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ENHANCE CONTROLLING SMART CHARGING TIME

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In this research discusses the storage of electrical energy into the battery itself must be managed in such a way that the process of charging and discharging the battery can take place properly, without causing the load to go out due to running out of battery power. designed a tool to compare the charging time of several batteries with charging using a solar tracker or not using a solar tracker to find out which battery is more efficient in its use. This research uses lead acid batteries, lithium ion batteries, and nickel-cadnium batteries. From the results of this study it is known that lead acid batteries have a charging time of 3 hours 30 minutes without using solar trackers and 3 hours 15 minutes using solar trackers with an efficiency of 7.14%, lithium ion batteries have a charging time of 3 hours 30 minutes without using solar trackers and 3 hours using solar trackers with an efficiency of 14.29%, while Nickel-Cadnium batteries have a charging time of 4 hours 30 minutes without using solar trackers and 4 hours 45 using solar trackers with an efficiency of 11.11%. Then it was found that lithium ion batteries have the fastest charging time of the three batteries used. The system is controlled by an Arduino UNO microcontroller, input in the form of 3 voltage sensors, 6 relays as actuators. relays as actuators, LCD as battery status displayer, and buzzer as warning sound actuator. sensor voltage sensor reads the voltage value on all installed batteries, then Arduino UNO will process the battery with a value above the setpoint. which has a value above the setpoint will be connected to the load through the load relay, while the battery whose voltage is below the setpoint value will be connected to the load. below the setpoint value will be connected to the charging system through the charging relay. In this study given The design of the battery monitoring and management system with the Arduino UNO microcontroller-based switching method has been successfully realized.

1. INTRODUCTION

A battery is a device that can convert energy. An electric battery is a device consisting of 2 or more electrochemical cells that convert stored chemical energy into electrical energy. When the battery is connected to an external circuit, the electrolyte can move as ions in it so that a chemical reaction occurs at both poles. The transfer of ions in the battery will drain the electric current out of the battery so as to produce work [1]. State of Charge (SOC) is defined as the ratio of the total usable energy capacity of a battery to the total battery capacity. SOC describes the available energy and is expressed as a percentage, sometimes considered the rated capacity of the battery [2].

Charging the battery on the solar panel is controlled by using a solar tracker. Several existing studies use Arduino-based solar trackers. However, the Arduino controller still has drawbacks, namely that it can only perform simple processing, not yet at the stage of high power efficiency and performance [2]. Therefore, in this study using a solar tracker based on STM32. Where in this study the authors analyze and compare the battery charging time in two ways, namely PV systems that use a solar tracker and a PV system without using a solar tracker. This study uses three batteries, namely Lead-Acid batteries, Li-Ion batteries, and Nickle-Cadnium batteries.

Indonesia is geographically located right on the equator with an average intensity of solar radiation per day is about 4.8 kWh/m2 [1]. Indonesia also has considerable potential in wind energy wind energy, which is 60,647 MW spread across 34 provinces in Indonesia [2]. provinces in Indonesia [2]. Realizing the potential potential for the development of new renewable energy is very large in Indonesia, and the electrification ratio in Indonesia which is not yet 100% [3], the

Indonesia's electrification ratio is not yet 100% [3], this renewable energy could be a solution for remote and underdeveloped areas [4]. be a solution for remote and unelectrified areas. electricity evenly. In its use, for example, the Power Plant Solar Power Plant (PLTS) depends on the amount of solar radiation, equivalent sun hours (ESH), or Equivalent Sun Hours (ESH), latitude angle [4]. Since the electrical energy generated is limited and unstable, then first the electrical energy must be stored in the battery, so that daytime use is stable and can be used at night. stable and can be used at night. Electrical energy that has been stored in the battery will later be converted using an inverter into a 220 volt AC voltage [5] so that it can be used to household appliances or the like. Storage of electrical energy into the battery itself must be managed in such a way that the process charging and discharging the battery can take place properly, without (discharging) can take place properly, without causing the load to go out due to running out of battery. Based on the problems in battery management that have been mentioned above, some research on battery management and the like have been carried out, briefly the research that has been done there is a using Arduino UNO and actuators in the form of Smart Relay Zelio [6], but it is found that the price of the Smart Relay Zelio is quite expensive and its size is quite small.

