# Design and Implementation of Smart Energy Management System Integrated with Internet of Things (IoT) Technology in Engineering Faculty Unila

*By* Dikpride Despa

# Design and Implementation of Smart Energy Management System Integrated with Internet of Things (IoT) Technology in Engineering Faculty Unila

Dikpride Despa
Department of Electrical Engineering
Universitas Lampung
despa@eng.unila.ac.id

Sandy Prasetiyo
Department of Electrical Engineering
Universitas Lampung
sandyprasetyo@gmail.com

Trisya Septiana
Department of Informatics
Universitas Lampung
trisya.septiana@eng.unila.ac.id

Gigih Forda Nama
Department of Informatics
Universitas Lampung
gigih@eng.unila.ac.id

*Abstract*— **Energy management is carried out for planning, recording, monitoring, and evaluating continuously without compromising the quality of its production or service. This research aims to investigate the value of Intensitas Konsumsi Energi (IKE), as an important part of energy management activity, this research was held at Gedung A Engineering Faculty, University of Lampung (Unila). The source of electrical energy supplies from PLN with 66 kVA 3-phase power contract with a voltage of 380 Volts and P2 tariff group. Monitoring of energy consumption can be observed through equipment installed at working room and distribution panel, that already implemented with Internet of Things (IoT) technology. Its recorded data of lighting condition, temperature, humidity, and also electrical quantities such voltage, current, energy consumption. The Energy Management System developed using C program, PHP program, JavaScript, HTML programming languages. Based on data captured on March 8, 2021 shown the humidity average at 65%, lux 155, temperature 27$^0$C, the maximum value of voltage at each phase was; phase R with 210 Volts, phase S with 208 Volts, and phase T with 195 Volts. The maximum value of current at each phase was; phase R with 38 Ampere, phase S with 41 Ampere, and phase T with 68 Ampere, while the energy consumption at phase R was 157534 Wh, at phase S was 245566 Wh, and at phase T was 182885 Wh, and total IKE value at that day was 0.151912, that means this building has efficient status energy usage.**

*Keywords*— ***Energy Management System, Energy Audit, IKE, Building A FT-Unila, Energy Efficiency, Web, IoT***

## I. Introduction

Smart building is a living and working environment by utilizing the use of information and communication technology to coordinate various aspects to improve user comfort, energy efficiency and user safety [1]. Energy saving potential studies are obtained by conducting energy audits in buildings and benchmarking their energy consumption index, which is expressed by energy consumption per area, both conditioned and unconditioned (kWh/m2/ year, or kWh/m2/ month). Benchmarking is a method that is commonly used to quickly see whether energy use in an industry/building is included in the criteria for saving or being wasteful. In practice, the application of benchmarking is not simple because there are differences in the energy system that is benchmarked, whether it includes differences in aspects of building design, building type, building area and designation, differences in the data collection process and calculation formulas. As a standard of comparison, the benchmark value of an energy system must always be updated in line with technological developments and building variations that continue to grow [5]. The IKE value is used to determine the level of efficiency in the use of electrical energy in a building as stated in the Regulation of the Minister of Energy and Mineral Resources No. 13 of 2012 concerning Saving Electricity Energy [ 3]. Smart energy is one of the important areas in Internet of Things (IoT) research, embedded technology can enable every connection and communication to run efficiently based on IoT technology [4] Therefore, it is necessary to develop a tool that can be monitored at any time to find out the consumption of electrical energy every day and can help the process of calculating the value of electricity IKE in residential or office buildings, so that it can estimate opportunities for saving electricity consumption.

## II. Literature Review

### A. *Energy Management*

Energy management is an integrated program that is implemented systematically to utilize energy resources effectively and efficiently by planning, recording, monitoring and evaluating continuously without compromising the quality of production or service [3]. One method that can be used in electrical energy management is a SWOT analysis technique that can evaluate, clarify and validate the plans that have been prepared, in accordance with the objectives to be achieved. The SWOT analysis technique emphasizes the need to assess the influence of the external and internal environment [4].

The process of evaluating energy use and identifying energy saving opportunities as well as recommendations for increasing efficiency for energy users and users of energy sources in the context of energy conservation [5].

Electrical power can be defined as a rate of change of energy. Electric power in complex form is expressed by the following equation.

$$S = P + jQ \qquad (1)$$

where,

S = apparent power (VA)
P = real/active power (watts)
Q = reactive power (VAR)

Meanwhile to find the energy value expressed in the equation

$$W = P \times t \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (2)$$

where,

W = electrical energy (kWh)
P = power used (kW)
t = time (hours)

The energy equation is valid for constant power conditions [6].

