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Electric Bicycle Battery Charging System Design Using Solar Panel

Rancang Bangun Sistem Pengisian Baterai Sepeda Listrik Menggunakan Panel Surya

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Abstract *_ This solar-powered electric bicycle charging system design and development uses solar panels as a renewable energy source to charge the battery, which drives the electric motor. The system consists of four main components: solar panel, solar charge controller, battery, and electric motor. The solar panels are connected in parallel to generate 36V, which is then stored in the battery. The system is designed to optimize energy harvesting and reduce dependence on fossil fuels. Testing was conducted with research stages, including system design, hardware implementation, and testing. The results show that the system can charge the battery efficiently, with a charging time of 3 hours. The system was also tested under different conditions, including morning, afternoon, and night, to evaluate its performance. It can be concluded that the solar-powered electric bicycle charging system is a viable alternative to traditional fossil fuel-based systems. The system is environmentally friendly, reduces energy dependence, and provides a sustainable solution for transportation. The results of this research can be used to develop a more efficient and sustainable transportation system.*

Keywords: *Solar Panel, Renewable Energy, Electric Motor, Solar Charge Controller, Battery*

Abstrak_ desain dan pengembangan sistem pengisian daya sepeda listrik bertenaga surya ini menggunakan panel surya sebagai sumber energi terbarukan untuk mengisi daya baterai, yang menggerakkan motor listrik. Sistem ini terdiri dari empat komponen utama: panel surya, pengontrol pengisian daya surya, baterai, dan motor listrik. Panel surya dihubungkan secara paralel untuk menghasilkan 36V, yang kemudian disimpan dalam baterai. Sistem ini dirancang untuk mengoptimalkan pemanenan energi dan mengurangi ketergantungan pada bahan bakar fosil. Pengujian dilakukan dengan tahapan penelitian, termasuk desain sistem, implementasi perangkat keras, dan pengujian. Hasil penelitian menunjukkan bahwa sistem dapat mengisi baterai secara efisien, dengan waktu pengisian 3 jam. Sistem ini juga diuji dalam kondisi yang berbeda, termasuk pagi, siang, dan malam hari, untuk mengevaluasi kinerjanya. Sehinggan dapat disimpulkan bahwa sistem pengisian daya sepeda listrik bertenaga surya merupakan alternatif yang layak untuk sistem berbasis bahan bakar fosil tradisional. Sistem ini ramah lingkungan, mengurangi ketergantungan energi, dan memberikan solusi yang berkelanjutan untuk transportasi. Hasil penelitian ini dapat digunakan untuk mengembangkan sistem transportasi yang lebih efisien dan berkelanjutan.

Kata Kunci: Panel Surya, Energi Terbarukan, Motor Listrik, Solar Charge Controller, Baterai

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I. INTRODUCTION

Fuel has an important role in supporting community activities [1]. However, the use of fuel is still considered not energy efficient, because the materials used are fossil fuels whose names are increasingly scarce [2].Therefore, energy is the biggest problem being faced by countries around the world including Indonesia [3]. Indonesia is currently facing a very concerning energy crisis [4]. Over time, the availability of fuel oil (BBM) in Indonesia is running low, so the government must import fuel oil fromother countries [5]. This is because most vehicles still use petroleum fuels [6]. Renewable energy is needed to meet the increasing demand for electricity [7]. Among the various renewable energy sources available, solar is one of the right choices to reducethe energy crisis [8]. Solar energy sources areunlimited and can be used as an alternative energy to generate electricity [9]. Solar cell power plants are theright choice that can be applied in various places [10].In utilizing solar energy is by using solar cells, or can be called PLTS
[11] is one of the means to meet people's needs for electricity which is very environmentally friendly [12], because it utilizes sunlight [13]. Currently, PLTS has been developed in many places in Indonesia [14]. One of the uses is as an energy supplier for environmentally friendly transportation tools such as electric bicycles [15]. Electric bicycles are very suitable for use in Indonesia [16]. This is because Indonesia has a tropical climate, electric bicycles are very suitable for users who live in cities and electric bicycles do not produce exhaust gasesthat harm the environment [17]. In this final project, solar energy is utilized as an alternative energy inelectric motors. Solar energy will be converted into electrical energy using solar cells which will be controlled by the sollar charger contrler (SCC) to be stored in the battery. Energy from the battery will be used to drive the electric motor [18].

