Irrigation Pump with Generating Source Solar Based Electricity Internet of Things

I Ketut Parti, Ni Wayan Rasmini and I Nyoman Sukarma
Department of Electrical Engineering, Bali State Polytechnic, Indonesia

Keywords: Solar Water Pump, Renewable Energy, IoT-Based.

Abstract: One of the uses of Solar Power Plants (PLTS) used in the agricultural irrigation sector is "Modeling Irrigation Pumps with PLTS Based on Internet Of Things (IoT)", in Subak Kance Tegeh, Selanbawak Village, district Tabanan, Subak kance tegeh whose irrigation is supplied from Tukad yeh Sungi, but 10 hectares of rice fields geographically higher cannot be reached by air, because it is located about 4 meters above the current water flow, as a result of water shortage in Peranian agriculture it cannot be done optimally. during the dry season, and from information obtained from subak kance tegeh, during the dry season, 10 ha of agricultural land cannot be planted with rice due to drought. The amount of loss due to drought every 1 Rp = 150,000, losses due to drought range from Rp = 150,000 x 100 x 10 = 150,000,000. To overcome this in one harvest, build a pump.

1 INTRODUCTION

Domestic Industry and the agricultural sector, to maintain macroeconomic health to reduce social and environmental impacts arising from fossil energy generation.

In the field of renewable energy utilization, many system models are used, namely to maintain a better quality of agricultural production. One application of a pump irrigation system with a solar power plant is in Subak

Kance Tegeh in Selanbawak, Marga District, Tabanan Regency, Bali Province (Imam Sanjaya o et al., 2019) (V BS et al., 2015) (Ali R and Shah MA ., 2018).

Subak Kance Tegeh is one of the subaks located in Marga Sub district, Tabanan District. Subak Kance tegeh with an area of 120 hectares which is fed by water from the Yeh Sungi but not all topography gets water flow because 10 hectares of rice fields are above about 4 m from the existing water flow, from 10 hectares of rice fields there is no water flow, so automatically dry season cannot produce agricultural products due to drought. (Kumara I et al.,) (Sari DP et al., 2020).

To overcome this, namely by engineering the installation of a water pump with PLTS will be able to overcome this, besides that this facility can be easily operated by subak members, and also maintenance costs are economical, therefore the application of PLTS Solar Power Generation Technology (PLTS) saves energy by utilizing the potential of solar energy available on site is the right solution. PLTS or better known as solar cells (Photovoltaic) is used as an energy source to drive a pump. The use of PLTS as an alternative energy source is increasing from year to year, especially in Indonesia, from the use of PLTS for small-scale to large-scale energy sources. In general, the performance of a solar water pump can run well if it gets enough solar radiation. so that the implementation of solar water pumps has very promising potential. Based on these problems, research was conducted on the utilization of Solar Power Plants (PLTS) which are used as an energy source to drive pumps in Subak Kance Tegeh, so that irrigation water discharge increases (Hamzah SR et al., 2019) (Hossain MA et al., 2014).

2.1 PLTS Centralized Solar Power Generation System (From the Grid). is a power generation system that utilizes solar radiation without being connected to the PLN network or in other words the only source of electricity generation only uses radiation with the help of solar power. panels or solar panels cell. photovoltaic to be able to generate the system.

One of the advantages of the off-grid system when compared to the on-grid system is that it can still

Parti, I., Rasmini, N. and Sukarma, I.
Irrigation Pump with Generating Source Solar Based Electricity Internet of Things.
DOI: 10.5220/0011713000003575
In *Proceedings of the 5th International Conference on Applied Science and Technology on Engineering Science (iCAST-ES 2022)*, pages 89-93
ISBN: 978-989-758-619-4; ISSN: 2975-8246

provide electricity in the event of a power outage from PLN. However, this system has a downside may not be able to meet the total electricity demand given the cost and volume of the battery can be very high. Communal PV mini-grid requires more complex equipment and costs higher than communal PV mini-grid. The main components of an off-grid system are solar panels, charge controllers, inverters, and batteries. The inverter used in the off-grid system is different from the on-grid system. In the off-grid inverter system used is an inverter with two-way capability so that it can charge the battery and drain electricity from the battery for use in the load.