Lighting Based on SNI 6197-2011 concerning Energy Conservation in Lighting Systems contains lighting level standards based on function [7].

The air system in Indonesia refers to SNI 6390-2011 concerning Energy Conservation of building Air System [8].

### B. *Intensitas Konsumsi Energi (IKE)*

In simple terms, IKE can be written in the equation:

$$IKE\ (kWh) = \frac{Total\ energy\ consumption\ (kWh)}{Total\ area\ (m^2)} \quad \dots\dots (3)$$

According to the Minister of Energy and Mineral Resources Regulation No. 13 2012, the criteria for energy use in office buildings based on specific electrical energy consum-ption (kWh/m2 per month) can be referred to in table 1 below:

Table 1. IKE standards according to the Minister of Energy and Mineral Resources Regulation No. 13 of 2012.

| Room with AC (kWh/m2 per month) | | Room without air conditioning (kWh/m2 per month) | |
|---|---|---|---|
| Very Efficient | < 8,5 | Very Efficient | < 3,4 |
| Efficient | 8,5 until <14 | Efficient | =3,4 until < 5,6 |
| Quit Efficient | 14 until < 18,5 | Quit Efficient | = 5,6 until < 7,4 |
| wasteful | ≥ 18,5 | wasteful | ≥ 7,4 |

If the results of the IKE calculation are within the specified range, then the use of energy is still within a reasonable level. However, if the IKE value exceeds the limit, energy saving measures are needed [9].

### C. *Embedded System and Internet of Things (IoT) Technology*

Microcontroller is a circuit that has several important features. The central processing unit ranges from 4 bits to 64 bits, has volatile RAM for storing data, ROM, EPROM, EEPROM, flash memory for programming and storing processing parameters, Bidirectional I/O pins allow to control and detect logic states, UART , serial communication inter-faces such as I2C, serial peripheral interfaces and controller area networks for system interconnection, perip-herals such as timers, PWM generators, timers, clock generators, ADCs, DACs, circuit programming and debugging support [10].

The development derivative modules from the IoT platform module include the NodeMCU ESP 8266. Its functions are similar to the Arduino module platform. The difference is that this module is specifically for "Connected to Internet". The NodeMCU module is a very small compact board and has the ability to be programmed and connected to a network via wireless. In addition, NodeMCU has input/output pins that can be connected to sensors or actuators so that data from sensors can be sent to the server and can activate actuators based on the data received [11].

Firebase Real-time Database is a hosted database that resides on a cloud system. Data is stored as JSON and synced in real-time to every connected client. The Firebase real-time database allows us to build collaborative applications by providing secure access to the database, directly from client-side [12].

IoT is considered as the third wave of the World Wide Web (WWW) after static web pages and social network-based web. IoT is a worldwide network that connects various types of objects anytime and anywhere through a very popular internet protocol called Internet Protocol (IP) [13].

### D. *Related Works*

This research is a continuation of previous research that has been done. Despa et al already developed an online monitoring power system using the sample data that recorded by PMU for several locations with same frequency, this research purpose was for power flow stability [15][16] and conducted at electrical power system 50 Hz in Japan, Singapore, and also Malaysia. Despa et al, on their previous research related with monitoring electrical quantities for 3-phase for several buildings at University of Lampung [14][17][18]. Some of prototype of electrical quantities monitoring system already made, and installed at some distribution panels in Engineering Faculty Unila.

In addition, research related to the measurement of electrical quantities are found on work [19] and [20]. In this study Gigih et al has built an online monitoring system that can be accessed through web application using the Internet of Things (IoT) technology. Research on paper [21], conducted a web-based monitoring system for monitoring the power systems in cell towers. Another research on paper [22] built a web server based monitoring system for power system monitoring using Raspberry-Pi as the controller. Data measurement results can be displayed in real-time in the form of tables on the web page. Another previous research related to the implementation of web technology can be found on works [23][24] also inspired on this research.

This research aimed was to find out the energy consumption in real time using the Internet of Things technology, and also to measure the IKE value at Building A, Faculty of Engineering, University of Lampung.

