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PROCEEDING

International Conference on Green Technology and Design

"A Dissemination platform for supporting green energy, green building, green automation, green transportation and environmental sustainability"

BANDUNG 4 – 5, DECEMBER 2019

BALE DAYANG SUMBI
INSTITUT TEKNOLOGI NASIONAL BANDUNG
WEST JAVA - INDONESIA

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BOOK OF PROCEEDING

INTERNATIONAL CONFERENCE ON GREEN TECHNOLOGY AND DESIGN

Bandung, 4 – 5 December 2019

Bale Dayang Sumbi
Institut Teknologi Nasional Bandung
West Java - Indonesia

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Address:
Jl. P.K.H. Mustapha No. 23, Bandung 40124 Telp: +62 22 7272215, Fax: +62 22 7202892
Email: penerbit@itenas.ac.id

RUNDOWN ICGTD

Day	*Time*	*Description*
Wednesday, December 4th 2019	*08.00 – 08.30*	*Registration*
	08.30 – 09.00	*Welcome speech:* ***ICGTD Chair, Rector of Itenas*** *and Opening*
	09.00 – 09.45	*Plenary Session: "Assessment of Solar PV Power Potential over Asia Pacific Region with Remote Sensing and GIS"* ***Jeark A. Principe, Ph.D (Philipine)***
	09.45 – 10.30	*Plenary Session: "Emissions and Mitigation Scenarios for Residential Combustion of Solid Fuels in Developing Countries"* ***Dr. Ekbordin Winijkul (Thailand)***
	10.30 – 10.45	*Coffee Break*
	10.45 – 11.30	*Plenary Session: "Water Resource Management Framework For West Java Province, Indonesia"* ***Iwan Juwana Ph.D (Indonesia)***
	11.30 – 12.30	*Ishoma Break*
	12.30 – 16.45	*Parallel Sessions – as attached*
	16.45 – 19.00	*Closing*

