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# PROCEEDING

# IC - ITECHS 2014

The 1st International Conference on Information Technology and Security

Malang, November 27, 2014

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**Lembaga Penelitian dan Pengabdian pada Masyarakat**

Sekolah Tinggi Informatika dan Komputer Indonesia

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## The 1st International Conference on Information Technology and Security (IC-ITechs)

## November 27, 2014

### Editors & Reviewers:

Tri Y. Evelina, SE, MM Daniel
Rudiaman, S.T, M.Kom Jozua
F. Palandi, M.Kom

### Layout Editor:

Eka Widya Sari

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# GREETINGS

## Head of Committee IC-Itechs

For all delegation participants and invited guest, welcome to International Conference on Information Technology and Security (IC-Itechs) 2014 in Malang, Indonesia.

This conference is part of the framework of ICT development and security system that became one of the activities in STIKI and STTAR. this forum resulted in some references on the application of ICT. This activity is related to the movement of ICT development for Indonesia.

IC-Itechs aims to be a forum for communication between researchers, activists, system developers, industrial players and all communications ICT Indonesia and abroad.

The forum is expected to continue to be held continuously and periodically, so we hope this conference give real contribution and direct impact for ICT development.

Finally, we would like to say thanks for all participant and event organizer who involved in the held of the IC-Itechs 2014. We hope all participant and keynote speakers got benefit from this conference.

# LIST OF CONTENT

# LIGHTING SYSTEM WITH HYBRID ENERGY SUPPLY FOR ENERGY EFFICIENCY AND SECURITY FEATURE OF THE BUILDING

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**ABSTRACT**

*Recently, many buildings' outside corridors have less lighting system at night, because their lamps mostly depend upon electrical energy from PLN (State Electrical Company). It affects the whole electrical power used. Due to this condition, we need to arrange the lamps' light to reduce electrical power. This research is going to create an automatic lighting efficiency system which is located outside of the building's corridor; and it uses time setting with the application of RTC (Real Time Clock) to detect human motion with motion-sensor detector (PIR). The primary aim of this research is to manage electrical energy more efficiently and to make a safety measure for the building itself. When PIR sensor detects any motion in safety-time-range that has been set before, it will send a short message to the central security system. It is supplied by hybrid system between solar cell and PLN electrical power. Though the use of the solar cell, an output voltage of 17-19 volt will be reduced through the buck converter to stabilize enough while filling 12-volt the accumulator. The output electrical voltage derived from accumulator will be converted from 12 Vdc to 12 Vac by an inverter; and then it will be increased to 220 Vac by step up voltage regulator to supply its lighting load. Otherwise, if the accumulator is not able to fulfill the supply, a microcontroller will force swith circuit to gain the lighting load another supply from PLN electrical power source. By implementing this management system, total energy within 10 hours (17.00-03.00 WIB) is 420 Wh; and it reduces the energy for 105 Wh with 25% efficiency.*

***Keywords:*** *lighting management, energy efficiency, hybrid power, inverter, solar cell, building's security*

## Introduction

Human need of energy increases while limited oil reserves forces the urgency to search for an alternative energy survey. Many developed countries have willingness to generate innovations and new technologies to substitute the crude oil as the primary energy resource competitively.
There are at least three requirements to find estimable resource; (1) it produces sufficient energy, (2) has economical price, (3) and has less negative impact to the environment. Therefore, the search of alternative-energy could be focused on utilization of the sunlight by using solar cell panel. However, if the intensity of the sunlight is not sufficient enough to supply its solar cell, a backup solution of emergency energy should be conducted. By using sunlight and backup energy from PLN, this research creates a system of utilization of hybrid power alternative energy resources to supply the building's corridors lighting and building security feature.

Besides, we find that many buildings' outside corridors have less lighting system at night since their lamps mostly depend upon electrical energy from PLN (State Electrical Company). It affects the whole electrical power usage. Due to this condition, we need to arrange the lamps' light to reduce electrical power. This research creates an automatic lighting efficiency system which is controlled by microcontroller to manage the electrical energy more efficiently and to be functioned as a safety feature for the building itself with hybrid supply. The security function which uses motion-sensor detector will turn on all the lighting, ring the alarm, and send a short message to an authorized security as a notification that someone has compromised the secure area. Using the lighting system, we optimize energy utilization and secure the building.