## III. RESEARCH METHODOLOGY

### A. *Location of research*

This research was conducted at building A FT-UNILA which is located on Jl. Prof. S. Brojonegoro No. 1, Bandar Lampung, Lampung, Indonesia. This building consists of 2 floors. which serves as the office of the Dean, Deputy Dean for Academic Affairs and Cooperation, Deputy Dean II for General Administration and Finance, Deputy Dean for Student Affairs and Alumni. Another function of this building is for the TPMPF office, TU FT Office, academic, student affairs, civil service, general and finance as well as

PS PPI FT Unila. The building area is ±1071.5 m2. Energy sources the electricity used in the building comes from PLN with a 3-phase power contract of 66 kVA with a voltage of 380 Volts and a P2 tariff group. The building's working hours are Monday to Friday from 08.00 WIB to 16.00 WIB, while for Saturday, Sunday, and national holidays there is still energy consumption. Office equipment expenses such as air conditioners, computers, printers, dispensers, televisions, other equipment and lighting. To control the operation of the equipment still using a manual operating system. In general, the operation of the equipment is the responsibility of each part/division in the office.

### B. *Research Materials*

Table 2. is the material used in the research with their specifications:

| No | Tools | Specification | Discription |
|---|---|---|---|
| 1 | NodeMCU | V3 | Microcontroller |
| 2 | ADS1115 | 16-bit,I2C | Analog-to-digital converter (ADC) |
| 3 | Light Sensor | BH1750 | Lux unit |
| 4 | Temperature Sensor | DS18B20 | $^0$C unit |
| 5 | Humidity Sensor | DHT11 | RH unit |
| 6 | Voltage Sensor | Zmpt101-B | Summing-amplifer |
| 7 | Current Sensor | SCT-013-000 | *Current Transformer* |

### C. *Development Stages*

The procedure flowchart describes the stages carried out on this research, starting from the formulation of the problem to the conclusion that forms a systematic flow as shown in Figure 1.

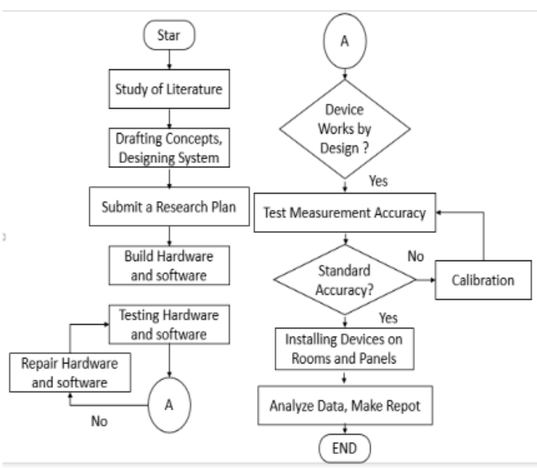


**Fig 1.** Development Stage

The implementation of audit system consists of 2 system block, those are placed in the working room, and the other at the electrical main panel, shown in Figure 2.

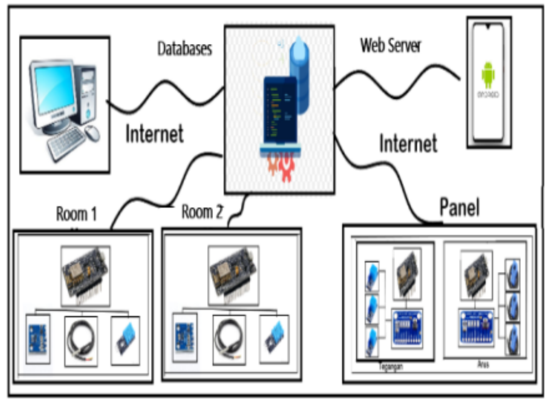


**Fig 2.** Architecture of IKE system monitoring

The system in working room, takes data on energy audit needs such as light intensity, temperature, humidity and can input the location of the room, area, electronic equipment and the state of the room related to audit data and the device on the panel sends voltage and current data, the data is sent automatically to the database with the internet network. This data contains the calculation of the algorithm that has been entered in the software system in order to find out the data in real time via the website of the results of the condition of the room or building to get the IKE value and recommendations for energy consumption in the building.

The software in this study was built using several programming languages, including the C programming language, PHP, HTML, and JavaScript.

Calculations are carried out using equations (1), (2) and (3). Several assumptions are also applied at this stage, including the length of hours of use of electrical equipment and the age of electrical equipment whose data is no longer available in the historical data of the electrical system.