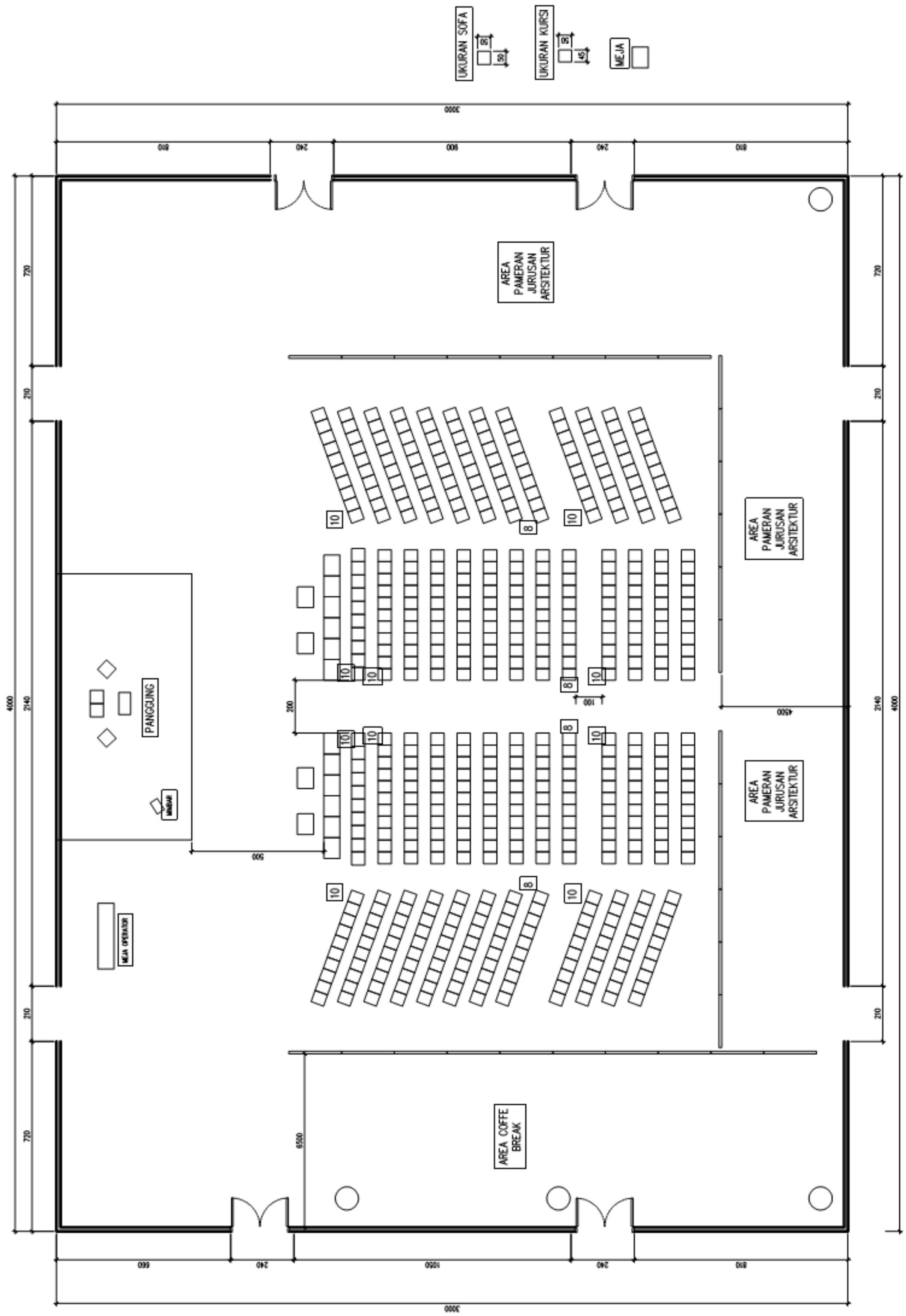
PRESENTATION SCHEDULE

No.	Name	Institution	Paper Topic	Presentation Time	Place
1	Niken Syafitri	Institut Teknologi Nasional Bandung	Green Automation	13.00	GSG Bale Dayang Sumbi Lt 1 (A)
2	Febrian Hadiatna	Institut Teknologi Nasional Bandung	Green Automation	13.15	
3	Florentinus budi setiawan	Soegijapranata catholic university	Green Automation	13.30	
4	Waluyo	Institut Teknologi Nasional Bandung	Green Automation	13.45	
5	Priyo Agus Setiawan	Politeknik Perkapalan Negeri Surabaya	Green Energy	14.00	
6	Lita Lidyawati	Institut Teknologi Nasional Bandung	Green Energy	14.15	
7	Bagus Rizky Pratama Budiajih	Institute Technologi Sepuluh Nopember	Green Energy	14.30	
8	Vibianti Dwi Pratiwi	Institut Teknologi Nasional Bandung	Green Energy	14.45	
9	Rachmad Ramadhan Yogaswara	Universitas Pembangunan Nasional (UPN) "Veteran"	Green Energy	15.00	
10	Lisa Kristiana	Institut Teknologi Nasional Bandung	Green IT	15.15	
11	Achmad Hizazi	Universitas Jambi	Green IT	15.30	
12	Dewi Rosmala	Institut Teknologi Nasional Bandung	Green IT	15.45	
13	Diki Ismail Permana	Institut Teknologi Nasional Bandung	Green Energy	16.00	
14	Yusup Miftahuddin	Institut Teknologi Nasional Bandung	Green IT	16.15	
15	Yudi Widiawan	Institut Teknologi Nasional Bandung	Green IT	16.30	
16	Rifqi Finaldy	Institut Teknologi Nasional Bandung	Green IT	16.45	
17	Hafidz Dayu Aditya	Institut Teknologi Nasional Bandung	Green IT	17.15	
18	Agus Hermanto	Institut Teknologi Nasional Bandung	Green Energy	17.30	
19	Meilinda Nurbanasari	Institut Teknologi Nasional Bandung	Green Energy	17.45	
20	Alfan Ekajati Latief	Institut Teknologi Nasional Bandung	Green Energy	18.00	
21	Lakshmanan Gurusamy	Universiti Malaysia Sarawak (UNIMAS)	Green IT	18.15	