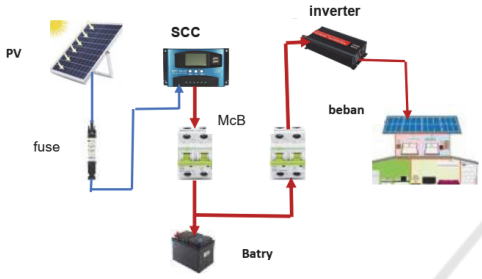

Figure 1:PLTS Of grid system.

On-grid solar power generation system.

On-grid solar panel system or PLTS Grid-Tie System is a system that works directly on solar panels. This technological system does not use batteries, and the electricity generated is directly used for various purposes. The electricity produced is AC so that this on-grid solar panel can be applied together with the PLN network. If there is an excess of power, the electric power will be sold to PLN if at night the power used comes from PLN.

This on-grid system of solar power plants is suitable for application in the field by utilizing the roof as a space to absorb solar energy. This system, if installed with PLN, will reduce electricity costs (Almanda D et al., 2020).

An interconnected PLTS system (On-Grid) or what is called a Grid-Connected PV System is a power generation system that utilizes solar radiation to generate electricity. As the name implies, this system will utilize the PLN network by optimizing the use of solar energy through solar modules or photovoltaic modules that generate as much electricity as possible. This system is also considered environmentally friendly and emission-free. The interconnected PLTS system is also a green energy solution for the community, both offices, and housing, which aims to reduce electricity bills from PLN and can provide added value for its owners (Septiadi D et al.,2009). (REGA MSN et al., 2021)

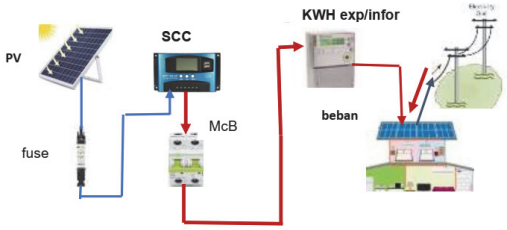

Figure 2: PLTS On grid system.

Internet of Things (IoT) has been widely applied over the last few years 5. The technology it self gives freedom to the users for free or paid terms for internet cloud memory usage. IoT is physical things that talk to each other connected to wired and wireless networks,6 through application programming interfaces (APIs). IoT is used not only for the field of consumer electronics and appliances but also in many other fields such as smart city, healthcare, smart home, smart car, smart grid systems, and many other industrial applications. As many hybrid rooftop photovoltaic wind turbine systems increase in existing grids, there is an increased time to no real power generation to optimize total performance and to maintain grid and power output.

2 METHODS

The materials used in this research are PLTS off grid specifications as follows:

Specification:

1. Solar Panel 300 x2 600 WP
2. Dc-dc up/down Converter 10A 12volt DC 30 A
3. SCC 40A/12/24volt.
4. Inverter 3000 watt /12 volt
5. Battry 100 x 3 = 300 AH VRLA

6 Arduino Uno
7. Esp 8266
8. Sensor tegangan dan arus

9 Motor Pump 400 watt
10 Distribution panel
11 Mcb ac
12 Mcb dc

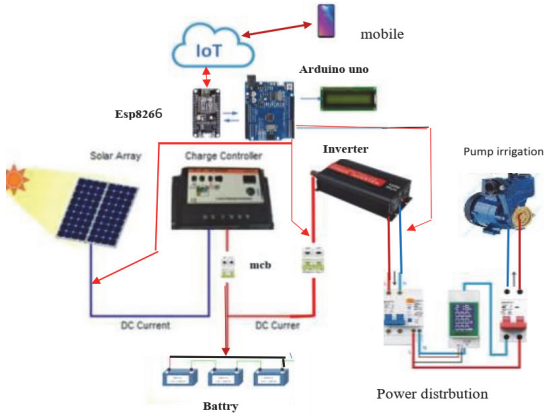

Figure 3: Irrigation pump system with PLTS Off Grid Base IoT.

