Prototype Design of Remote Smart Car 4WD Robot Car with Additional Power Photovoltaic Source Integrated Arduino

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Abstract

The problem addressed in this research is designing an Electric Car Prototype, a technology design using Arduino Uno, L298N Driver Module, and HC-06 Bluetooth sensor which is controlled automatically using an application. The method used is a hybrid PLTS (Solar Power Plant) system based on Arduino Uno. This prototype combines electrical energy from batteries with solar energy produced by solar panels, and the main controller is Arduino Uno. Tests were carried out to evaluate the performance and efficiency of this electric car. The results of solar panel experiments in designing electric car prototypes, testing will be carried out on the efficiency of solar panels on the power produced. The following is the data from the experimental results measured through the following table 2 experiments. solar panels were installed on the roof or other parts exposed to sunlight on a prototype electric car. Solar panels consist of photovoltaic solar cells which are capable of converting solar energy into electrical energy. When sunlight falls on a solar panel, the solar cell produces an electric current. The electric current generated from the solar cell is then channeled to the charging module to charge the battery. The battery charging module regulates the voltage and electric current according to battery charging needs. This is important so that the battery does not receive too much or too little power during the charging process. After passing through the battery charging module, the electrical energy from the solar panels is used to charge the electric car battery. Electric car batteries function as energy storage which is used to control the engine and other electronic systems in the car. Obtained were the development of an environmentally friendly and sustainable electric vehicle.

Keywords: Robot Car Prototype, Power Photovoltaic Source, Arduino Uno.

I. INTRODUCTION

An electric car is a vehicle with electric power that requires one or more electric motors to move the wheels. Electric cars use batteries as the main energy source, which can be recharged using an external power source [1]–[3]. This is different from conventional cars which use internal combustion engines that use fossil fuels [4], [5] . The presence of electric cars is considered more environmentally friendly than cars that use oil fuel and can help save fossil energy and prevent energy shortages. Energy efficient vehicles are needed to reduce fuel consumption in transportation[6]–[8]. One type of energy-saving vehicle that can be an alternative to reduce fuel consumption is electric vehicles[9]–[11]. An electric vehicle is a vehicle where an electric motor is used to drive it, so it does not require fuel like conventional vehicles. The source of electric vehicles is not only fuel, but also other alternative energy producers such as wind power, solar power plants or others [12], [13] [14], [15].

Apart from saving energy, electric vehicles are also environmentally friendly, because they do not produce exhaust gas or are exhaust gas-free, so the surrounding air can be cleaner. Not only that, electric cars are also designed not to make loud noises, unlike conventional cars which make noise when operating, therefore electric cars are considered capable of competing in the world market [16]–[18]. Hybrid System Electric Car with an Arduino Uno-based control system using Android, this electric car uses Arduino Uno as a control system or microcontroller, while the Bluetooth Hc-06 acts as an interface to receive commands sent via Android, and a DC motor acts as the car's control station via smart installation of Android Playstore [19].

Advances in Android technology and Arduino microcontrollers make programming easier to build more complex and powerful electronic systems for everyday use. Apart from that, this remote controller car is also equipped with a PV-Solar system, where this Pv-Solar system is a power generation system designed to produce solar energy using solar electricity[20]–[22]. This electric car is also very beneficial for the local community, one of which is by using this electric car, in particular we can reduce the consumption of fuel products commonly known as fossil fuels which are usually used in conventional cars. usually made from

limited natural resources, namely a material that will run out if it is continuously produced [23], [24]. Based on previous research references, it shows that it is possible to create a sustainable hybrid solar power generation system with an automatic transfer network controller, then the involvement of a solar power plant with a robotic system. Photovoltaics can become solar renewable energy, where sunlight can be converted into electricity. Solar panels can convert solar energy into electricity using the photovoltaic phenomenon. Solar cells in solar panels generate electrons when exposed to sunlight, producing an electric current. The electrical energy can be used directly or placed into batteries as an environmentally friendly and sustainable alternative power source.