No.	Name	Institution	Paper Topic	Presentation Time	Place
22	Abu Arif Jalaluddin	Universiti Malaysia Sarawak (UNIMAS)	Green IT	18.30	
23	Yanuar Z. Arief	Universiti Malaysia Sarawak (UNIMAS)	Green IT	18.45	
24	Nur Laela Latifah	Institut Teknologi Nasional Bandung	Green Building	13.00	GSG Bale Dayang Sumbi Lt 2 B
25	Riny Yolandha Parapat	Technische Universität Berlin (TU-Berlin), Berlin, Germany	Green Transportation	13.15	
26	Erwin Yuniar Rahadian	Institut Teknologi Nasional Bandung	Green Building	13.30	
27	Ardhiana Muhsin Machdi	Institut Teknologi Nasional Bandung	Green Building	13.45	
28	Tiara Anantika	Institut Teknologi Nasional Bandung	Green Building	14.00	
29	Wahyudi	Institut Teknologi Nasional Bandung	Green Building	14.15	
30	Dwi Prasetyanto	Institut Teknologi Nasional Bandung	Green Transportation	14.30	
31	Fred Soritua Rudiyanto Manurung	Institut Teknologi Bandung	Green Transportation	14.45	
32	Tarsisius Kristyadi	Institut Teknologi Nasional Bandung	Green Transportation	15.00	
33	Tarsisius Kristyadi	Institut Teknologi Nasional Bandung	Green Transportation	15.15	
34	Reza Phalevi	Institut Teknologi Nasional Bandung	Green Building	15.30	
35	Hendro Prasetiyo	Institut Teknologi Nasional Bandung	Green Building	15.45	
36	Ratna Agustina	Institut Teknologi Nasional Bandung	Green Transportation	16.00	
37	Jatmiko Wahyudi	Regional Development Planning Agency	Suistanability Environment	13.00	GSG Bale Dayang Sumbi Lt 1 (B)
38	Desti Santi Pratiwi	Institut Teknologi Nasional Bandung	Suistanability Environment	13.15	
39	Nguyen Thi Kim Oanh	Asian Institute of Technology (AIT)	Suistanability Environment	13.30	
40	Agung Pramudya Wijaya	Institut Teknologi Nasional Bandung	Suistanability Environment	13.45	
41	Edi Wahyu Wibowo	Politeknik LP3I Jakarta	Suistanability Environment	14.00	

No.	Name	Institution	Paper Topic	Presentation Time	Place
42	Taufan Hidjaz	Institut Teknologi Nasional Bandung	Suistanability Environment	14.15	
43	Elvira Rizqita Utami	Institut Teknologi Nasional Bandung	Suistanability Environment	14.30	
44	Farah Fauzia Raihana	Institut Teknologi Nasional Bandung	Suistanability Environment	14.45	
45	Byna Kameswara	Institut Teknologi Nasional Bandung	Suistanability Environment	15.00	
46	Ajeng Alya Hidrijanti	Institut Teknologi Nasional Bandung	Suistanability Environment	15.15	
47	Fenty Wastika Sari	Institut Teknologi Nasional Bandung	Suistanability Environment	15.30	
48	Yudi Adi Pratama	Institut Teknologi Nasional Bandung	Suistanability Environment	15.45	
49	Jono Suhartono	Institut Teknologi Nasional Bandung	Suistanability Environment	16.00	
50	Iredo Bettie Puspita	Institut Teknologi Nasional Bandung	Suistanability Environment	16.15	
51	Ronny Kurniawan	Institut Teknologi Nasional Bandung	Suistanability Environment	16.30	
52	Yulianti Pratama	Institut Teknologi Nasional Bandung	Suistanability Environment	16.45	
53	Maya Ramadianti Musadi	Institut Teknologi Nasional Bandung	Suistanability Environment	17.00	
54	Maya Ramadianti Musadi	Institut Teknologi Nasional Bandung	Suistanability Environment	17.00	
55	Soni Darmawan	Institut Teknologi Nasional Bandung	Suistanability Environment	17.15	
56	Soni Darmawan	Institut Teknologi Nasional Bandung	Suistanability Environment	17.30	
57	Rika Hernawati	Institut Teknologi Nasional Bandung	Suistanability Environment	17.45	
58	Ida Wati	Institut Teknologi Nasional Bandung	Suistanability Environment	18.00	
59	Caecilia Sri Wahyuning	Institut Teknologi Nasional Bandung	Suistanability Environment	18.15	
60	Fifi Herni Mustofa	Institut Teknologi Nasional Bandung	Suistanability Environment	18.30	
61	Enni Lindia Mayona	Institut Teknologi Nasional Bandung	Suistanability Environment	18.45	
62	Maharani Dian Permanasari, M. Ds., PhD.	Institut Teknologi Nasional Bandung	Green Design	13.00	GSG Bale Dayang

No.	Name	Institution	Paper Topic	Presentation Time	Place
63	Ibrahim Hermawan	Institut Teknologi Nasional Bandung	Green Design	13.15	Sumbi Lt 2 A
64	Maugina Rizki Havier	Institut Teknologi Nasional Bandung	Green Design	13.30	
65	Dwi Novirani	Institut Teknologi Nasional Bandung	Green Design	13.45	
66	Mohamad Arif Waskito	Institut Teknologi Nasional Bandung	Green Design	14.00	
67	Edi Setiadi Putra	Institut Teknologi Nasional Bandung	Green Design	14.15	
68	Sulistyo Setiawan	Institut Teknologi Nasional Bandung	Green Design	14.30	
69	Edwin Widia	Institut Teknologi Nasional Bandung	Green Design	14.45	
70	Agung Pramudya Wijaya	Institut Teknologi Nasional Bandung	Green Design	15.00	
71	Gita Permata Liansari	Institut Teknologi Nasional Bandung	Green Design	15.15	
72	M. Djalu Djatmiko	Institut Teknologi Nasional Bandung	Green Design	15.30	
73	Detty Fitriany	Institut Teknologi Nasional Bandung	Green Design	15.45	
74	Andri Masri	Institut Teknologi Nasional Bandung	Green Design	16.00	
75	Aditya Januarsa	Institut Teknologi Nasional Bandung	Green Design	16.15	
76	Bambang Arief Ruby,	Institut Teknologi Nasional Bandung	Green Design	16.30	