**The Design of Energy Management**

The most important components of energy management in this research are accumulator capacity design, the converter design, inverter design, step up electrical transformer design, and setting of RTC (Real Time Clock). Planning of implementation of solar cell is located at a place with high intensity light in order to gain adequate light. The attachment of solar cell below is in its precision; its inclination angle is linear with lighting resources. The Figure below shows about that.

Figure 1. The attachment of Solar Cell

Total loading of 6 LED lamps is 7 W 220 Vac

***Accumulator***

We use a 12 V 45 Ah accumulator with an extrapolation of its capacity based on efficiency of using it from inverter to electrical load. In contrast, theory of it shows that:

Inverter input = usage of current = 4.27A
Ah Battery = current x usage of timing
= 4.27 A x 10
= 42.7 Ah
Available Ah Battery = 45 Ah
Usage of timing = 45 Ah/4.27 A = 10.53 hours
Time remainder = 10.53 – 10 = 53 minutes
Average timing of filling battery per day = 8 hours

Current charging = 1-% - 30% Ah
Current charging = (30% x Ah) per hour
Current charging = (0.3 x 45) / 8
Current charging = 1.6875 A
Current discharge = Ah battery / usage of timing

Current Discharge = 45 Ah/10 hours
Current discharge = 4.5 Ah

<u>Solar Cell needed:</u>
Accumulator's power / time to fill = 45 Ah/8 hours = 5 A
Thus, the necessity of solar cell = 5A x 14.4 = 72 WP
Buck Converter Design. Buck converter, in many industrial applications, needs an additional tool which could change stable DC's voltage resources to a variable one. It could be done by using DC converter. The technique is turning as DC to DC. DC technique converter can be used as a regulator of electrical switch mode to change from unregulated DC's voltage to a regulated one.
One of the basic topology of electrical switch is Buck. Its working principle can be classified into the step down DC converter. Output voltage from it is always smaller from its input voltage. This research uses a regulator (as a Buck) to overcome 12 V loading. It consists of some primary components: mosfet as a switch, inductor, capacitor, diode, and a load.

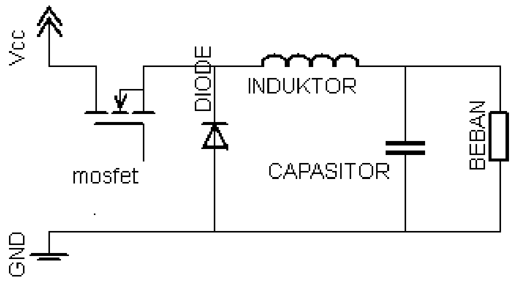

*Figure 2. The Circuit of Buck Converter*

Buck converter is designed with a 5A current.

$$C_{Out} = C_L = 5A$$

Inverter design: It is a single phase full bridge inverter which needs four switching mosfet that works paired and one by one. The amount of output voltage from inverter depends on each inverter gate's starting point. It is switched on by using SPWM methods raised by ATMega 16 microcontroller. This single phase full bridge inverter gains input from accumulator's output around 12 Vdc.

Inverter's parameter:
Input voltage = 12 Vdc
Output voltage = 12 Vac
Inverter's output current = Transformer's primer current = 3,85 A
Frequency = 50 Hz

$$\text{Inverter Efficiency} = \frac{\text{Pout}}{\text{Pin}} \text{ x } 100\ \%$$

$$90\% = \frac{\text{V out x C out}}{\text{V in x C in}}$$

$$90\% = \frac{12 \text{ x } 3{,}85}{12 \text{ x C in}}$$

Input current = 4.27 A

The Single Phase Full Bridge Inverter circuit needs four paired alternating (on-off) switching equipment. Thus, there will be two alternating on-off pulses since the Single Phase Full Bridge Inverter as pictured in Figure 3.3 to produce a voltage of 200 Vac; then, the suitable equipment for it would be MOSFET type IRFP 460.

Transformer design. The step up voltage transformer is designed to increase the voltage from 12 Vac to 220 Vac to supply the lighting directly.