Smart Relay Zelio is quite expensive and relatively large in size, but can be used for large loads and but can be used for large loads and there is no LCD to determine the status of the status of the battery that is being used and that is being recharged.Then there is also research that uses AVR ATmega 8535 microcontroller [7], which uses Li-Po batteries as storage media. using Li-Po batteries as a storage medium electrical energy. Based on the two studies that have been mentioned, in this This Final Project is carried out a development that is more focuses on the design of the switching system, namely by using a 5 volt electro mechanical relay module which is the price is much cheaper than Zelio's Smart Relay, then using Arduino UNO as a microcontroller which is easier to understand the programming language, and is more widely used today, some additions such as 2x16 LCD as a viewer status of the voltage of the battery used and which being charged and buzzer as sound output, using 3 dry batteries [8] [9] 12 volts 5 ah as a storage medium for electrical energy, as well as fuse as a safety device from overcurrent due to overload or short circuit.

Overload or short circuit. In this research made a tool that can connect the system charging and discharging system on three batteries. three batteries. The initial process of the Arduino microcontroller UNO microcontroller through a voltage sensor [10] will read the condition of the voltage of the three batteries installed voltage of the three batteries installed, then the system will choose which battery has a voltage of ≥11.5 volt and if there is more than one battery that more than one battery that has a voltage ≥11.5 volts, the system will select the battery with a smaller order first, then the battery will supply the load, and the voltage will be decreases until it passes the voltage limit <11.5 volts later the battery will be removed from the load and will be charged until it reaches a voltage of ≥13 volts, then the load will be connected to the next battery that is will be connected to the next battery whose voltage ≥11.5 volts, this automatic system is called with switching which will be regulated by Arduino UNO [11] and the actuator is an electromechanical relay.

Then, if the voltage of the three batteries is not ≥11.5 volts or no battery is installed, resulting in a voltage reading of 0 volts. which results in a voltage reading of 0 volts, Arduino UNO will activate the buzzer [12] as a warning that all batteries cannot be used, in this system is also used 2x16 LCD [13] as a viewer real time battery voltage conditions & LEDs that displaying which battery is being used and which is being charged. which is being charged. The charging system and the use of battery system will take place alternately (one is charged and the other is used to load, and alternately) as described above is expected to make the use of has been explained above is expected to make the use of electrical energy can be used much longer compared to if the battery is charged simultaneously and used at once (the battery is fully charged, then used at once until it runs out, and is charged again).

2. METHOD

Method of this paper:

a. Input Section

In the input section, input is given in the form of battery voltage obtained from the voltage sensor module.

b. Process Section
The Arduino UNO will process the battery according to the conditions that have been read by the voltage sensor. Batteries that have a voltage value above the setpoint will be forwarded to the load, while batteries that are below the setpoint value will be forwarded to the charging system. This process is carried out by a relay as an actuator. The status of the batteries will be displayed by the Arduino via the 2x16 LCD, and if all the batteries are below the set point, the Arduino will activate the buzzer as a sign that there are no batteries ready to be transferred to the load.
c. Output Section
The output parts are 2x16 LCD, buzzer and relay

The concept of solar cells or photovoltaic (PV) is very simple, namely converting sunlight into electrical energy. Sunlight is a form of energy from natural resources. This solar cell can produce an unlimited amount of electrical energy directly taken from the sun, without any rotating parts and also does not require fuel. So that solar cells are often said to be clean and environmentally friendly. The working principle of the battery is divided into two processes, namely discharge and charge as shown in Figure 1

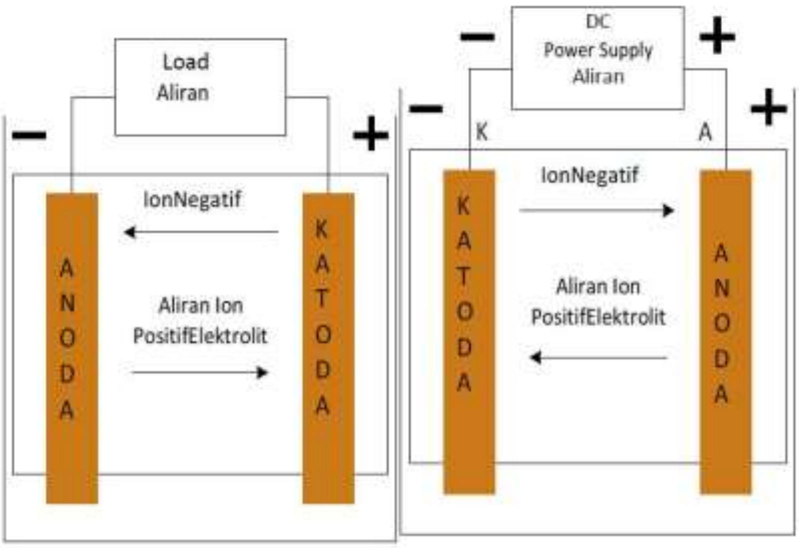

Figure 1. Battery Discharging and Charging Process

In this experiment, three batteries were used, namely Lead-Acid, Li-Ion, and NiCd. The series of experiments in this study are shown in Figure 2.