UKURAN SOFA
UKURAN KURSI
MEJA
AREA PAMERAN JURUSAN ARSITEKTUR
PANGGUNG
MEJA OPERATOR
AREA PAMERAN JURUSAN ARSITEKTUR
AREA PAMERAN JURUSAN ARSITEKTUR
AREA COFFE BREAK

FOREWARD

Welcome to the 1st International Conference on Green Technology and Design. This conference takes place in Bandung, 4th December 2019 and become our first international conference in green technology and design.

It is our responsibility to contribute in the national development and sustainability, the Institut Teknologi Nasional (Itenas) Bandung through its Lembaga Penelitian dan Pengabdian kepada Masyarakat (LP2M) conducts this conference and draws upon the expertise of wide range of knowledge.

The ICGTD 2019 conference aims to promote research in the field of Green Energy, Green Building Green Automation, Green Transportation, Sustainability Environment, Green IT and Green Design, and to facilitate the exchange of new ideas in these fields among academicians, engineers, junior and senior researchers, scientists and practitioners. It also includes the plenary, keynote and invited speakers.

On behalf of Organizing Committee, it is a great pleasure to welcome you in Itenas Bandung and look forward to meeting you at ICGTD2019.

Warm regards,

Chair
Dr. Ir. Nurtati Soewarno M.T.

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IoT Thingspeak for Miniature Smart Grid Monitoring System

Waluyo
Department of Electrical Engineering
Institut Teknologi Nasional Bandung
Bandung, Indonesia
waluyo@itenas.ac.id

Charly Maulana Khafi
Department of Electrical Engineering
Institut Teknologi Nasional Bandung
Bandung, Indonesia
charlimaulana77@gmail.com

Febrian Hadiatna
Department of Electrical Engineering
Institut Teknologi Nasional Bandung
Bandung, Indonesia
febrian@itenas.ac.id

Andre Widura
Department of Electrical Engineering
Institut Teknologi Nasional Bandung
Bandung, Indonesia
andre.widura@itenas.ac.id

***Abstract*—At present, energy sources are running low with advancing technological advancements so that renewable source energy needed that can fulfill human necessary. One of them is a solar power plant that can be used for energy sources that utilize solar radiation. With the progress of technological development, where information and communication can be accessed through the internet, it easy to find out information from a system by implementing the internet of things system on solar power plants. The design of loading miniature smart grids with photovoltaic systems uses the thingspeak website monitoring system carried out using NodeMCU as a control to monitor and Arduino IDE software to run the program. The monitored parameters were voltage and current from solar panels, batteries, and loads. From the results of the monitoring on the voltage and current parameters on the solar panel, it was obtained the average energy of 405 Wh with measurements from 08:00-16:00. Based on the results of the design, the monitoring system could operate adequately, as indicated by several sending data parameters.**

***Keywords*—arduino, current, internet of things, photovoltaic, voltage**

I. INTRODUCTION

Solar power generation is energy that utilizes solar energy to become electrical energy. Where, at present, energy sources are running low, and technological advances are developing, so renewable energy is needed to meet human needs. On the other hand, the use of fossil fuels is still the primary choice for producing electrical energy. Fossil fuels are not an unlimited source of energy; the number of fossil fuels is increasingly depleting [1]. One of them is renewable energy, which can be utilized is solar energy because sunlight is a source of energy that never runs out. Indonesia is on the equator, which makes our islands irradiated with sunlight for 10 hours per day. Therefore the use of solar energy sources is very suitable to be applied, but within 10 hours, it is not in stable conditions for the adequate sun in sunny weather for only 4-5 hours. A solar power generation is an energy source solution that can be utilized to meet human needs and current technological developments despite the relatively high investment costs [2]. A monitoring system is needed to find out the activities of the solar power plant regularly to monitor so that the power plant can be optimally and efficiently maintained. A smart grid combines information and communication technology into aspects of power generation, shipping, and consumption to minimize environmental impacts, increase reliability, reduce costs, and increase efficiency [3].

