

Implementation of telecontrol of solar home system based on Arduino via smartphone

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Abstract. The purpose of this study was to implement telecontrol of solar home system. Implementation of Internet of Things in this research is used to support the design of monitoring system to control electric power load generated by solar panel. The design of the system begins with a field comparative study and then simulated before it is manufactured and tested system parameters that include current, power and duration of time when the device connected power load control via internet network. The technique used is to collaborate the value of current and voltage measured by the current and voltage sensors as the value of power used. The results show that during the charging of energy within 10 hours obtained average power of 1.35 Watt when the maximum power is measured at 5.2 Watts. The moment of discharging takes place the battery's reserve energy is capable of switching on 4 lamp loads over a period of 30 minutes with current and average power consumption of 1.16 A and 14.35 Watt respectively when the process of sending data from the microcontroller to web server done within ± 7.9 seconds. Therefore, the system designed to work well and is able to provide convenience for users in controlling and controlling the use of power in real-time at a very long distance.

1. Introduction

Solar Home System is a power plant by utilizing solar panels as a source of energy. Solar panels are systems consisting of solar cells with the ability to convert solar light energy into electrical energy. The use of solar panels itself is widely used as a source of energy for the purposes of electronics devices. Its main advantages are free of charge bills and are quite environmentally friendly [1]. But as it came to the problem of low supervision and control of the condition of charging and discharging power to the load making it difficult in estimating the amount of power generated and used. To obtain certainty, then required a system capable of monitoring and controlling the current state of power. This makes it easier to fix and identify power uptake by the load. Usually, the main system comprises solar panels, charge controllers and batteries as a backup resource by including the involvement of internet network connectivity in order to facilitate access of data transmission remotely.

Internet of Things is a network concept that aims to extend continuous connectivity to its capabilities such as data sharing, remote control. Broadly speaking, the application of IoT in a monitoring system and controlling of solar electric power load of the home system is more to facilitate observation of power change through smartphone device even though in fact the problem of time delay when data access process will always happen [1,2,3]. Based on the results of previous research [1,4] shows the involvement of IoT in the process of monitoring and controlling the use of power



loads by solar panels. But the fact is there is a shortage of research [4] that display data information is only stored on the SD card and LCD with time delay data transmission by 1 minute. While in the study [1] more to the absence of backup power storage system when the intensity of sunlight is not detected solar panels. Another shortcoming is also seen when the system of supervision and control cannot be integrated with smartphone devices. The focus of this research is to fix these weaknesses and develop them by adding login and password features as protection against system security on smartphone devices.

2. Research methods

The method approach in this research is a quantitative approach because the final result is presented in the form of numbers by involving the corresponding mathematical formula. The stage begins the process of collecting information data related parameters to be tested and measured which refers to the results of field observation data, literature studies, component studies including current, voltage, power and control system testing through IoT connection via smartphone. The next step is to design the system model through simulation comparative approach with hardware for the purpose of testing the conformity of measured parameters before it will be fabricated into a viable device.

The system designed is a monitoring system and load controlled solar home system or a solar power plant for housing aims to facilitate users in managing the power consumption used so that users can maximize the use of solar home systems efficiently.

2.1. Block diagram

By block diagram monitoring system and load power usage controller on a solar home system via IoT based smartphone described as in figure 1.

