Application of Arduino in Measuring, Monitoring, and Analyzing the Performance of Home Solar Panel

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Abstract. Solar panels are commonly used to replace power sources like fossil fuel. The usage of solar panels is because it is eco-friendly to the environment and can keep producing electricity freely as long as there is sun 's light. Although there is a downside for solar panels, it is still a safe choice for producing or replacing any kind of power source. This research gives the details related to solar panel power and includes the usage of the solar panel to the household appliance. The main content of this paper is monitoring, analyzing, measuring Solar PV panel DC power output and using Arduino based modules to do the monitoring, analyzing, measuring for this research. After the measuring and analyzing the output, this result can give the researcher to achieved and accurate result of the DC power output of the solar panel and can be used for industrial purposes and household appliances and also monitoring that are created on LCD can be used for maintenance if there is in need for maintenance, so that the power output can be check all the time automatically without physical interference.

Keywords: Solar Panel, DC power, Monitoring, Analyzing, Measuring, Arduino.

1. INTRODUCTION

The constant usage of fossil fuel on earth are increasing by year and increasing their unit cost, global warming and controversies surrounding problem of nuclear energy have pushed people to seek renewable energy source with low cost, eco-friendly. The sun's light is one of the clean source energies but disclose when the night time come. Producing electricity directly by using photovoltaic system is one of the major ways. Photovoltaic cells are made from semiconductors materials that can convert the incoming sunray into DC (direct current) electric without any other means. Using Arduino module to store data so that the output power source can be measured, monitored, analyzed automatically.

2. LITERATURE REVIEW

Electric power generally produces by an electric generator, but supplies like batteries can also generate electric power. Electric power is divided into Direct Current (DC) and Alternating Current (AC). Where DC power are supplied with solar panel, batteries, and thermocouples. While AC power usually supplied by electric generators, where AC power are used in homes. Electric Power SI unit is Watt or Joule per Second.[1][2]

3. METHODOLOGY

Solar panel are groups of solar cells that combine together. Solar panel are in everyday things like calculators, watches, etc. Using solar panel means that we never have to run out of batteries since solar panel can charge up electricity where there is a presence of light.[8]

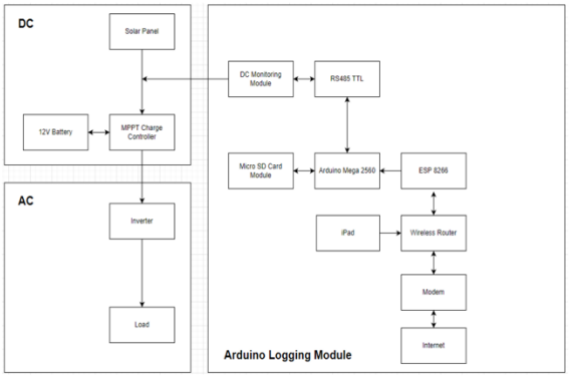

Figure 1. Solar Panel Block Diagram

This block diagram represents how the assembly of this research are conducted. Solar panel and 12V battery are connected to the MPPT Charge Controller then the output of solar charge controller is connected to inverter to power up AC devices. To do the logging there are 2 way one using the ESP8266 which send the data online through the internet while MicroSD Card module serves as a backup if there is an error on the internet.

