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Implementation Of Solar Electric Energy Monitoring For Household Electricity Loads Using IOT

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Abstract - In a power plant using solar power to provide household electricity is a supply for electricity consumers towards carbon-free energy, the use of solar panels by the community has begun to be done this is because the community canalready have a good reference for solar panels. The research method uses an experimental method, namely implementing and analyzing the use of solar cell system electrical energy for electrical loads in households for the right analysis results and getting a good design as planned. The equipment used are photovoltaic modules, solar chargecontrollers, inverters, batteries, control panels, household electrical loads, multimeters, luxmeters and digital temperature gauges and IoT. The results showed that for household electricity needs of 35.131 watts hour, it normally requires 1300 Wp solar panels, 3 batteries with a capacity of 24 volts 200 Ah each, assuming 2 days. In this study, PLTS uses 600 Wp solar panels, 1 battery with a capacity of 24 volts 200 Ah, and PLTS can serve 78 watts hour andthe investment cost required is Rp. 35,000,000, - with electricity savings of Rp. 35,975, - per month assuming the price of electricity is Rp.1300,-/Kwh.

Keywords - Solar panel, Implementation, Electric energy, IoT

1. INTRODUCTION

Renewable energy is energy that is produced from natural sources namely sun, wind, rain, geothermal and can beproduced repeatedly as needed. The energy is available in large quantities and so far, is the source of energy that remains available on this planet. For examples energy from the sun can be used to produce electricity. Likewise, energy from wind, geothermal, biomass from plants and tides. When the price of oil in the world market rises, this renewable energy becomes the main alternative to be used as a substitute for the use of non-renewable energy. Renewable energy sources such as solar, water and wind are renewable energy sources that are not depleted or have significant harmful effects on the environment. The world's fossil fuel resources cannot sustain energy needs for the next few decades and hence the need for cheap alternative energy is now urgently needed. Over the last few years many research groups around the world have investigated the semiconductor properties of conjugated materials and their use for led, photovoltaics and transistors. Research on electricity generation through the use of solar cells is an example of one-way scientists try to reduce some of the dependence on non-renewable resources.

The threat of global warming on earth makes it necessary to find alternative energy sources. The search for renewable and cheap energy is the subject of several current studies, and the discovery of solar cells is one of the breakthroughs towards reliable alternative energy. The development of solar cells shows impressive evolution over the last few years. This technology has been largely tested in laboratories using integrated devices. The performance of photovoltaic solar cells perovskite is evaluated in tropical weather conditions. Specifically, two perovskite modules with active areas of 17 and 50cm2 were created, encapsulated and tested. and commercial silicon panels as a reference, the two technologies are evaluated for 500 hours by connecting I-V measurements with atmospheric variables measured every minute during sunny weather to get the average performance and efficiency of solar cell equipment, graphically visualizing the characteristics of solar cells in various atmospheric conditions. The results show that the power delivery and short circuit current of the two technologies are linearly correlated with atmospheric variables. In addition, the open circuit voltage of perovskite technology shows nonlinear behavior and improved performance with temperatures at high irradiance.

Solar cells are an important part of optical devices because of their ability to convert solar energy into electrical energy. While the use of solar cells to provide electricity is still at an early stage, accounting for only about 1.5% of electricity supply using solar cells from electricity demand worldwide, solar cells are used continuously and increasingevery year, further research in all aspects of solar cell installations, from material to devices to the system continues. Systems with a 308V DC microgrid voltage for household appliances (internal DC) are modified to operate on 48V DC from the DC distribution line. The electrical system using universal and induction motors for the BLDC (Brushless DC) motor is proposed because it is very efficient with minimum electro-mechanical and no loss of energy conversion.The proposed DC system reduces the power conversion stage, thereby reducing power losses and

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increasing overall system efficiency. For this reason, conventional AC systems can be replaced by DC systems that have many advantages both in terms of cost and performance.

Electricity consumption profile data that includes details on electricity consumption can be generated with a bottom-up load model. In this model, the load is built from basic load components which can be household or even individual equipment. This research presented a simplified bottom-up model to produce realistic domestic electricity consumption data every hour. This model uses the input data available in reports and statistics. The results of the analysis show that the resulting load profile correlates well with real data. In addition, three case studies with generated load data show several opportunities for demand-side management. With this scheme, the daily peak load can be reduced by an average of 7.2%. and the peak load on annual peak days can be averaged with a peak reduction of 42% and a sudden loss of 3-hour burden can be compensated with an average load reduction of 61%. The design for photovoltaic (PV) systems provides electricity needed for households. Radiation data and typical household electrical load data at the site are taken into account during the design steps. System reliability is quantified by loss of load probability. A computer program is used to simulate the behavior of a PV system and numerically find the optimal combination of PV arrays and battery banks to design stand-alone photovoltaic systems in terms of reliability and cost. this study calculates the

Annual life cycle costs. and annual unit electricity costs. Simulation results show that the valueof the probability of loss of load can be met by several combinations of PV arrays and battery storage. The uniquely developed method determines the optimal configuration that meets load demands with minimum costs.