II. METHOD

The methods used in system design are: (1) Design Method, which is a system design process that is applied to achieve the expected research results which are used as research objects. Then, (2) Design Realization, is a process so that a design can occur. Then in section (3) is Implementation, namely activities planned to implement a design that has been processed carefully and in detail. Lastly in section (4) is Analysis which is a comparative analysis of tool implementation and tool design to meet system requirements.

A. Hardware Design

The hardware design of this tool begins with arranging the components in the form of Car Chassis, Wheels, Dynamo, Arduino Uno with ATMega 328 Microcontroler, L298N Driver Module, Hc-06 Bluetooth Sensor, Lithium Ion Battery, Mini Solar Panel, Arduino Breadboard, Jumper Cables, Led lights, diodes, Tp4056 charger modules, and smartphones as electric car controllers.

B. Chassis Design

The chassis is the frame or basic structure of an electric car. This car uses electric power as its main source of propulsion, different from conventional cars which use an internal combustion engine. To see the chassis design that has been designed, see Figure 1 below.

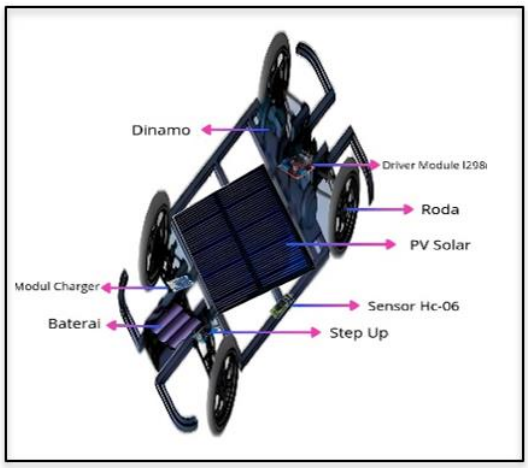

Figure 1 Chasis Design

C. Control Circuit

After the design of the electric car robot was created, the control circuit for the hybrid renewable energy system electric car was carried out. Figure 2 shows the control design for the car robot that will be installed.

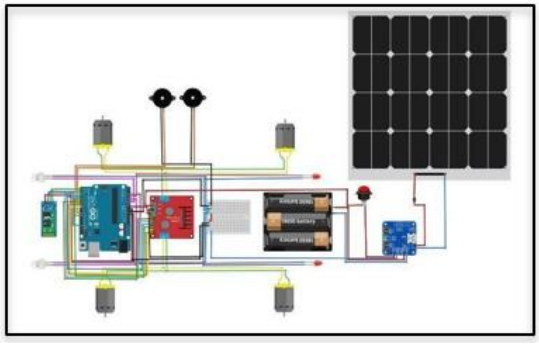

Figure 2 Control Circuit

Figure 2 shows the control circuit for a hybrid electric car based on solar panels, where solar panels are used as an additional energy source to reduce electricity consumption from PLN. The advantage of using solar panels as an additional power supply for the car prototype is to supply energy to the battery so that the car can move longer. Communication between the smartphone and Arduino is carried out via a Bluetooth connection, with the first process being pairing to connect the smartphone to the Arduino electric car using the Hc-06 sensor. The HC-06 sensor plays an important role in facilitating the pairing process between the two devices to ensure a smooth and stable connection. Once successfully paired, the Arduino can receive commands from the smartphone via Bluetooth. The pairing process for the battery power source involves a PLN source and a solar cell source connected to the TP4056 charger module. The TP4056 charger module functions as an inverter to charge lithium batteries efficiently and safely, ensuring the battery charging process runs smoothly and stably.

D. Block Circuit Diagram

Block diagram of controlling a Bluetooth electric car using Android based on Arduino Uno which consists of Arduino, smartphone design, Hc-06 Bluetooth module, L298N driver module and DC motor. The block circuit diagram can be seen in figure 3.