## IV.RESULT AND DISCUSSION

### A. *Hardware Implementation*

The lighting, temperature and humidity monitoring system hardware is a tool consisting of several components and sensors and a controller that functions as controlling the sensors so that they work as we expect as shown in figure 3 & 4.

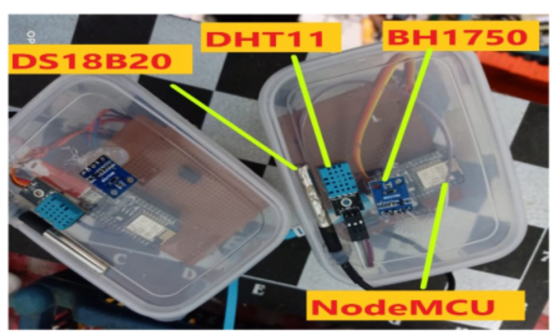


**Fig 3.** Hardware monitoring at working room

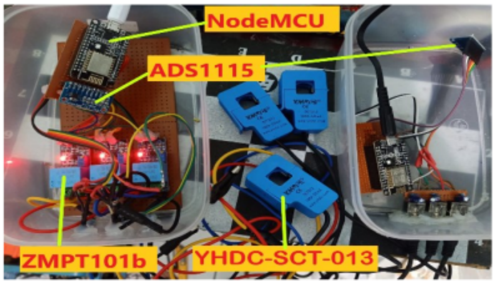


**Fig 4.** Hardware monitoring at panel system

### B. *Software Implementation*

The first step in implementing the lighting, humidity, temperature and electricity monitoring system software is to prepare the database. Database preparation includes creating identity tables as storage containers for measuring data. The table structure in the database is as shown in Figure 5.

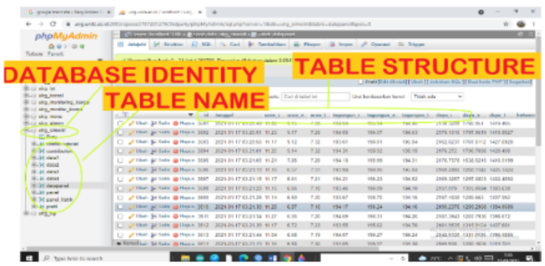


**Fig 5.** Table structure in the energy consumption monitoring data base

The second step in implementing the room monitoring system software and electricity quantity is to build a web page that functions as an interface between the user and this monitoring system. The web design that is built will display the measurement data in the form of values and graphs. This web page is composed of programs built using the PHP, JavaScript, HTML, and CSS programming languages. The final structure of the web page that has been built can be seen in Figure 6.

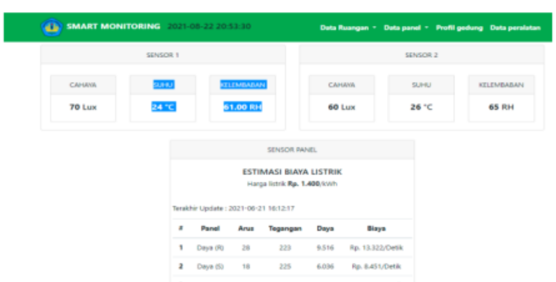


**Fig 6.** Structure of the monitoring system web page

### C. *Testing and Calibration of Monitoring System*

Accuracy is one of the main parameters in determining the feasibility test of a measuring instrument. Measurement accuracy tests that have been carried out include testing the accuracy of lighting measurements, measuring humidity, measuring temperature, measuring voltage, measuring current and measuring electrical energy consumption, compare the data from the measurement results with the standard measuring instrument. The testing process is carried out in an integrated electrical engineering laboratory, as shown in Figure 7.

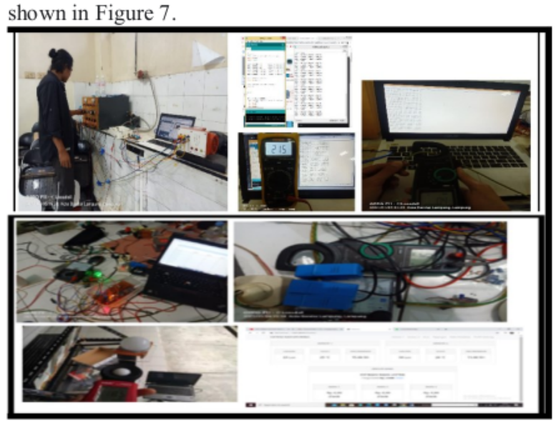

**Fig 7.** Testing and calibration of equipments

### D. *Results Analysis*

The lighting conditions, temperature and humidity in the PPI admin room were taken from March 8, 2021 at 00:00 WIB to 24:00 WIB, can be seen in Figure 13.