2. METHOD

This research method uses experimental research methods, namely by designing solar power plants. then make observations and measurements on solar power generation systems such as current, voltage, temperature and solar radiation intensity. Measurement of temperature and solar radiation intensity is done by placing a measuring device next to the photovoltaic module. Measurements were made for 36 hours with control using IoT. In this research calculates and discusses the need for electrical energy for households, the realization of power services by solar power plants, the investment costs of making solar power plants and the savings in electricity bills that can be saved.

Based on the above problems, it is necessary to design an online monitoring tool system for solar panels that is practical, minimal financing, and fast data transmission The hardware design of this tool starts from the placement and installation of small components such as sensors, power supplies and IoT System in the box, and the installation of components. The design of the entire series of Internet of Things (IoT)-based monitoring systems uses Polycrystalline Ber type solar cell material with a capacity of 600 Wp and the main thing is the use of IoT System tools as a control system technology to facilitate communication to be recorded to the web and android is used.

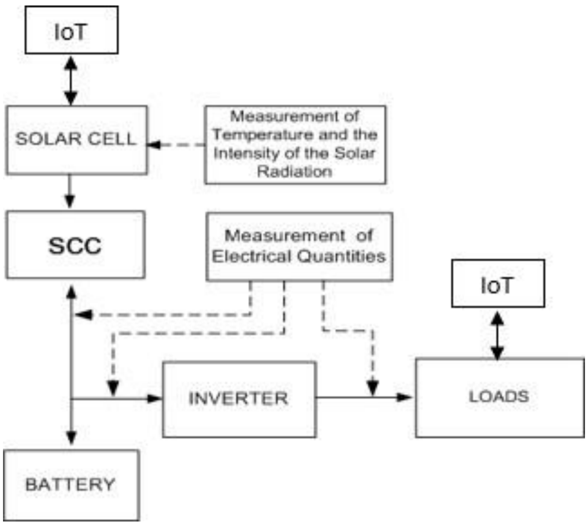

Figure 1. Block diagram of the system

This test connects the IoT system circuit connected to the solar panel and the test image of controlling usingIoT can be seen in Figure 2.

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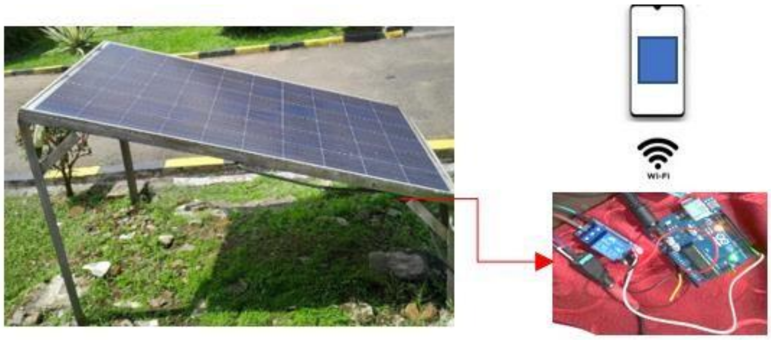

Figure 2. Design IoT System

Overall testing on the circuit connecting the IoT system circuit connected to the solar panel and connected to themanagement and control system to the load by adding the Iot system to the load can be seen in Figure 3.

Figure 3. Overall testing Design IoT System

The amount of electric current delivered from a power supply to a device or component receiving power. Most power supplies are only capable of providing a certain amount of power, The load factor is the actual number of kilowatt- hours (kWh) delivered on the system in a given time period, compared to the total kWh that could possibly be delivered on the system in a given time period, according to the following equation (1):

$$Eb = Ep - (15\% \times Ep) \qquad (1)$$

Where: Eb = load energy (watt/hour)

Ep = solar panel energy (watt/hour)

Measurements of the PLTS network system with this load are not carried out at different times and at different times, so that from the voltage measurement graphs of various types of loads above show some measured output voltage values of 220 Volts or more. The magnitude of the output current value that will be measured indicates the amount of power in the load that will be used by the user. as in the equation (2):

$$\text{Electricity usage (Watt)} = \text{appliance power} \times \text{usage time} \qquad (2)$$

Where: Appliance power (Watt)

Usage time (hour)

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3. RESULTS AND DISCUSSION

This research uses the following equipment:

- 6 units of solar modules with a total capacity of 600 Wp.
- 4 units of 12V 100 Ah VRLA Battery (Valve Regulated Lead Acid) Batteries.
- 1 unit of SCC (Solar Power Chargers).
- 1 unit of Inverter 2000 W.
- 6 digital ampere meter units
- 3 units of digital voltmeter
- 1unit luxmeter
- 1 unit of digital temperature gauges
- 25 meters of solar cell cable measuring 2 x 4 mm