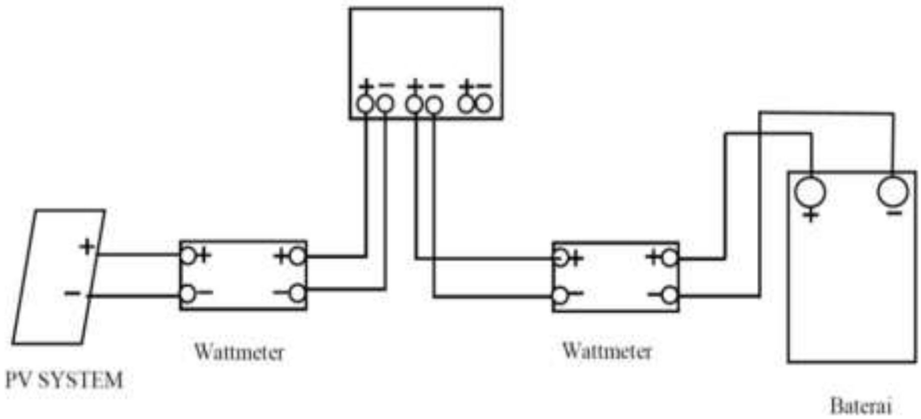

Figure 2. Experimental Circuit

The procedure for this research will be described through a flowchart in Figure 3.

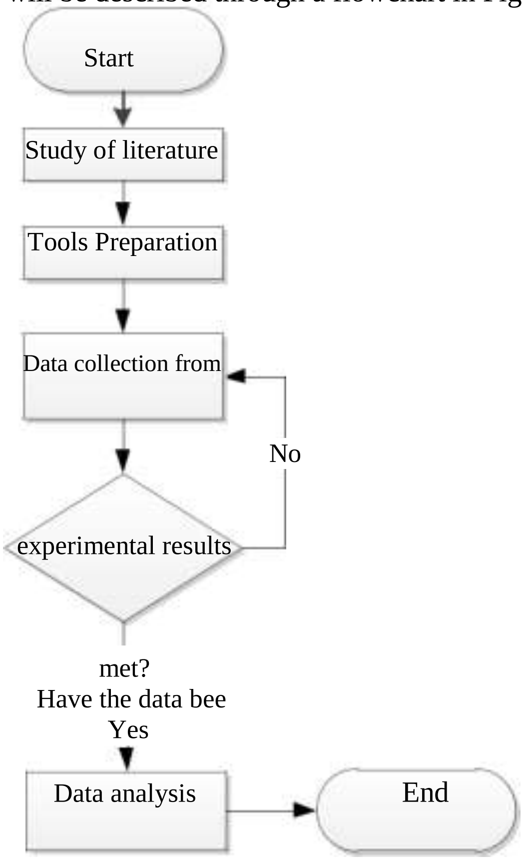

Figure 3. Research Flowchart

3. RESULT AND DISCUSION

The data from the observation results of the solar panel output of the Lead-Acid battery are shown in Table 1 and Table 2.

Table 1. Solar Panel Output Test Data Without Solar Tracker

Time (WIB)	Voltage (V)	Current (A)	Power (W)	Temperature (0C)	Solar Radiation Intensity (W/m2)
10:30	12,12	1	12.1	32.3	580.6
11:00	12.1	1.22	14.5	30.5	244.4
11:30	12.9	0.55	7	32.3	296.9
12:00	13.05	1.5	19.5	32.5	518.1
12:30	13.45	1	14.5	32.4	705.5
13:00	13.35	0.78	10.4	32	642.2
13:30	12.1	0.67	0.65	34	643.1
14:00	11.55	1.1	12.6	34.4	153.1
14:30	12.5	1.02	12.5	35.3	594.1
15:00	11.25	0.5	5.5	35.4	295.5