Working diagram of the image above:

1. Sunlight that falls on the solar panel will be converted into voltage and current flows through the SCC (solar charger controller). At SCC the voltage is to be controlled so that it can be stable 2. At SCC the battery charging is regulated so that the charging can be more optimal.
2. To operate the pump, the power from the battery will make an inverter, from the inverter the DC voltage will be converted to a voltage of 220 Volts ac because the pump load requires a voltage of 220 volts.
3. To be able to monitor the voltage generated from the solar panel, the voltage is controlled by Arduino by installing a voltage sensor at the output of the solar panel and a current sensor, as well as the output voltage from the inverter.
4. connection, we can monitor the flow wirelessly with the installation of Esp 8266, we can do this monitoring in real-time.

3 RESULTS AND DISCUSSION

Voltage measurement of no-load solar power plants.

Measurements are made on the output of the solar panel and the voltage that has been flowed to the dc-dc converter, this is done to see how effectively it can stabilize the voltage. Produced by solar panels

Table 1: solar panel voltage measurement and converter dc-dc output.

Measurement 10 May 2022

Table 1: Measurements May 10, 2022.

Hour	*Vout PV (volt)*	*V out Dc-dc conveter(Volt)*
10:00	16.5	12
10:10	16.5	12
10:20	16.5	12
10:30	17	12
10:40	17	12
10:50	17	12
11:00	17	12
11:10	17.5	12
11:20	17.5	12
11:30	17.5	12
11:40	17.5	12
11:40	18	12
11:50	18	12
12:00	16.5	12

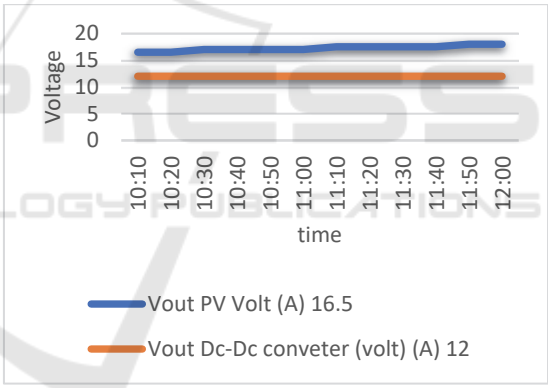

Figure 4: Characteristics of the voltage function of time.

From the above characteristics, the voltage generated from the solar panel is a minimum of 16 volts dc and a maximum of 18 volts dc and after being exposed to a dc-dc voltage, the stabilized voltage becomes 12 volts dc where the voltage will work as a voltage out of the dc-dc voltage to 12 volts dc.

Table 2: Measurements May 20, 2022.

Hour	*Vout PV (Volt)*	*V out Dc-Dc Converter (Volt)*
13:00	17.5	12
13:10	17.5	12
13:20	17.5	12
13:30	17.5	12
13:40	17.5	12
13:50	17.5	12
14:00	17	12
14:10	17	12
14:20	16	12
14:30	12	12
14:40	9	11.5
14:50	9	11.5
15:00	10	12

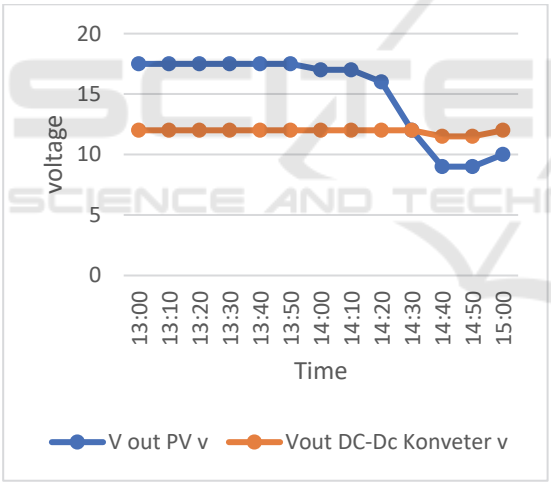

Figure 5: Characteristics of the voltage function of time.