Table 1. Electricity Energy Usage

No	Load	Watts	Qty	Hours per day	Days / week used	Weekly Watt hours
1	Back Room Lights	26	1	8	7	1456
2	Center Room Lights	28	1	8	7	1568
3	Kitchen lights	25	1	11	7	1925
4	Side Porch Lights	18	1	7	7	882
5	Home Rear Lights	30	1	6	7	1260
6	Refrigerator	95	1	24	7	15.960
7	Rice Cooker	350	1	1	7	2450
8	Fan	90	1	2	4	720
9	Washing machine	350	1	3	7	7.350
10	TV	30	1	4	7	840
11	Laptop	60	1	4	6	720
	Total hours per day			78		35.131

Total weekly watt-hours of AC Load (Wh) = 35.131 watt-hours
Divided by days per week = (7)
Average total watt-hours per day = 35.131/7 = 5.018,71 watt-hours
Divided by dc nominal voltage (12, 24 or 48 Volts)
Average amp-hours per day (Ah /d) = 5018,71/24 = 209,11Ah
Divided by inverter efficiency see detail specs, let say (0,9) = 209,11/0,9 = 232,34 Ah/day Divided by battery efficiency, let say (0.85) = 232,34/0,85 = 273,35 Ah/day
Divided by Depth of Discharge (let say 80% remaining) = 273,35/0,8 = 341,68 Ah/day Multiplied by days of autonomy = 2 x 273,35 = 683,37Ah.
Battery Bank Size Required (Ah)= 683,37 AhBattery Ah = 200 Ah, 24 volt
Battery qty based on the capacity = 2,7 or 3 unit
Battery qty based on the voltage from 12v 100 Ah each to supply 24 V, = 3x4 = 12 unitTotal Load watt hours per day = 3963 watt-hour.
Solar Panel KIT 100 watt, with capacity per day (5 - 6 hours) = 13,21Total solar panel kit required = 13 unit

While the table not shown in this paper is a charging and loading table by solar power plants because the number of lines is very large, so that only the calculation results for the average electricity needs that can be served for 1 day is 3035watt hours with 2 days of charging without loading. For that the cost can be saved in 1month if the price of electricity is Rp. 1352/Kwh, the cost saved is Rp.45,662 / month.

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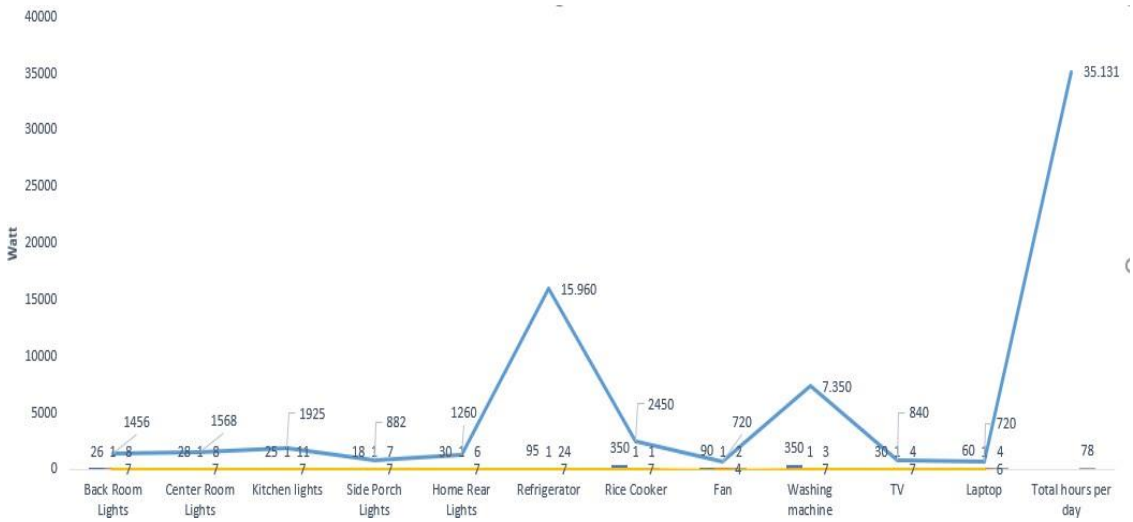

Figure 4. Graph of energy utilization

4. CONCLUSION

Household Electricity Demand, This Study Is 78watt Hours, In This Calculation Requires 1300 Wp Solar Panels, 3 Batteries, With A Capacity of 24 Volts Each, 200 Ah, Assuming 2 Autonomous Days. In This Study PLTS Uses 600Wp Solar Panels, 1 Battery with A Capacity Of 24 Volts 200 Ah, And PLTS Can Serve 35.131Watt Hours, And Investment Costs of Rp. 35,000,000, - With Electricity Cost Savings of Rp. 45,662- Per Month Assuming. An Electricity Price of Rp. 1720/Kwh, there is energy regulation on the use of IoT as energy monitoring in solar power plants

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