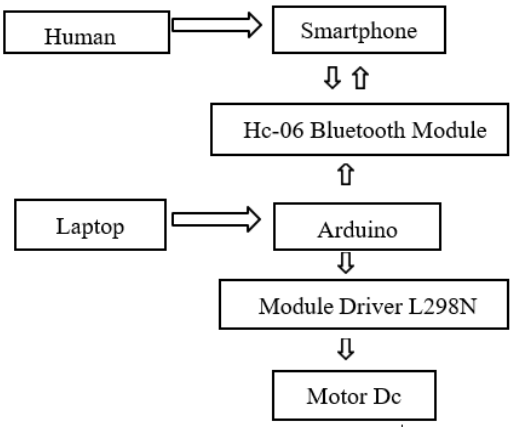

Figure 3 Block Circuit Diagram

Smartphones are used to control electric vehicles via wireless connection with the Hc-06 Bluetooth module. Arduino Uno plays a role in processing data in program form which can then be downloaded from a laptop via USB serial. This laptop functions as a programming device to control an Arduino Uno-based Bluetooth car. L298N driver module as an H-bridge driver maker for four DC motors. The DC motor acts as the driving force for the main body of the electric vehicle which is controlled by a smartphone.

E. Block Diagram of Hybrid Energy Resources Circuit

The tp4056 Charger Module functions as a charging medium from 2 energy sources, namely from the PLN source and also from a Solar Cell source which is then converted into a battery, then the power in the battery will be distributed to the load to drive the Electric Car Prototype. To see the Power source circuit block diagram, see figure 4.

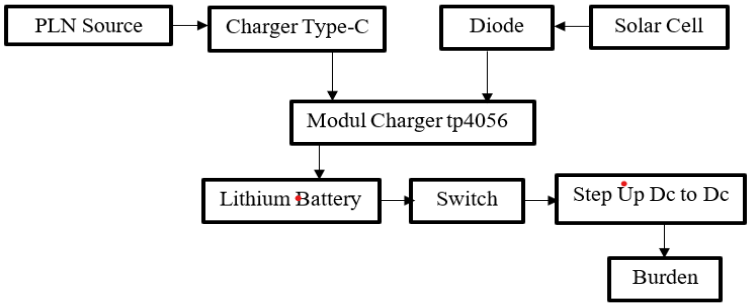

Figure 4 Power Source Circuit Block Diagram

III. RESULTS AND DISCUSSION

Based on the results of the Arduino Uno-based Hybrid System Electric Car Prototype Design Analysis using an Android Smartphone, it was found that the use of the Arduino Uno on the Robot functions as a Bluetooth HC-06 control system, the Bluetooth Module is useful for capturing command sensors that can be controlled from an Android Smartphone, and the DC Motor acts for signal receivers controlled by smart Android. Android to drive an electric car uses the Bluetooth RC Car application which can be installed via Playstore. The results obtained by the author in this research can be seen in the following figure 5.

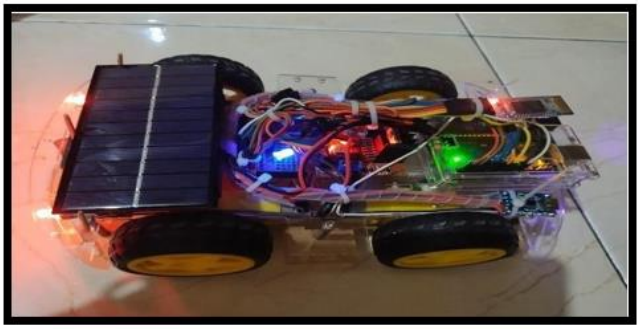

Figure 5 Result of an Assembled Electric Car Prototype

After making the electric car prototype, then start installing and using the Bluetooth RC Car application which will be used as a button to control the car. We can install the Bluetooth RC Car application in the Playstore. After the application is installed, the next step is to pair the Bluetooth HC-06 with an Android Smartphone. Open the installed Bluetooth RC Car application, press the settings section and select connect to car from the options menu, then select Bluetooth HC-06, then the Bluetooth connection is connected and the robot is ready to be driven. The Bluetooth RC Car application is an application that is used to connect a prototype electric car with an Arduino Uno-based hybrid system, so that the car can be controlled using a smartphone as the car controller so that it can run according to the commands in the Bluetooth RC Car application feature. the. The robot control screen using the Bluetooth RC Car application can be seen in figure 6 below.