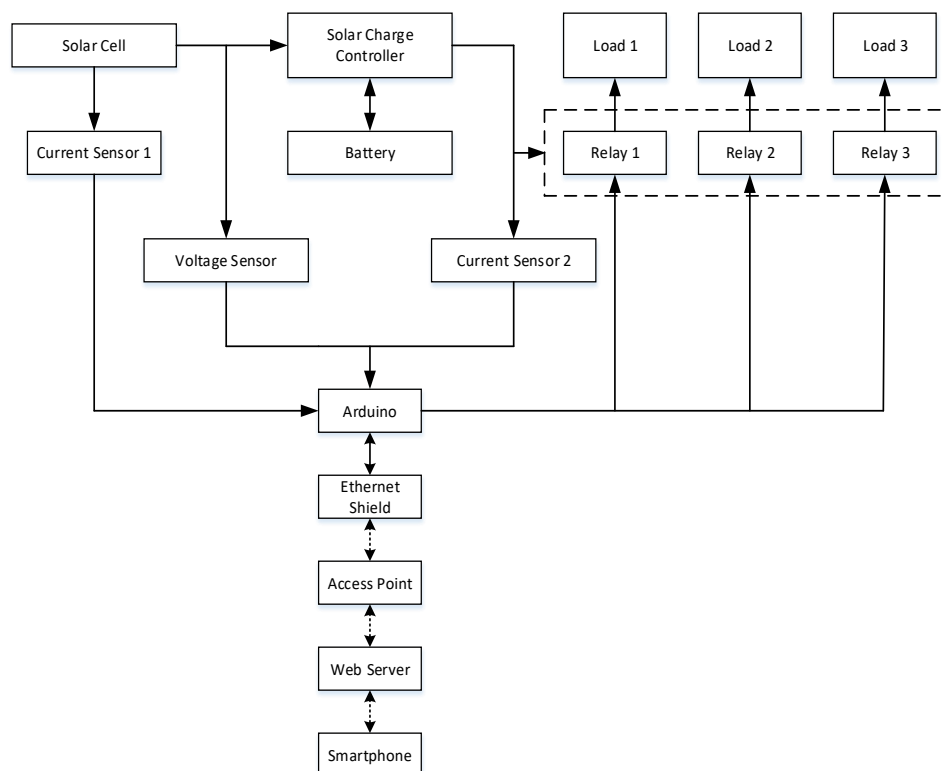


Figure 1. Block diagram monitoring and controlling solar home system via IOT based on smartphone.

2.2. Hardware design

The design of monitoring system is composed of two sensors that are current and voltage sensors connected to the solar panel where the microcontroller is functioned to process the value of the current and voltage of the sensor which is then informed to the smartphone device through internet network access. The design of the circuit is shown as in Figure 4. (a). While the design of the control system is composed of a combination of an Arduino microcontroller with a relay as an on / off switch connected to the load [5]. The working principle is that when the solenoid in the iron core is fed by an electric current, the lever will be attracted because of the magnetic force that occurs in the solenoid so that the switch contact will close. Conversely, when the electric current to the solenoid is not detected, the lever will return to its original position and the switch contact is opened again. The circuit configuration is made Vcc voltage and all ground relays are joined and connected to Arduino. The design of the circuit is shown as in Figure 2. (b).