II. METHODS

2.1 Research Stages

To facilitate tool design and fabrication, a block diagram of the entire system as a whole is shown in Figure 1. This block diagram process consists of inputs, processes, and outputs.

[Figure 1 about here.]

The block diagram design consists of 4 parts, namely: Solar panels as a power source Electricity is arranged in parallel where the peripheral part of the panel is will be installed with SCC then it will be given a dc mcb and diode which is used as a safety then goes to the battery, the circuit will be carried out as many as 3 pieces which will be assembled in series to produce 36V tension, will also be branched for charging using pln electricity. The load used is a 36V 350 wattelectric bike.

2.2 Software Flow Diagram

In software design, it can be seen the process flow in the system in Figure 2 regarding the design and stepsof the program to detect the work system in the design of this research system.

[Figure 2 about here.]

In the entire circuit above starts from the initial conditions, where all systems are in a condition that has been installed In this flow starts from the start process then charging the battery by PV, when the battery is full then the system will detect and run. However, if the battery has not been charged, thebattery will be charged by PV until the battery is full or the system will not work. Then there will be a system that detects that the baerai will be fully charged or not. If the battery is not fully charged and the system is running, it will be recharged using the pin on the battery. So that the process will be said to be complete if the battery is fully charged inaccordance with the process that has been designed.

III. RESULTS AND DISCUSSION

3.1 Hardware

In the hardware design, this system consists of a series of 12V 30wp x 3 solar panels connected to an inverter where the inverter is to change the voltage on the solar panel then the results of the solar cell will be stored in the battery. Then it will be forwarded to the SCC(Solar Charge Controller) to optimize charging on the battery.

[Figure 3 about here.]

Figure 3 shows the parts that are installed separately to be able to perform optimal charging of the battery. Then the parts will be installed in series to get a voltage of 36V.

3.2 Implementation and testing of the system

In the process of implementing the hardware placement of solar panels and other components on motorized vehicles, this layout is intended to obtain an optimal position when absorbing light.

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sun and produce optimal power in accordance with the specified design system.

[Figure 4 about here.]

In Figure 4, it can be seen that the position of the solar panel is above the driver and facing upwards to get optimal sunlight for the source of electricity used to drive the motor. The testing process was carried out using the device implemented in morning, afternoon and evening light conditions.

[Figure 5 about here.]

In Figure 5 the position of the battery and other components is under the solar panel to facilitate testing on battery charging. And also to facilitate the driver's focus on driving. The test results on battery charging when empty with PLN are shown.

[Table 1 about here.]

Based on the test results in Table 1 testing when the battery is empty with voltage from the PLN source, thedata obtained in the time required for charging the battery is 3 hours with a battery voltage condition of 34V and a current of 0.10A resulting in a discharged battery condition. Then in the condition of the battery with a voltage of 37V and a current of 1.60A produces a full battery condition.

3.3 Discussion

This test is carried out using 3 batteries to get a voltagethat can move the electric motor with the use of sunlight. This test is done to find out how long it takes in the battery charging process shown in Table 2.

[Table 2 about here.]

Table 2 shows the test data, where tests were carried out at times per 20 minutes to optimize the voltageand ampere test results on each battery. 13 tests were conducted to obtain accurate voltage and current values. This test has produced an average voltage on each battery of 13.24V and a current of 0.55A. so that this test data is declared stable in accordance with the data values contained in Table 2.

[Table 3 about here.]

Table 3 shows the test results on the battery used for driving and knowing the distance traveled when the battery is in full condition. From the data generated, itcan be seen that the vehicle can be used up to a distance of 26 km with an average speed of 29 km / h and usage time.

lasts up to 3 hours 30 minutes under full battery condition and stable voltage and current.

[Table 4 about here.]

Table 4 shows the test results of vehicle usage when the PV is installed and the battery is fully charged. From the table it can be seen that the battery will last up to 4 hours 20 minutes with the use of vehicles at a distance of 35 km and an average speed of 30 km / hour. In this test the battery condition is full.