So in the research of smart grids, miniature design system photovoltaic loading uses a thingspeak website monitoring system to facilitate monitoring of the generating system and for the use of energy savings generated by photovoltaics. Formulation of the problem is how to send data and monitoring via the internet to be easily accessed remotely via the device to laptops and Android-connected mobile phones. The research purpose is planning, and implementation of off-grid solar power consumption - electricity grid monitoring system using IOT system is obtained.

In 2010 conducted a study of the graphic capabilities of the relationship between threshold and current generated from solar radiation in the sun is planning to be calculated according to the needs of residential homes per day. Battery change regulator, the current capacity of the battery, and the inverter to channel the energy stored during charging and conversion into AC are also taken into account in the design of photovoltaic based electricity generation [4].

The concept of the Internet of Things, also known by the abbreviation IoT, is a concept that aims to expand the benefits of internet connectivity that is connected continuously. Internet of Things (IoT) is a structure in which objects, people are provided with an exclusive identity and the ability to move data through networks without requiring two directions between humans to humans, that is, the source to the destination or the interaction of humans to computers [5].

According to Clark W. Gellings, Smart Grids is one that combines information and communication technology into aspects of power generation, shipping, and consumption to minimize environmental impacts, increase reliability, reduce costs, increase efficiency, and secure electricity networks [3].

NodeMCU is an open-source IoT platform and Kit development that uses the Lua programming language to help programmers create prototypes of IoT products or can use sketch with Arduino IDE. The development of this Kit is based on the ESP8266 module, which integrates GPIO, PWM (Pulse Width Modulation), IIC. 1-Wire and ADC (Analog to Digital Converter) all on one board. The uniqueness of this Nodemcu itself is its minimal board, which is 4.83 cm long, 2.54 cm wide, and weighs 7 grams. But despite its small size, this board is equipped with wifi and its open-source firmware.

NodeMCU uses the standard JEDEC (Joint Electron Device Engineering Council), which is a 3.3-volt threshold standard. Unlike other micro-tolerance such as AVR and Arduino, which has a 5-volt source.

However, nodeMCU can still be connected with a 5-volt threshold via a micro USB pin or Vin pin caused by the board.

In general, there are three NodeMCU producers whose products are now on the market, namely Amica, DOIT, and Lolin / WeMos. With several board variants produced, namely V1, V2, and V3. NodeMCU V3 is not an official version released by NodeMCU. The manufacturer Lolin created this third version with minor improvements to V2. Claimed to have a faster USB interface. Although this V3 uses the same ESP8266 version, ESP12-E, there are some differences. The size of the board is more significant than the two previous versions, which is certainly not suitable for use on a breadboard; it takes two breadboards to apply it. The physical form of NodeMCU V3 can be seen in Fig. 1.

Fig. 1. NodeMCU V3

The ESP12-E Wi-Fi module supports Wi-Fi STA + AP mode, which functions as a station and access point. This feature allows ESP8266 to be programmed to form a mesh network, and a NodeMCU can function as a station that is connected to the NodeMCU access point, and simultaneously functions as an access point for other NodeMCU stations. The WiFi module operates at 2.4GHz frequency. If in a closed room metal or wall-bounded.

NodeMCU V3 supports UART, SPI, and 12C serial communication. There are two UART interfaces, UART0 and UART1. SPI serial communication on NodeMCU has one SPI / Master salve and one HSPI Slave / Master. 12C-Master and 12C-Slave are supported by NodeMCU V. The 12c interface function can be realized through programming software, and the clock frequency reaches a maximum of 100 kHz. A multiplexer is a logic circuit that accepts several digital data inputs and selects one of these inputs at a given moment, to be output at the output side. The selection of input data is performed by the line selector, which is also the input of the multiplexer.

ZMPT101B AC sensor is one of the most widely used sensors to measure AC voltage and monitor the parameters of the shutter with the advantage of an ultra-micro voltage transformer, which has high accuracy and good consistency to take measurements. Fig. 2 shows the physical form of the ZMPT101B AC sensor module. The ZMPT101B sensor module is a sensor that can measure from a range of 0-1000 V. Some things that can be done using this ZMPT101B threshold sensor include a sensor to detect overcurrent, a ground fault detection, measurement of AC electric current and a device for analog to digital converter.