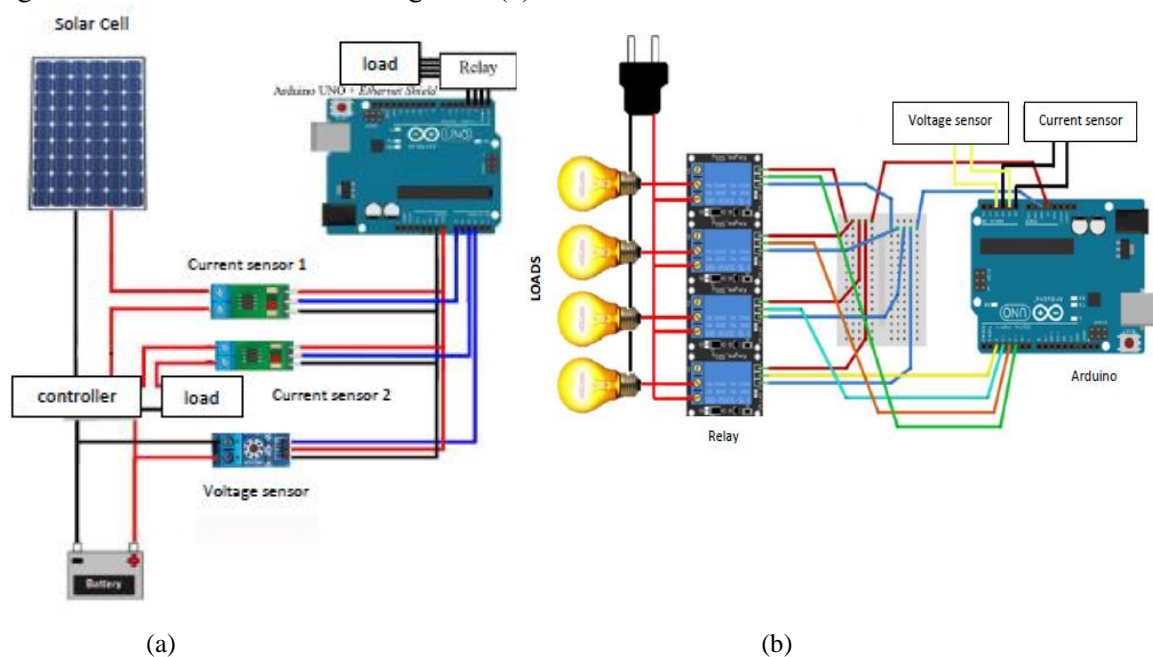


Figure 2. Hardware design circuit system of solar home system: (a) Monitoring system (b) Controlling system.

2.3. Software design

The designed software is used to determine the flow of the execution process of the monitoring system devices and the control of the solar panels. Each input data received from the current and voltage sensors will be arranged through the program source code that has been created which will then be processed by the microcontroller to determine the execution on the output. The program flow is divided into two execution paths that are program flow for monitoring and controller system as shown in figure 3 and figure 4.

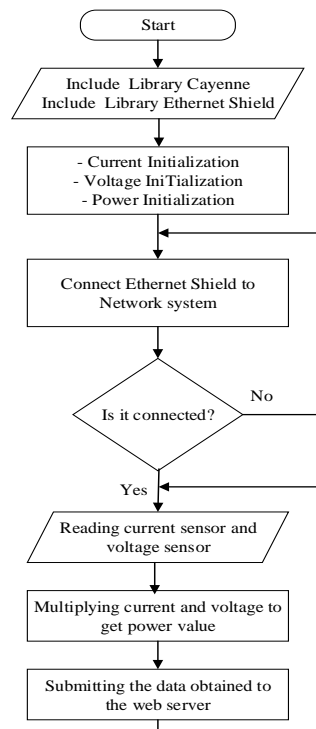


Figure 3. Program for monitoring system solar home system.