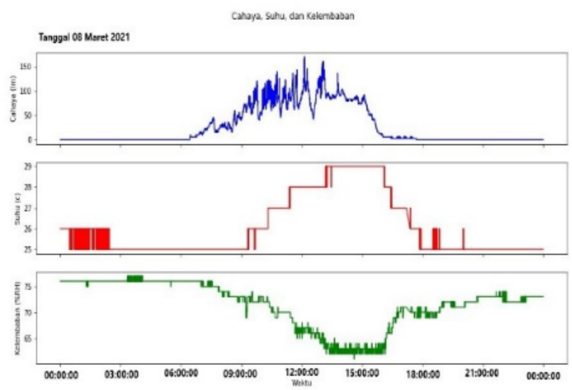


**Fig 8.** Graph of lighting, temperature and humidity

Figure 8 shown a significant change in the value of lighting, temperature and humidity, it can be seen from the lighting value which changes at March 8, 2021 at 06:00 WIB until 12:00 WIB, the highest lighting value is lux 150, and decreases again at 18:00 WIB, the temperature value can be seen to change starting at 09:00 WIB until the peak value at 14:20: WIB with a value of 290C and decreasing again at 18:00 WIB, the humidity value is inversely proportional to the figure and has a significant change in 08:00 WIB, the humidity value is 75% and decreases to 63% at 14:00 WIB. Based on the analysis in Figure 13, changes in the value of lighting, temperature and humidity occur during hours' office work starts from 07:00 WIB to 17:00 WIB.

We observed energy consumption in building A of the Unila Faculty of Engineering from March 8, 2021 at 00:00 WIB to 24:00 WIB, including voltage and current values.

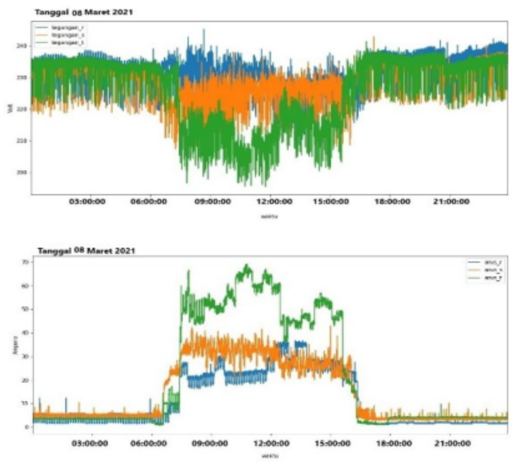


**Fig 9.** Graph of voltage and current March 08, 2021

Figure 9 shown that the voltage and current values are in 3 phases R, phase S, and phase T, starting at 00:00 WIB until 24:00. The graph shows that the voltage value fluctuates. The R phase profile (blue color) looks fluctuating in the voltage value range of 210 volts to 245 volts, the current value is 0 amperes to 38 amperes, the S phase (orange color) looks fluctuates in the 208 volt to 243 volt voltage value range 0 amperes to 41 amperes, phase T (green color) looks fluctuating in the range of 195 volts to 240 volts, 0 amperes to 68 amperes. Based on Figure 14, the voltage drop is quite large in the S phase and the T phase. The voltage drop and the increase in the current magnitude occurred in the time span from 08.00 WIB to 17.00 WIB, which coincided with Monday which is working hours caused by the large use of electrical loads such as air conditioners, computers, and other equipment during working hours.

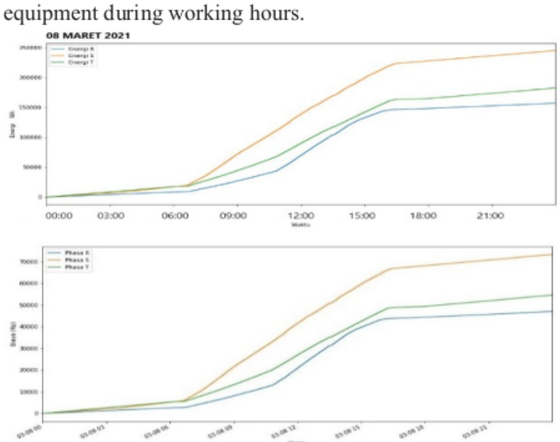


**Fig 10.** Graph of energy and rupiah 08 March 2021

Figure 10 shown that the energy value and rupiah value are continuous in 3 phases R, phase S, and phase T, starting at 00:00 WIB until 24:00. The graph shows that the energy value is continuous. The R phase profile (blue color) is seen continuously in the range of energy values from 0.52964072 Wh to 157534 Wh. In the morning until the evening. It is known that the energy in the s phase reaches 245566 Wh.