Fig. 2. ZMPT101B Voltage Sensor

The ZMPT101B sensor module has small dimensions, high measurement accuracy, and stable output consistency for voltage and power measurements. This sensor module is usually used to measure power/energy, household equipment, and industrial equipment. DC threshold sensor is one of the sensors used to monitor DC voltage parameters, the working principle of a voltage sensor module that is based on the principle of suppression of resistance and can make the input voltage decrease up to 5 times the original voltage. Measure the voltage from 0-25 V. The following is the physical form of DC sensor Fig. 3.

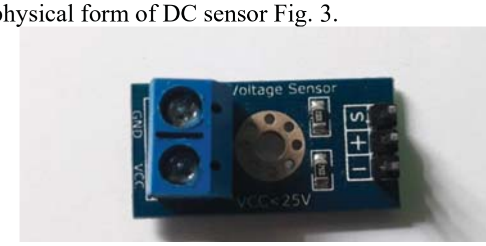


Fig. 3. DC Voltage Sensor

The specifications of the DC voltage sensor module are 0-25 volt, 3.3-5 volt, and 2% for Voltage input range, Voltage supply, and total error respectively.

The ACS712 current sensor is a Hall Effect current sensor. Hall effect allegro ACS712 is a precision sensor as an AC or DC sensor in current readings in the industrial, automotive, commercial, and communication systems. In general, the application of this sensor is usually used to control the motor, detection of electrical loads, switched-mode power supplies and overload protection, the physical form of the ACS712 current sensor can be seen in Fig. 4 below.

Fig. 4. Current Sensor

This sensor has a high accuracy reading because in it, there is a series of low-offset linear Hall with a path made of copper. The way this sensor works is the current that is read flows through the copper cable contained therein, which generates a magnetic field that is captured by the integrated Hall IC and converted into a proportional voltage. Accuracy in sensor reading is optimized by installing components inside it between the conductor that produces the magnetic field and the transducer hall close together. Accurately, a low proportional voltage will stabilize the Bi CMOS Hall IC inside, which has been made for high accuracy by the factory. The specifications of the ACS712 current sensor module are 0-30 A, 4.5-5 volt, and 1.5 % for a current input range, supply voltage, and total error, respectively.

Internet of Things, or also known by the abbreviation IoT, is a concept that aims to expand the benefits of internet connectivity that is connected continuously. Internet of Things (IoT) is a structure in which objects, people are provided with an exclusive identity and the ability to move data through the network without requiring two directions between humans to humans, that is, the source to the destination or the interaction of humans to computers [5]. The development of the internet infrastructure, then we are going to the next round, where not only smartphones or computers can be connected to the internet. But a variety of real objects will be connected to the internet. For example, this could be production machinery, cars, electronic equipment, equipment that can be worn by humans (wearables), and including any real objects that are all connected to the local and global network using sensors and or actuators that are embedded. The internet of things in this study used the website "ThingSpeak is an open-source Internet of Things (IOT) application platform and API for storing and retrieving data from things using the HTTP protocol over the Internet or through the Local Area Network. Thingpeak is an open-source container in the form of a website providing services for the needs of the internet of things (iot) that can store and receive data using the HTTP protocol over the internet. Thingspeak was initially launched in 2010 by ioBridge as a service to support the application of IoT Thingspeak can be used free of charge with several limits the service provided is that it can only receive data once every 20 seconds Thingspeak can be used for several applications namely sensor logging, location tracking, etc. In another sense, Thingspeak is an IoT platform that is able to be used to collect, store, analyze, visualize n, and act on data from sensors or actuators, such as Arduino, Raspberry, and node MCU. The main elements in Thingspeak activities are channels that contain data fields and status fields. Fig. 5 shows the block diagram of thingspeak as a cloud server.

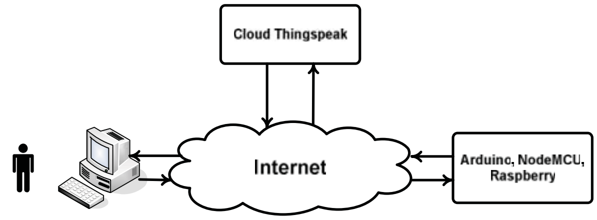


Fig. 5. Thingspeak as a cloud server

II. RESEARCH METHODS

Designing of website thingspeak for miniature smart girds with photovoltaic was based on a network monitoring system of the internet of things. A solar power generation system and integrated PLN network system to supply loads by using a monitoring system to know the activities of Generators and consumers (loads). Achievement of this Final Project is carried out by carrying out a number of problem-solving steps as a method of implementing activities. In this step, the system is optimally designed to get the results of measurements and data transmission results from solar power plants. The system design of this tool is divided into two parts, namely: hardware design and software design. There are several stages to implementing the internet of things system in solar power plants. In this planning, the solar power generation system alternately supplies the load with the PLN network system with a thingspeak monitoring system.