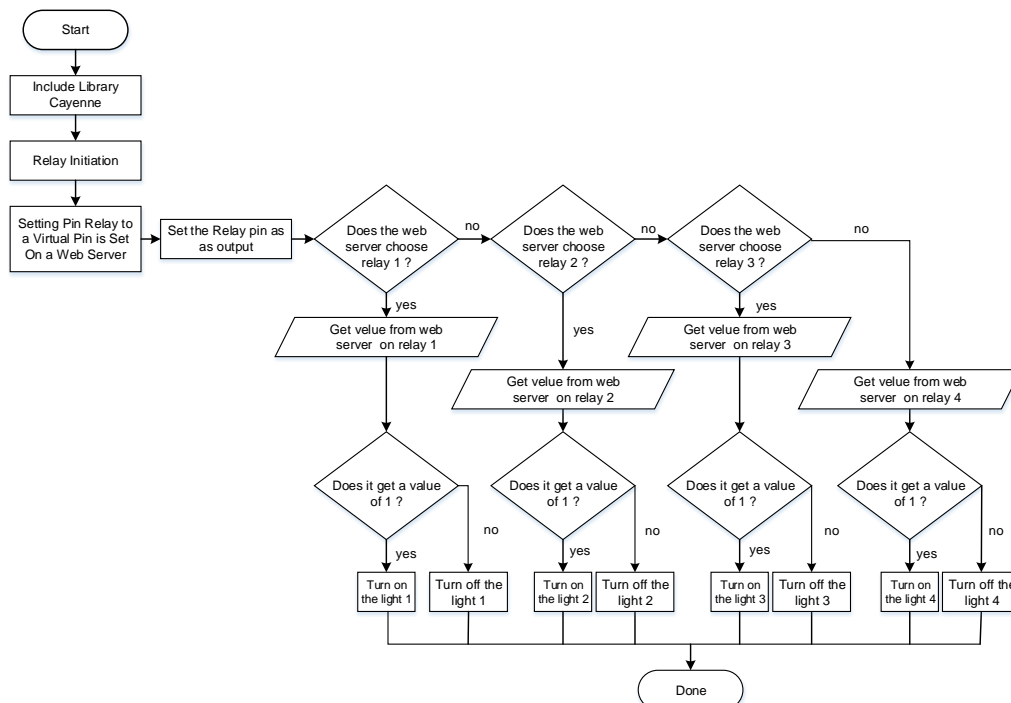


Figure 4. Flow program for controlling system solar home system.

3. Results and discussion

The process of testing and measuring system designed is done through two stages of monitoring and controlling system. The average power value generated by a solar panel to be used at the load is expressed by equation 1 [6, 7].

$$P = \frac{1}{T} \int_0^T p(t) dt \quad (1)$$

The test method of a load power monitoring system is done based on two conditions that are when charging and discharging energy from solar panel to battery. Whatever the result is shown by a curve as in figure 5.

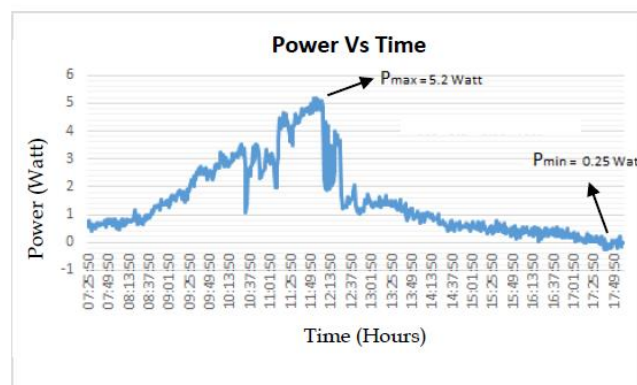


Figure 5. Test results monitoring system power charge during battery charging.

According to the test results in figure 7 above shows that the highest power generated by solar panels is 5.2 Watts when the time is 11:49:50. This situation is achieved because the intensity of sunlight at that hour is experiencing the highest intensity. Furthermore, linear will decrease power as decreasing of sunlight intensity. As for the test when the power discharges occur which simultaneously with the process of power consumption by the load results are shown as in Figure 6.

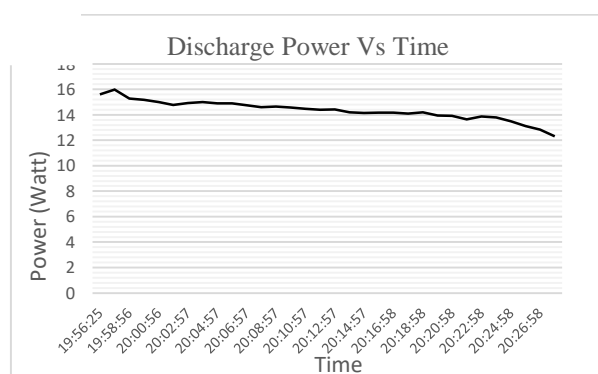


Figure 6. Test results monitoring system power charge during battery discharging.

The maximum value of current and power according to the above test results from the start of discharge shows the result of 1.22A and 15.98 Watt when the initial load usage is precisely at 19:57:25. While the current and average power of 1.16 A and 14.35 Watt. While control system experiments performed by pressing the button the lamp 1, lamp 2, lamp 3, and lamp 4 to instruct the system to turn on or turn off the light using smartphone as show in figure 7.a, 7.b, 7.c and 7.d.