From the above characteristics, the voltage generated from the solar panel is a minimum of 9 volts dc and a maximum of 18 volts dc after obtaining a dc-dc conversion, the voltage is stabilized to 12 volts dc, where the converter will work as a voltage amplifier when the voltage is 9 volts where the output voltage from dc-dc converter to an average of 11.5 volts. serves as a voltage when the solar panel voltage is 12 volts dc until the voltage reaches 18 volts dc so that the output voltage of the dc-dc converter becomes 12 volts dc.

Table 2 solar panel voltage measurement and no-load dc-dc converter output

Table 3: Measurements May 20, 2022.

hour	*Vout Pv (volt)* v	*Vout Dc-dc Conveter* v
13:00	17	12
13:10	17	12
13:20	16	12
13:30	10.5	12
13:40	10.5	12
13:50	10.5	12
14:00	10.4	12
14:10	10.4	12
14:20	10.4	12
14:30	9.5	12
14:40	9.5	11.5
14:50	9.5	11.5
15:00	9.2	11

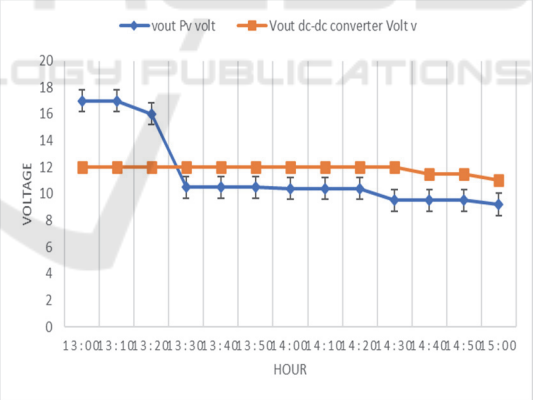

Figure 6: Characteristics of the voltage function of time.

From the characteristics above in Figure 7. the magnitude of the voltage generated by the solar panel is at least 9, at 2 volts dc after switching to the dc-dc converter, the voltage is stabilized to 11 volts d, where the change will work as. increase the voltage when the solar panel voltage is above 16 to 18 volts dc so that the output voltage of the dc-dc converter becomes 12 volts dc. Then as a voltage reduce.

4 CONCLUSION

Optimization of the solar panel voltage generation system can be done as follows:
1. The solar panel voltage can be stabilized by installing a dc-dc up/down converter.
2. If the solar panel voltage is above the setting voltage of the dc-dc converter, then the converter will function as a down voltage so that the output is by the settings. And if the voltage (UP) of the solar panel is below the voltage setting of the dc-dc converter, the converter will function as a voltage increaser in accordance with the settings.
3. Voltage that can be stabilized above 16Volt dc will be reduced to 12 volts dc.While the stabilized voltage is below the converter setting voltage, which is from 9 volts, it is increased to 12 volts dc.

REFERENCES

Iman Sanjaya O, Giriantari I, Satya Kumara IN. *Oya Iman Sanjaya, IAD Giriantari, I N Satya Kumara Perancangan Sistem Pompa Irigasi Pembangkit Listrik Tenaga Surya (PLTS) Untuk Pertanian Subak Semaagung*. Vol 6.; 2019.