IV. CONCLUSIONS

The system is designed to reduce the energy crisis and produce alternative energy that is environmentally friendly. In this system, solar energy is converted into electrical energy using solar cells, then stored in a battery and used to drive an electric motor. The test results show that the system can produce a voltage of 36V and a current of 0.55A, and can be used to drive up to 26 km with an average speed of 29 km/h and a usage time of up to 3 hours 30 minutes in full battery condition. In addition, this system can also be used to charge the battery in 3 hours with a battery voltage of 34V and a current of 0.10A. Thus, this electric bicycle battery charging system using solar panels can be one solution to reduce dependence on fossil fuels and produce alternative energy that is environmentally friendly.

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Tabel 1 Pengujian Pengisian Pada Saat Baterai Kondisi Kosong Dengan Sumber PLN

Waktu Yang Dibutuhkan Pengisian Baterai	Kondisi Baterai		Kondisi Baterai
	Volt	Amper	
3jam	34	0.10	Habis
	37	1.60	Penuh

Tabel 2 Pengujian Pengisian Baterai, Tegangan Dan Arus Panel Surya. Dengan PV

NO	Waktu Pengujian	Panel Surya					
		Baterai 1		Baterai 2		Baterai 3	
		V	A	V	A	V	A
1	10.00	12.00	0.10	12.10	0.11	12.12	0.13
2	10.20	12.20	0.12	12.25	0.13	12.20	0.13
3	10.40	12.50	0.30	12.52	0.31	12.55	0.35
4	11.00	12.70	0.50	12.75	0.55	12.73	0.53
5	11.20	13.00	0.58	13.05	0.58	13.08	0.58
6	11.40	13.15	0.60	13.16	0.61	13.18	0.65
7	12.00	13.30	0.65	13.29	0.62	13.30	0.65
8	12.20	13.40	0.70	13.44	0.70	13.42	0.70
9	12.40	13.55	0.70	13.55	0.70	13.55	0.70
10	13.00	14.00	0.80	14.05	0.80	14.03	0.80
11	13.20	14.10	0.80	14.11	0.80	14.11	0.80
12	13.40	14.25	0.80	14.23	0.80	14.24	0.80
13	14.00	14.00	0.60	13.98	0.57	13.90	0.55

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Tabel 3 Lama Pemakaian Pada Saat Baterai Penuh

No	Waktu	Jarak yang ditempuh (km)	Kecepatan	Kondisi baterai
1	3 jam 30 menit	26 km	29 km/jam	Penuh
2	3 jam 16 menit	25 km	30 km/jam	Penuh

Tabel 4 Lama Waktu Pemakaian Pada Saat PV Dipasang Dengan Keadaan Baterai Penuh

No	Waktu	Jarak yang ditempuh (km)	Kecepatan	Kondisi baterai
1	4 jam 20 menit	35 km	30 km/jam	Penuh
2	4jam 12 menit	32 km	33 km/jam	Penuh