Table 2. Solar Panel Output Testing Data Using Solar Tracker

Time (WIB)	Voltage (V)	Current (A)	Power (W)	Temperature (0C)	Solar Radiation Intensity (W/m2)
10:30	12.07	1.12	13.6	32.3	580.6
11:00	12.1	1.22	14.5	30.9	296.9
11:30	13	0.85	11.3	33.5	705.9

12:00	13.21	1.5	19.9	32.8	623.1
12:30	13.45	1.31	17.5	32.9	265.5
13:00	13.42	1.02	13.4	34	649.2
13:30	12.1	0.99	12.2	34.9	523.1
14:00	12.26	1.1	13.5	34.4	153.1
14:30	12.75	1.05	13.5	35.3	594.4
15:00	11.97	0.7	9.5	34.5	296.9

Based on the table above, a graph of changes in solar radiation intensity with time will be obtained as shown in Figure 4.

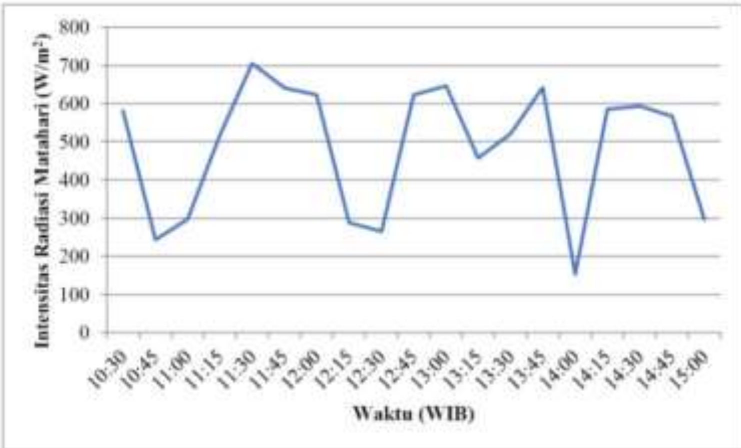

Figure 4. Graph of Changes in Solar Radiation Intensity Against Time

From the data obtained in table 2, and also in figure 4, it can be seen that the switching process from battery 1 to battery 2 occurs at the 115th minute. The voltage value of battery 1 slowly decreases to <11.5 volts for approximately 115 minutes, then battery 1 will be disconnected from the load and will be recharged. You can see the increase in voltage on battery 1 starting from the 115th minute to the 223rd minute. Shortly after battery 1 reaches voltage≥13 volts, the battery voltage will be stable in the range of 12.68 volts. When battery 1 is disconnected from the load, battery 2 is immediately connected to the load, seen at 115 minutes to In the 223rd minute, approximately 108 minutes, the voltage value of battery 2 drops to <11.5 volts, then battery 2 will be disconnected from the load and will be recharged. You can see the increase in battery 2 voltage in the 223rd minute to the 285th minute. Shortly after battery 2 reaches voltage≥13 volts, the battery voltage will be stable in the range of 12.65 volts. When battery 2 is disconnected from the load, battery 3 is immediately connected to the load, seen from the 223rd minute to the 330th minute for approximately 107 minutes battery 3 experiences a voltage drop to past 11.5 volts, then battery 3 will be disconnected from the load and will be recharged until it reaches voltage≥13 volts. When battery 3 is disconnected from the load, battery 1 is immediately connected to the load, and the system will repeat itself (loop) until the switch is turned off, or the system power supply source is removed. In the battery switching process, the load in the form of a light bulb does not go out at all during the switching process, this is because the process of moving from NC to NO contact on the relay takes place very quickly, so the load does not have time or even goes out.

4. CONCLUSION

The conclusions that can be drawn based on the research conducted are as follows.The average output power produced by solar panels on lead acid batteries without using a solar tracker is 12.08 W while using a solar tracker is 14.25 W. With an increase in power of 17.96%. Charging the lead-acid battery to its full capacity of 3 Ah without using a solar tracker takes 3 hours and 30 minutes. Meanwhile, using a solar tracker takes 3 hours 15 minutes. Save time for 15 minutes with charging time efficiency of 14%. The average output power produced by solar panels on a li-ion battery without using a solar tracker is 11.74 W while using a solar tracker is 13.25 W. With an increase in power of 12.86%. Charging the li-ion battery to its full capacity of 3 Ah without using a solar tracker takes 3 hours 30 minutes. Meanwhile, using a solar tracker takes 3 hours. Saves 30 minutes of diving time with 14.29% charging time efficiency.

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