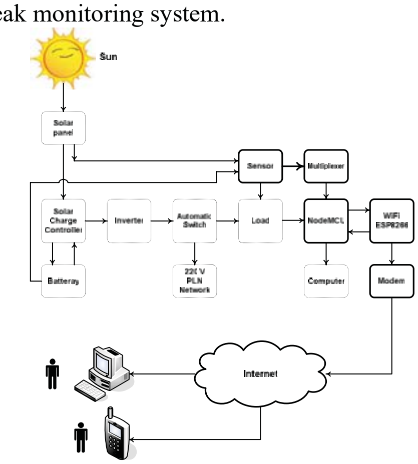


Fig. 6. Thingspeak based monitoring block diagram of solar cell system

Fig. 6 shows how to work on the system. Initially, solar or photovoltaic panels will receive sunlight that is converted into electrical current directly by utilizing the properties of semiconductor materials. Through the photovoltaic effect, photons coming from sunlight produce a jump in electron jumps in the semiconductor material, the semiconductor material consisting of electrical characteristics in the form of currents, voltages, and obstacles that change when exposed to the sun. Electricity from the solar panel to the battery, when the remaining battery charge 20% to 30%, then the Solar charge controller disconnects the load. The solar charge controller can regulate excess battery charging and keep the temperature of the battery regulator also equipped with a protection diode to keep the DC current from the battery from entering the solar panel again. Inverter to change to convert direct current into (DC) into an alternating electric current (AC) Supply the load Electric relay functions as an automatic switching if the photovoltaic based electricity generation does not supply the load, the PLN network will enter the load alternately. With the implementation of the sensor, in several parameters, it will read the current and current in the system photovoltaic based electricity generation and load, then united in the multiplexer module by selecting the selector, the output voltage and current sensors in the form of digital signals will be read and processed by the multiplexer sent to the microcontroller. Esp8266 Wifi will connect to the internet network and will be displayed via the internet website of things that is thingspeak with each time specified and can be accessed via thingspeak.

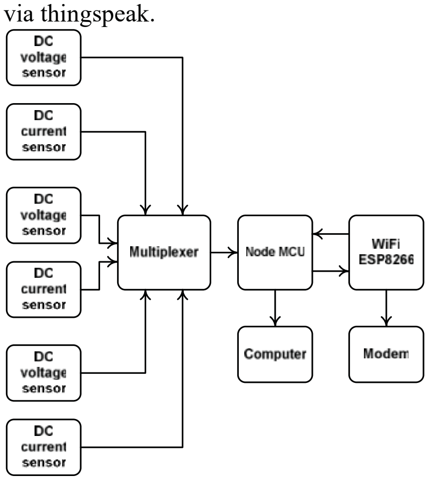


Fig. 7. Block diagram of a microcontroller design system

In Fig. 7 shows the block diagram of the design of the microcontroller, the sensor will read the current and current in the photovoltaic based electricity generation and load system and be integrated in the multiplexer module by selecting the selector, the output of the current sensor and current in the form of a digital signal will be read and processed by the multiplexer sent to the NodeMcu Wifi Esp8266 will connect to the internet network.

This section discusses the design and implementation of a miniature smart girds design system with photovoltaics using the Halpeak application monitoring system, which includes a series of photovoltaic based electricity generation: systems and a microcontroller system. The Arduino IDE software is needed to run the NodeMCU V3 program and the thingspeak library to connect to the channels available on the thingspeak webserver. Thingspeak is used to record some data coming from each sensor. Data from each sensor will be displayed on the thingspeak website. This section will explain the program flowchart on the Arduino IDE software, create a dashboard or channel on the thingspeak website.

Fig. 8 shows the design of microcontroller software with software using the Arduino IDE. Programs that are applied to NodeMCU V3 to use the Arduino IDE on the program must be installed ESP8266 and the addition of several NodeMCU libraries and thingspeak to the Arduino IDE. Initiation library to make it easy for the coding process to belong. The process that the program requires is to fill in the SSID initialization, Password with the modem device that is used by the id channel, and Apikeys to determine the channel used on the thingspeak website. Each "sensor voltage and current from several parameters such as solar panels, batteries and loads send it to the multiplexer by selecting the signal selector to put the data to A0 as analog readings. The command will repeat according to the specified counter with a delay of 15 minutes after the data collected will be sent to thingspeak will repeat according to the commands in the program.