*E. Recommendations*

Recommendations in building A, Faculty of Engineering, University of Lampung to carry out energy management are carried out using the SWOT analysis method.

Recommended to replacing the lamp with a Philips LED 19 W. Table 3 is the total consumption of electrical energy (kWh/day) based on the results of recommendation :

Table 3. Total Electrical Energy Use Recommendation Results .

| Total Equipment Energy Consumption (kWh) | Total Recommended Lamp Energy Consumption(kWh) | Total kWh/day |
|---|---|---|
| 201,108 | 31,464 | 232,572 |

Table 3 shows the total electricity consumption per month (kWh/day) from recommendation, which is to replace all lamps with 19W LED lamps and recalculate the number of light points based on the standard lighting level. The total electrical energy consumption of the equipment is 201.108 kWh and the total electrical energy consumption of the recommended lamps is 31.464 kWh. Then the total consumption of electrical energy per day in Building A FT Unila recommended is 232.572 kWh/day.

Table 4. Needs of Recommended Lamp Results

| Floor | Number of Lamps According to Standard | Number of Recommended Results Lamps | Light Reduction |
|---|---|---|---|
| Floor 1 | 112 | 110 | 2 |
| Floor 2 | 114 | 97 | 17 |
| Total | 226 | 207 | 19 |

While table 4 shows the need for lamps based on recommendations. The number of lamps according to the standard based on the calculation is 226 lamps and after a recommendation is made the number of lamps needed is 207 lamps, which means there is a reduction in the number of lamps by 19 lamps.

Air Conditioning System Recommendations

1. Set the air conditioning temperature at 24$^0$C to 27$^o$C.
2. Close the air vents in rooms that use air conditioning.
3. Close the doors and windows when the air conditioner is turned on.
4. AC maintenance every 3 months while changing the refrigerant.

Electrical System Recommendations

The following is the potential that can be done on the electrical system referring to the analysis of energy consumption in real time on March 8 to March 14, 2021:

1. Perform load balancing by moving some of the load from the S phase to the R phase and T phase.
2. Re-drawing of the electrical system and the naming of loads on the main panel.
3. Placing Electrical System Operator officers to monitor and be responsible for the condition of the electrical system

Comparison of Electrical Energy Consumption before and after the Implementation of SOP. The following is a comparison chart before and after applying the SOP for electrical energy management as a result of the SWOT analysis:

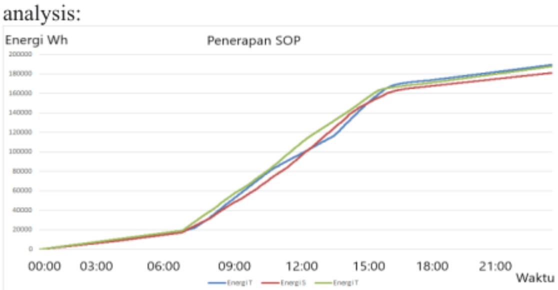


**Fig 11.** energy graph according to the load balance SOP in each phase R, S & T

Figure 11 shows the load balance between phases so that the energy value is continuously and balanced in the R phase, the S phase and the T phase, the balance between phases is carried out through direct observation in the field by making a single line in the building and real time observations by the tool so that it can balance consumption. energy between phases, avoiding voltage drop when energy usage in phases is not balanced.

## V. CONCLUSION

The Energy Management System that already implemented at Gedung A Engineering Faculty, University of Lampung, can be used to observe the energy usage on a real-time, including the IKE indicators.

## REFERENCE


[1] D. Sciuto and A. A. Nacci, "On How to Design Smart Energy-Efficient Buildings," Proc. - 2014 Int. Conf. Embed. Ubiquitous Comput. EUC 2014, no. April, pp. 205–208, 2014, doi: 10.1109/EUC.2014.37.