V BS, S SW. Solar photovoltaic water pumping system for irrigation: A review. *African Journal of Agricultural Research*. 2015;10(22):2267-2273. doi:10.5897/ajar2015.9879

Ali R, Shah MA. Solar Powered Irrigation System for Agriculture based on Moisture Content in the Field and Saving Energy and Water with Optimum Designing The Brunel Navigation System for Visually Impaired Pedestrians View project(2017). doi:10.13140/RG.2.2.32397.90085

Hermanu C, Apribowo B, Endah T, Anwar M. *PROTOTYPE SISTEM POMPA AIR TENAGA SURYA UNTUK MENINGKATKAN PRODUKTIVITAS HASIL PERTANIAN(2017)*.

Sari DP, Kurniasih N, Fernandes A. Pemanfaatan Listrik Tenaga Surya Sebagai Pasokan Listrik Untuk Menghidupkan Mesin Pompa Air Masyarakat Dusun Cilatak, Desa Sukadana, Kecamatan Ciomas, Kabupaten Serang, Banten (2020). *TERANG*. 2020;3(1):68-79. doi:10.33322/terang.v3i1.1019

Hamzah SR, Irianto CG, Kasim I. Sistem PLTS Untuk Pompa Air Irigasi Pertanian di Kota Depok. *Jetri : Jurnal Ilmiah Teknik Elektro*. Published online August 16, 2019:73-86. doi:10.25105/jetri.v17i1.4788

Hossain MA, Salleh Hassan MH, Mosmar Alawad Ahmmed S, Hassan MS, Ahmmed S, Islam MS. *Solar Pump Irrigation System for Green Agriculture Wheat and Maize Production Systems:Assessment and Measures for Strengthening Food Security View Project Solar Pump Irrigation System for Green Agriculture*. Vol 16.; 2014. http://www.cigrjournal.org

Almanda D, Akhsin M, Muttaqin Z. Analisa dan Perbandingan PLTS on Grid yang Terpasang di Atap Gedung Utama PT Subur Semesta dengan PLTS On Grid yang Bergerak Mengikuti Arah Matahari(2020). 3(2).

Septiadi D, Nanlohy P, Souissa M, et al. *PROYEKSI POTENSI ENERGI SURYA SEBAGAI ENERGI TERBARUKAN (STUDI WILAYAH AMBON DAN SEKITARNYA)(2009)*. http://www.bom.gov.au/

REGA MSN, SINAGA N, WINDARTA J. Perencanaan PLTS Rooftop untuk Kawasan Pabrik Teh PT Pagilaran Batang. *ELKOMIKA: Jurnal Teknik Energi Elektrik, Teknik Telekomunikasi, & Teknik Elektronika*. 2021;9(4):888. doi:10.26760/elkomika.v9i4.888

Wasri Hasanah A, Koerniawan T, Elektro T, Tinggi Teknik -PLN S. KAJIAN KUALITAS DAYA LISTRIK PLTS SISTEM OFF-GRID DI STT-PLN. *JURNAL ENERGI & KELISTRIKAN*. 2018;10(2).

Yasir Pohan M, Pinayungan D, Zambak Mf, Hardi S, Warman E. ANALISA PERANCANGAN PEMBANGKIT LISTRIK TENAGA SURYA PADA RUMAH TINGGAL DI PONDOK 6(2021).

SAODAH S, UTAMI S. Perancangan Sistem Grid Tie Inverter pada Pembangkit Listrik Tenaga Surya. *ELKOMIKA: Jurnal Teknik Energi Elektrik, Teknik Telekomunikasi, & Teknik Elektronika*. 2019;7(2):339. doi:10.26760/elkomika.v7i2.339

Kumara I, Setiawan I, Studi Teknik Elektro P. *GRID TIE INVERTER UNTUK PLTS ATAP DI INDONESIA: REVIEW STANDAR DAN INVERTER YANG COMPLIANCE DI PASAR DOMESTIK(2020)*. Vol 7.

Herwandi. Implementasi grid tie inverter pada pembangkit listrik tenaga surya on grid untuk golongan pelanggan rumah tangga masyarakat perkotaan. *JURNAL ELTEK*. 2021;19(1):108. doi:10.33795/eltek.v19i1.292