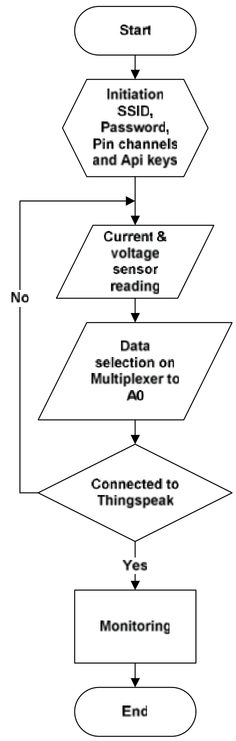


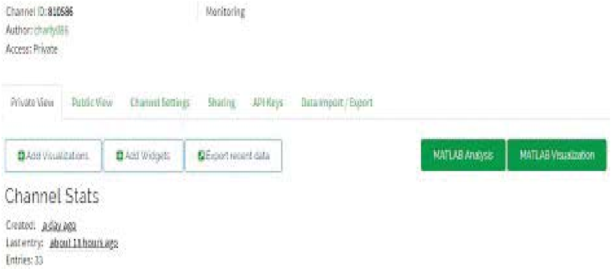
Fig. 8. Program flowchart

III. Results and Discussion

The first step is to calibrate the voltage and current sensor by comparing the results obtained by the sensor with the data obtained using a digital multimeter. Conducting testing by taking data from the panel threshold, battery current, and load current.

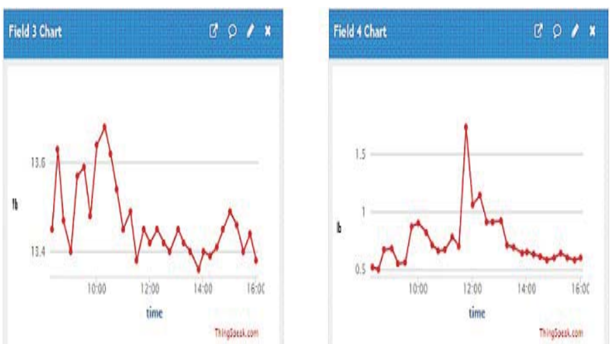
It was shown that the results of the calibration of each experiment with the value between the sensor with the multi-meter instrument carried out on the battery line, the battery current to the inverter, and the voltage of 220 V PLN. There is a DC voltage reading error value of 2.3%, a current of 6, 93%, the AC rate is 2.34%. Reading errors occur because the sensitivity of each sensor is different. This sensitivity occurs because the smaller the reading time, the sensor sensitivity to changes in reading values. Another factor is the irregularity of the individual components "on the sensor modules such as R, L, and C as well as other components that are used so as to cause inaccuracies in the results of sensor readings.

The monitoring system obtained can be seen directly on the thingspeak website on the photovoltaic based electricity generation monitoring channel. Fig. 9 shows the monitoring results on the thingspeak website.

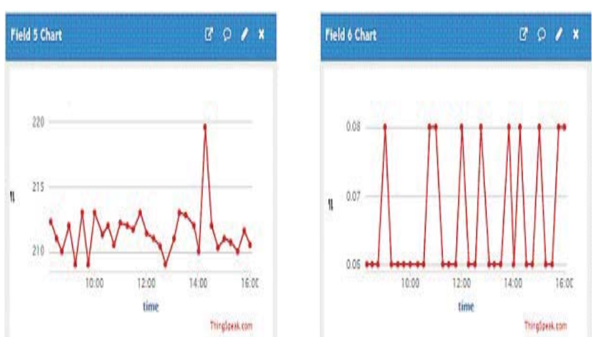


(a) Identity display

(b) Voltage & current charts of solar panel



(c) Voltage & current Voltage & current charts of battery



(d) Voltage and current Voltage & current charts of load

Fig. 9. Monitoring results on the thingspeak website

IV. CONCLUSIONS

Based on the results of testing and data processing carried out on solar power generation systems with a monitoring system application thingspeak internet-based network of things. The application of a monitoring system using a solar power plant can be done on each photovoltaic based electricity generation component with six channels, namely voltage and current on photovoltaic, battery, and load by sending data around 15 minutes and can be monitored on the thingspeak website. As for suggestions for development so that research is not interrupted for solar power generation systems with a monitoring system application thingspeak internet-based network of things is as the adding light intensity and temperature as parameters needed for solar panel analysis. A stable internet is needed for more precise data transmission. An adding internet website creation of things so that there are no limitations of channels or data that enter the internet of things system.

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penerbit itenas
Jl. PKH. Mustapha No.23, Bandung 40124
Telp. +62 22 7272215, Fax.: +62 22 7202892
e-mail: penerbit@itenas.ac.id

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