[2] Badan Pengkajian dan Penerapan Teknologi. "Perekayasaan Teknologi Efisiensi Energi, Peralatan dan Sistem Energi 3864.002.001": BPPT 2016

[3] Peraturan Menteri Energi dan Sumber Daya Mineral Republik Indonesia No.13 Tahun 2012 tentang Penghematan Pemakaian Tenaga Listrik. Kementrian ESDM, 2012.

[4] A. González-Vidal, V. Moreno-Cano, F. Terroso-Sáenz, and A. F. Skarmeta, "Towards Energy Efficiency Smart Buildings Models Based on Intelligent Data Analytics," Procedia Comput. Sci., vol. 83, no. BigD2M, pp. 994–999, 2016, doi: 10.1016/j.procs.2016.04.213.

[5] Direktorat Konservasi Energi, Direktorat Jenderal Energi Baru, Terbarukan, dan Konservasi Energi. 2020. Data & Informasi Konservasi Energi 2020. Jakarta : Indonesia Direktur Konservasi Energi

[6] L. Raymond, "Prediksi Kebutuhan Energi Listrik Di Sulawesi Utara" Jurnal Online Poros Teknik Mesin Volume 7 Nomor 1, 2016.

[7] SNI 6197-2011 tentang Konservasi Energi pada Sistem Pencahayaan, BSNI. 2011.

[8] SNI 6390-2011 tentang Konservasi Energi Sistem Tata Udara Bangunan Gedung. BSNI. 2011.

[9] Peraturan Menteri Energi dan Sumber Daya Mineral No.13 Tahun 2012 Tentang Penghematan Pemakaian Energi Listrik.

[10] M. K. Parai, B. Das, and G. Das, "An Overview of Microcontroller Unit : From Proper Selection to Specific Application," IJSCE, No. 6, pp. 228–231, 2013.

[11] E. Media and M. Rif, "Internet of Things (IoT): BLYNK Framework for Smart Home," (3rd ICTVET 2018) , pp. 579–586, 2019, doi: 10.18502/kss.v3i12.4128.

[12] A. M. A. P. P. Analytics, "Introducing Firebase Analytics."

[13] M. Bilal, "A Review of Internet of Things Architecture, Technologies and Analysis Smartphone-based Attacks Against 3D printers.," CoRR, vol. abs/1708.0. 2017, [Online]. Available: http://arxiv.org/abs/ 1708.04560.

[14] D. Despa, A. Kurniawan, M. Komarudin, Mardiana, G. F. Nama, 2015. Smart monitoring of electrical quantities based on single board computer BCM2835, 2nd International Conference on Information Technology, Computer, and Electrical Engineering (ICITACEE).

[15] D. Despa. PMU Base Monitoring and Estimation of Inter-Area Power Oscillation for Singapore-Malaysia Inter Connection Power System.

[16] Q. Liu, D. Despa, Y. Mitani, 2012. Application of Phasor and Node Voltage Measurements to Monitoring Power Flow Stability, International Journal on Electrical Engineering and Informatics, vol. Vol. 4, no. Printed ISSN 2085-6830/Online e-ISSN 2087-5886.

[17] D. Despa, Mardiana, G. F. Nama, M. Bernard, 2016. Multi-Area Smart Monitoring of Electrical Quantities Based on Mini Single Board Computer BCM 2835. 8th International Conference on Electrical Power, Electronics, Communications, Controls and Informatics System 2016 (EECCIS 2016), Malang.

[18] D. Despa, M. A. Muhammad, H. Gusmedi, N. Amaro. 2017. Sistem Monitoring Besaran Listrik Dengan Teknologi IoT (Internet of Things). Bandar Lampung

[19] G. F. Nama, M. Komarudin, H. Priambodo, Mardiana, H. D. Septama, 2014. Electricity, Temperature, and Network Utilization Monitoring at Lampung University Data Centre Using Low Cost Low Power Single Board Mini Computer. in The Regional Conference on Computer and Information Engineering(RCCIE), Yogyakarta Indonesia, Pp 184-189.

[20] G. F. Nama, D. Despa, Mardiana, 2016. Real-time monitoring system of electrical quantities on ICT Centre building University of Lampung based on Embedded Single Board Computer BCM2835, International Conference on Informatics and Computing (ICIC), Lombok, Indonesia.

[21] H. Gambhir Jayant, Wani Lalita K. 2013. Power Insfrastructure Monitoring System On Embedded Web, I.J.E.M.S., Pune.

