

## Design of Battery Charging Time Based on Microcontroller

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### ABSTRACT

In this study, a tool is designed 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 battery, lithium ion battery, and nickel-cadmium battery. From the results of this study, it is known that the lead acid battery has a charging time of 3 hours 30 minutes without using a solar tracker and 3 hours 15 minutes using a solar tracker with an efficiency of 7.14%, lithium ion batteries have a charging time of 3 hours 30 minutes without using a solar tracker and 3 hours using a solar tracker with an efficiency of 14.29%, while Nickle-Cadnium has a charging time of 4 hours 30 minutes without using a solar tracker and 4 hours 45 using a solar tracker with an efficiency of 11.11%. Then it was found that lithium ion batteries have the fastest charging time of the three batteries used.

### 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.

### LITERATURE REVIEW

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.

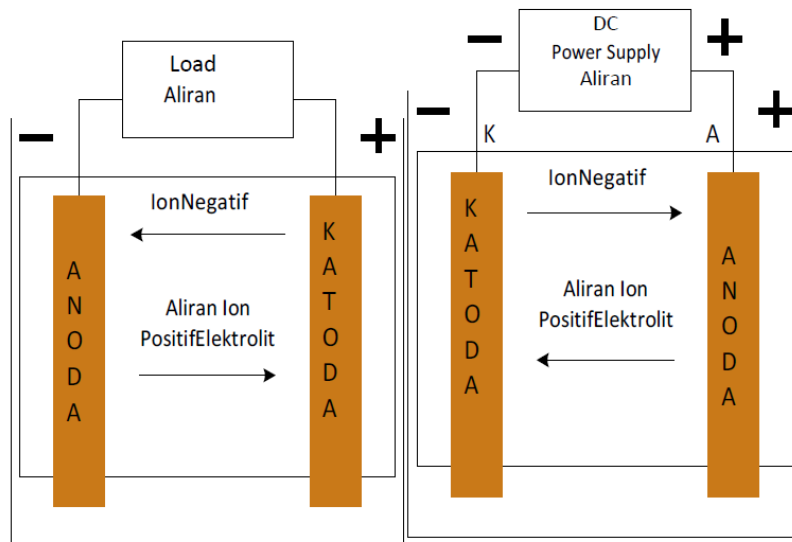


Figure 1. Battery Discharging and Charging Process

### METHOD

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.

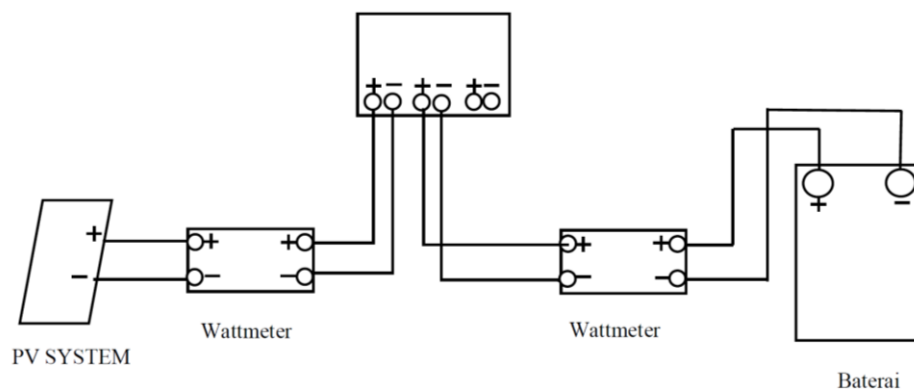


Figure 2. Experimental Circuit

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

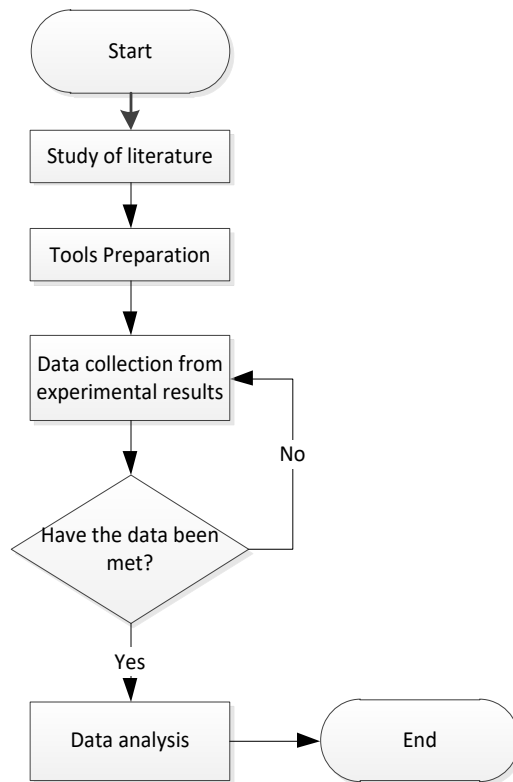


Figure 3. Research Flowchart

### RESULT

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 (OC)	Solar Radiation Intensity (W/m <sup>2</sup> )
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

### DISCUSSION

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

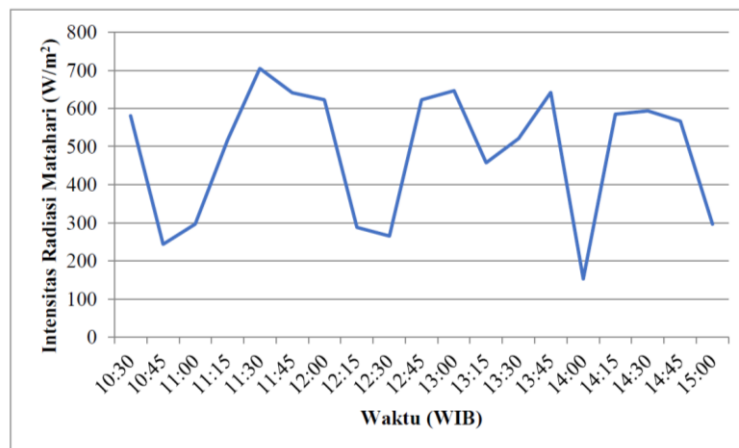


Figure 4. Graph of Changes in Solar Radiation Intensity Against Time

### CONCLUSION

The conclusions that can be drawn based on the research conducted are as follows.

1. 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%.
2. 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 7.14%.
3. 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%.
4. 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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