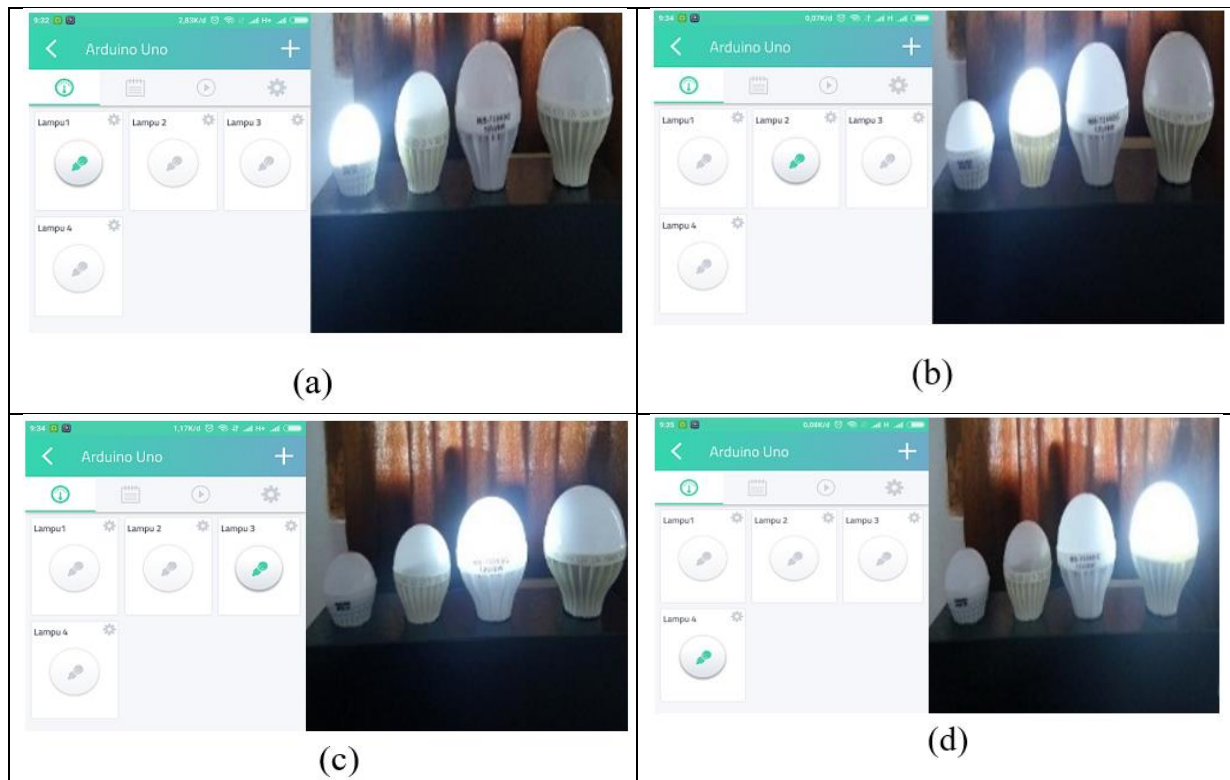


Figure 7. Results testing load light via smartphone: (a) Load 1, (b) load 2, (c) Load 3, (d) Load 4.

Based on the results of comparison with previous research [8] where the current and power values generated by the system designed is better and able to light the lights with a well-controlled and monitored in Realtime by smartphone devices through the IoT network the amount of power usage. If compared to other research by using an approach of DC-DC converter technique of voltage increase which its controlling step is determined by a change of input resistance controller value as explained by equation 2 [9], then the output voltage of this designed system is larger and more stable results.

$$\Delta R_{(Capture)} = \left[\frac{V_{out}}{V_{ref}} - 1 \right] x R_{in} \quad (2)$$

4. Conclusion

Based on the results of system design and test results and analysis that has been done can be drawn some conclusions that the system test results show the amount of electrical load power consumption produces power average charging power for 10 hours of 1.35 Watt when the maximum power showed 5.2 Watts. While at discharge, the battery is capable of switching on 4 pieces of the light load for 30 minutes with the current and average power generated respectively for 1.16 A and 14.35 Watt. Then the system is able to control the power load remotely in real time seen from the view of the smartphone that shows the average delay time of 7.9 seconds when accessing data from the reading of voltage and current sensors to the IoT network.

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