[22] Y. Prakruti, V. N. Chavda. 2014. Development of Power Monitoring and Analysis System based on Web Server, IJEDR, Gandhinagar.

[23] G. F. Nama, M. Ulvan, A. Ulvan, A. M. Hanafi, 2015. Design and Implementation of Web-Based Geographic Information System for Public Services in Bandar Lampung City - Indonesia, 2015 International Conference on Science in Information Technology (ICSITech), pp 270-275, Yogyakarta, Indonesia.

[24] G. F. Nama, M. Komarudin, H. D. Septama. 2015. Performance Analysis of ArubaTM Wireless Local Area Network Lampung University, 2015 International Conference on Science in Information Technology (ICSITech), pp 41-46, Yogyakarta, Indonesia.

# Design and Implementation of Smart Energy Management System Integrated with Internet of Things (IoT) Technology in Engineering Faculty Unila

ORIGINALITY REPORT

14%
SIMILARITY INDEX

PRIMARY SOURCES

| | | |
|---|---|---|
| 1 | wwww.easychair.org<br>Internet | 196 words — 6% |
| 2 | digilib.unila.ac.id<br>Internet | 60 words — 2% |
| 3 | journal.umy.ac.id<br>Internet | 29 words — 1% |
| 4 | D Despa, G.F Nama, M.A Muhammad, K Anwar. "The Implementation Internet of Things(IoT) Technology in Real Time Monitoring of Electrical Quantities", IOP Conference Series: Materials Science and Engineering, 2018<br>Crossref | 28 words — 1% |
| 5 | Vicky Prasetia, Denis, Sugeng Dwi Riyanto. "Energy System Audit of Lighting and Air Conditioning in Building E and F Cilacap State Polytechnic", International Journal of Advances in Scientific Research and Engineering, 2019<br>Crossref | 27 words — 1% |
| 6 | mafiadoc.com<br>Internet | 22 words — 1% |
| | repository.unri.ac.id | |

7 Internet

22 words — 1%

8 Syaiful Ahdan, Erliyan Redy Susanto, Nana Rachmana Syambas. "Proposed Design and Modeling of Smart Energy Dashboard System by Implementing IoT (Internet of Things) Based on Mobile Devices", 2019 IEEE 13th International Conference on Telecommunication Systems, Services, and Applications (TSSA), 2019

Crossref

19 words — 1%

9 Suhono, A D Athaya, L H Anwari, F D H Sinaga, S F Hadaina, S O Novantri. "Analysis of energy usage in mosques in urban area with tropical climate: case study in Yogyakarta, Indonesia", IOP Conference Series: Earth and Environmental Science, 2020

Crossref

16 words — < 1%

10 Massus Subekti, Imam Arif Rahardjo, Eka Mardiana. "The effect of changing the type of lamp, lighting power, and adding light points to the strength of the lighting in the Classroom and Reading Room of the Postgraduate Program in the Bung Hatta Building, Universitas Negeri Jakarta", 2020 Third International Conference on Vocational Education and Electrical Engineering (ICVEE), 2020

Crossref

11 words — < 1%

11 iopscience.iop.org

Internet

10 words — < 1%

12 Hery Dian Septama, Ardian Ulvan, Gigih Forda Nama, Melvi Ulvan, Robert Bestak. "Dynamic tunnel switching using network functions visualization for HA system failover", 2015 International Conference on Science in Information Technology (ICSITech), 2015

Crossref

8 words — < 1%

| | | |
|---|---|---|
| 13 | M Komarudin, H D Septama, T Yulianti, A Yudamson, J Hendri, M A D Arafat. "Multi node sensors for water quality monitoring towards precision aquaculture", IOP Conference Series: Earth and Environmental Science, 2021<br>Crossref | 8 words — < 1% |
| 14 | ejournal.unesa.ac.id<br>Internet | 8 words — < 1% |
| 15 | if.unila.ac.id<br>Internet | 8 words — < 1% |
| 16 | R Z H Suyoto, M Komarudin, G F Nama, T Yulianti. "Classification of Civet and Canephora coffee using Support-Vector Machines (SVM) algorithm based on order-1 feature extraction", IOP Conference Series: Materials Science and Engineering, 2021<br>Crossref | 6 words — < 1% |

| | | | |
|---|---|---|---|
| EXCLUDE QUOTES | ON | EXCLUDE SOURCES | OFF |
| EXCLUDE BIBLIOGRAPHY | ON | EXCLUDE MATCHES | OFF |