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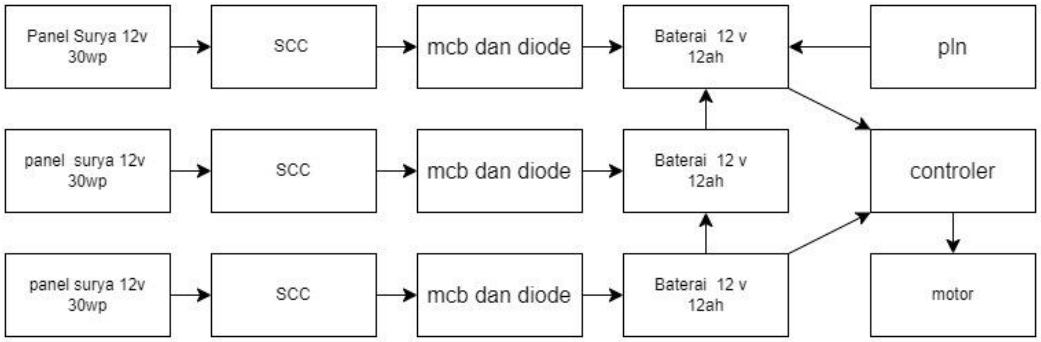
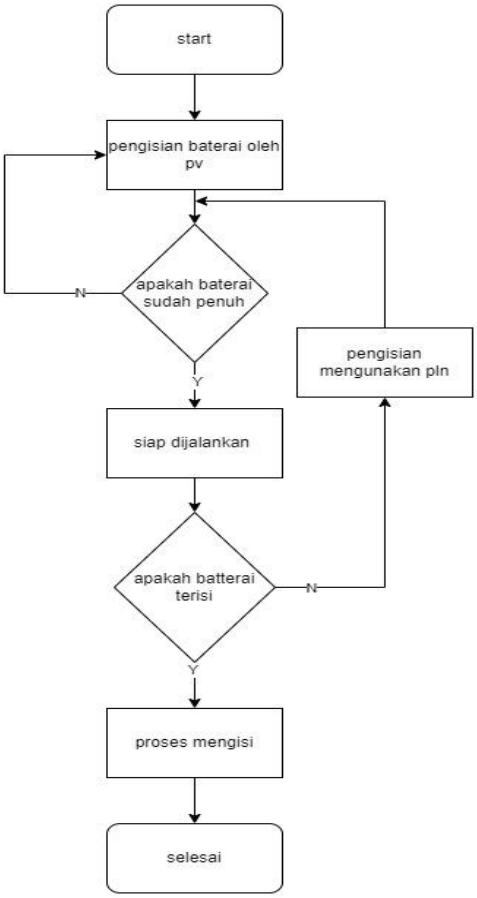


Gambar 1. Blok Diagram



Gambar 2. Alur Diagram Rangkaian

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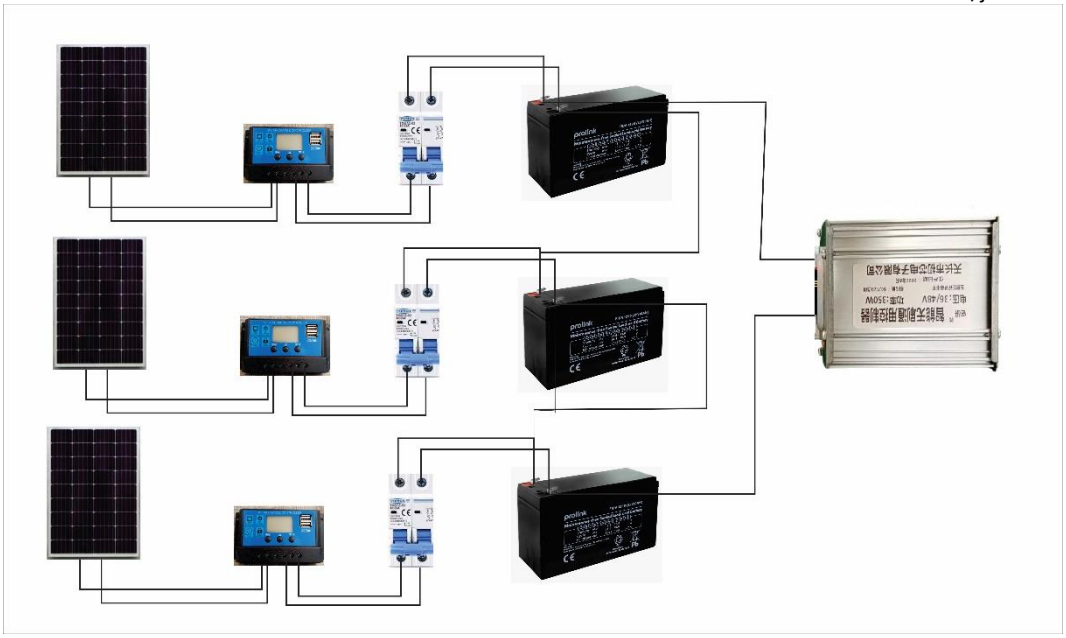

Gambar 3. Rangkaian Perangkat Keras

Gambar 4. Rangkaian Motor Listrik Tamak Samping

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Gambar 5. Rangkaian Motor Listrik Tampak Depan