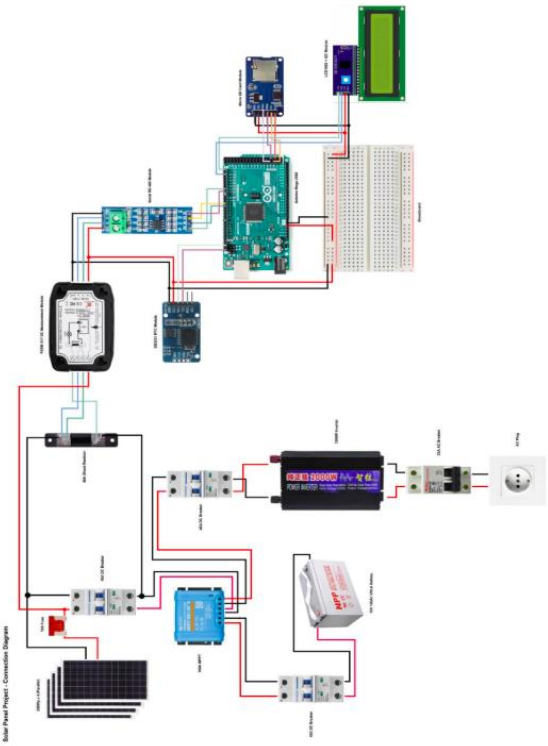

Figure 2. Connection Block Diagram

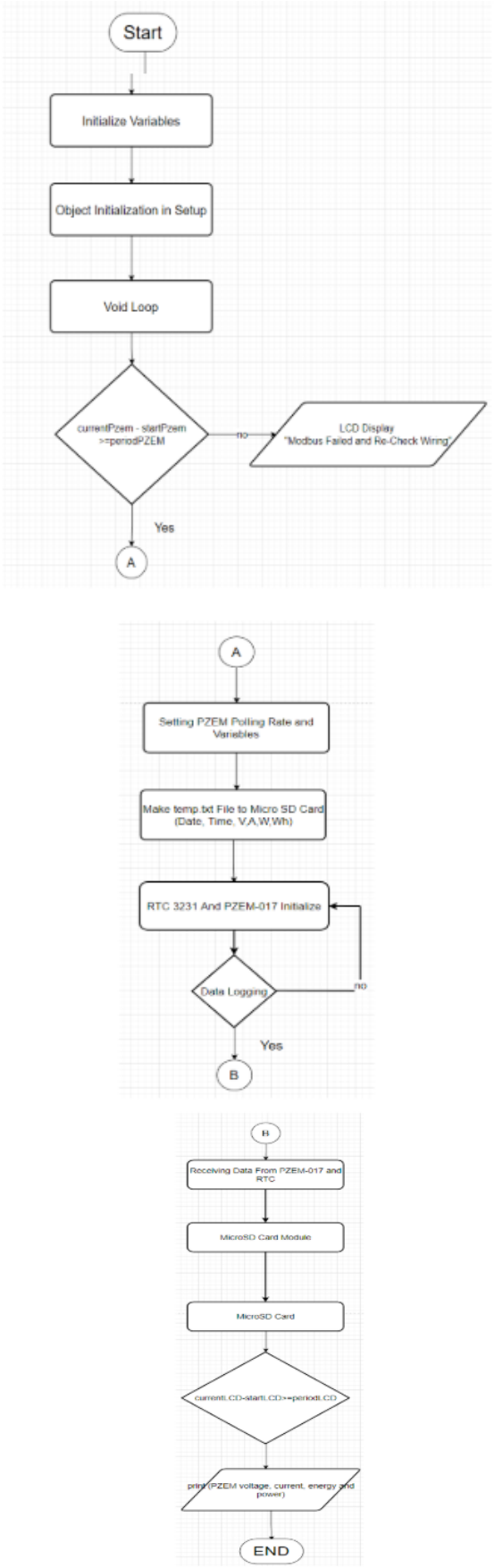

Figure 3. Solar Panel Project-Arduino Flowchart

The flowchart explains the flow of the application in the sequential order. The flow starts with initializing the variables and then followed by some object initializations in setup, then goes to loop. In the loop, if the PZEM current time minus the start time bigger than the period PZEM, then if yes it goes to setting the PZEM polling rate and if no, it prints out the LCD and says the MODBUS is failing and the user needs to re-check the wiring. After setting the polling rate, it goes into making a temp.txt text file into the MicroSD Card and it writes the date, time, Voltage, Current, Watt and Watt-hour. Following the temp file writing, initialize the DS3231 RTC Module and PZEM 017 and begin the logging data process by sending the command to the MicroSD Card module via SPI and then by writing it physically to the MicroSD Card. After all that done, check if the Current LCD time minus the start LCD time is bigger than the LCD period. After that the module can print the voltage, current, energy and power to the LCD.

4. RESULT

The data will be taken from 6AM to 5PM. Table 1 is some of the examples of the data. The resolution for the voltage and current measurement 0,01V and 0,01A. For the power measurement the resolution is 0,1 Watt. The accuracy of the voltage, current, and power is 1%.

Table 1. Data Result

Date	Time	Voltage (V)	Current (I)	Power (Watt)
28/06/2022	08:01	14.38	15.75	226.4
28/06/2022	08:02	17.5	17.45	305.3
28/06/2022	08:03	24.46	19.39	474.2
28/06/2022	08:04	14.51	13.92	201.9
28/06/2022	08:05	23.39	19.61	458.6
28/06/2022	08:06	22.07	13.61	300.3
28/06/2022	08:07	28.07	21.54	604.6
28/06/2022	08:08	27.47	17.27	474.4
28/06/2022	08:10	19.34	15.31	296
28/06/2022	08:11	14.32	13.08	187.3
28/06/2022	08:12	14.36	12.61	181
28/06/2022	08:13	14.31	13.11	187.6
28/06/2022	08:14	14.12	10.09	142.4
28/06/2022	08:15	14.04	9.13	128.1
28/06/2022	08:16	14.02	8.93	125.1
28/06/2022	08:17	14.02	9.16	128.4
28/06/2022	08:18	14.06	9.78	137.5
28/06/2022	08:19	14.18	11.44	162.2
28/06/2022	08:20	14.3	12.69	181.4
28/06/2022	08:21	14.51	15.93	231.1
28/06/2022	08:22	20.85	20.51	427.6
28/06/2022	08:23	22.34	18.86	421.3
28/06/2022	08:24	20.78	15.8	328.3
28/06/2022	08:25	22.84	13.85	316.3
28/06/2022	08:26	30.62	20.32	622.1
28/06/2022	08:27	21.58	15.99	345

5. CONCLUSION

After replacing the solar panel into the new position with an tilt angle of 26°, unfortunately due to the bad weather, the solar panel could not work optimally with an average output of 116 Watt, this output is bigger than the previous output when the solar panel are put on flat surface which are 89 Watt. After comparing both of the data, it has an increased efficiency by 2,7%. Additionally, if the weather is not cloudy, the result will be better than 116 Watt. Also, the usage of ESP8266 failed is because the desmos ESP8266 is incompatible with the firmware that are available in Arduino. Even if it is compatible with the existing firmware in Arduino, the firmware that are expected is not compatible with the google firebase. Because of this error the usage of IPadOS, Xcode, Swift, Firebase are not used.

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