid, M., Salam, N., Piarah, W., & Djafar, Z. (2022). Utilization of Solar Water Pump for Agricultural Irrigation System. 5, 102-107.