Figure 6 Rc Car Bluetooth Application

Moving on to the testing stage, testing is carried out on the Bluetooth connection distance between the smartphone and the car to determine the maximum distance that can be used to control the car, namely, when the Bluetooth connection distance is connected, the car can be controlled, when the Bluetooth connection is unstable then the car is difficult to control, when the Bluetooth connection is connected. disconnected then the car cannot be controlled. The results of testing the Bluetooth car connection distance are shown in the following table 1.

Table 1 Test Result for Bluetooth Connection Distance in Electrical Cars

Trials	Distance (meter)	Result	Information
1	7 m	Connected	The car can be controlled
2	14 m	Connected	The car can be controlled
3	21 m	Connected	The car can be controlled

Trials	Distance (meter)	Result	Information
4	28 m	Connected	The car can be controlled
5	35 m	Connected	The car can be controlled
6	42 m	Connected	The car can be controlled
7	49 m	Connected	The car can be controlled
8	50 m	Break up	The car is difficult to controlled
9	55 m	Break up	The car is difficult to controlled
10	57 m	Disconnected	The car cannot be controlled

From the table above, it can be concluded that the HC-06 Bluetooth connection distance between an Android Smartphone and a Bluetooth Electric Car has a maximum range of 49 meters, a distance of 49-55 meters means the signal is less stable and a distance of more than 57 meters means the signal will be cut off and the car cannot be used. controlled again. Based on the author's analysis, data transfer communication for robot control is influenced by Bluetooth signals captured by smartphones. After testing the distance of the electric car. Next, carry out tests on the solar panels. For the results of solar panel experiments in designing electric car prototypes, testing will be carried out on the efficiency of solar panels on the power produced. The following is the data from the experimental results measured through the following table 2 experiments.

Table 2 Data Test Results for Solar Panels on Electrical Cars

No	Robot Condition	Voltage Value (V)	Current Value (A)	Generated Power (W)
1	Moving	4.16	0.02	0.083
2	Moving	5.12	0.08	0.409
3	Moving	5.24	0.12	0.628
4	Idle	5.2	0.1	0.52
5	Idle	4.24	0.03	0.12
6	Idle	4.54	0.01	0.45

In this experiment, solar panels were installed on the roof or other parts exposed to sunlight on a prototype electric car. Solar panels consist of photovoltaic solar cells which are capable of converting solar energy into electrical energy. When sunlight falls on a solar panel, the solar cell produces an electric current. The electric current generated from the solar cell is then channeled to the charging module to charge the battery. The battery charging module regulates the voltage and electric current according to battery charging needs. This is important so that the battery does not receive too much or too little power during the charging process. After passing through the battery charging module, the electrical energy from the solar panels is used to charge the electric car battery. Electric car batteries function as energy storage which is used to control the engine and other electronic systems in the car.

IV. CONCLUSION

To sum up, data transfer communication for robot control is influenced by Bluetooth signals captured by smartphones. After testing the distance of the electric car. Next, carry out tests on the solar panels. For the results of solar panel experiments in designing electric car prototypes, testing will be carried out on the efficiency of solar panels on the power produced. The following is the data from the experimental results measured through the following table 2 experiments. solar panels were installed on the roof or other parts exposed to sunlight on a prototype electric car. Solar panels consist of photovoltaic solar cells which are capable of converting solar energy into electrical energy. When sunlight falls on a solar panel, the solar cell produces an electric current. The electric current generated from the solar cell is then channeled to the charging module to charge the battery. The battery charging module regulates the voltage and electric current according to battery charging needs. This is important so that the battery does not receive too much or too little power during the charging process. After passing through the battery charging module, the electrical energy from the solar panels is used to charge the electric car battery. Electric car batteries function as energy storage which is used to control the engine and other electronic systems in the car.

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