Primary voltage = 12 V
Secondary voltage = 220 V
Secondary current = 0,2 A

$$\text{Secondary Current} = \frac{42\ \text{W}}{220} = 0.227\ \text{A}$$

RTC setting design is based on flowchart below:

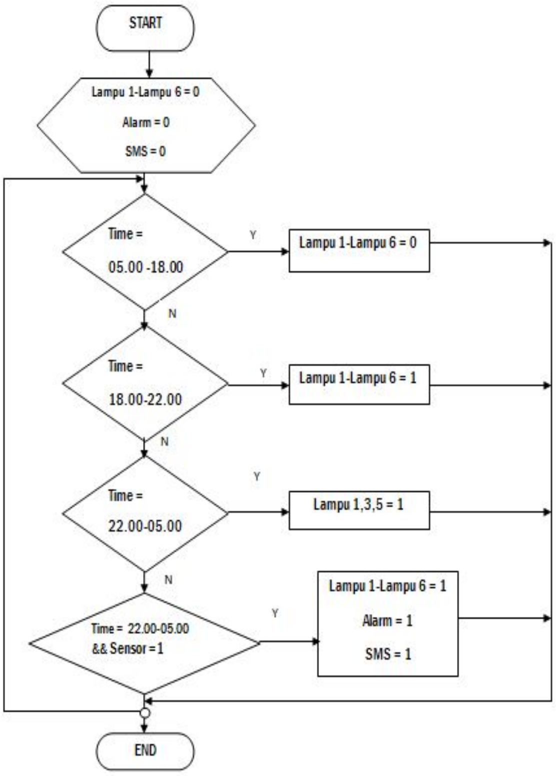


Figure 3. Flowchart System

**RESULT AND DISCUSSION**

Based on the partial testing results for each element and integrated system testing, this research derives several results,

**Solar cell's testing**

**Table 1. Solar Cell Testing**

| **No.** | **Waktu** | **Tegangan Output (V)** | **Kondisi** |
|---|---|---|---|
| 1 | 8:00 | 18.9 | Bright |
| 2 | 9:00 | 19.2 | Bright |
| 3 | 10:00 | 18.5 | Bright |
| 4 | 11:00 | 17.63 | Bright |
| 5 | 12:00 | 19.27 | Bright |
| 6 | 13:00 | 18.40 | Bright |
| 7 | 14:00 | 17.77 | Bright |
| 8 | 15:00 | 15.67 | Clear |
| 9 | 15:30 | 5.81 | Cloudy |
| 10 | 16:00 | 11.24 | Cloudy |
| 11 | 16:30 | 7.14 | Cloudy |
| 12 | 17:00 | 7.10 | Cloudy |

Based on the table 1, we know that the solar cell have the highest amount of output voltage at 12:00 with the voltage of 19.27 volt. If the weather becomes cloudy, reduction of sunlight intensity happens. Thus, at 14.00-17.00, it decreases almost 7.10 volt. In testing the solar cell with a 14.5 Ohm load, we have a fact that the highest efficiency occurs at 12.00 is 21.84%. The efficiency of solar cell is minimizing because of the cloudy day and overload.

**Testing of Buck Converter**

Table 2. Testing of Buck Converter

| Duty Cycle | Vin (V) | Iin (A) | Io (A) | Voprak (V) | Efisiensi (%) |
|---|---|---|---|---|---|
| 20 | 20 | 0,045 | 0,19 | 3,88 | 73,29 |
| 30 | 20 | 0,099 | 0,24 | 7,24 | 87,75 |
| 40 | 20 | 0,131 | 0,26 | 9,03 | 89,61 |
| 50 | 20 | 0,167 | 0,29 | 10,99 | 95,422 |
| 60 | 20 | 0,211 | 0,31 | 12,82 | 94,2 |
| 65 | 20 | 0,212 | 0,4 | 12,86 | 95,5 |
| 70 | 20 | 0,225 | 0,32 | 13,44 | 99,6 |
| 75 | 20 | 0,25 | 0,44 | 14,46 | 99,2 |

The testing of buck converter series is executed by using PWM analog. It could be done by changing the amount of duty cycle with input voltage of stable buck converter. From the table 2, we can analyze that a series of buck converter is able to work effectively with its amount of efficiency up to 99.6%.

**Inverter testing and step up transformer testing**

**Table 3. Inverter Testing**

| Vin (V) | Iin (A) | Vout (V) | Io (A) | Efisiensi (%) |
|---|---|---|---|---|
| 5 | 0.15 | 5.24 | 0.127 | 88 |
| 10 | 0.29 | 10.69 | 0.25 | 92 |
| 20 | 0.55 | 21.9 | 0.45 | 89.5 |
| 24 | 0.65 | 24.7 | 0.52 | 91.29 |

**Table 4. Step Up Electrical Transformer Testing**

| Vin (V) | Iin (A) | Vout (V) | Io (A) | Efisiensi (%) |
|---|---|---|---|---|
| 10 | 10 | 84 | 1 | 84 |
| 15 | 11.8 | 123 | 1.22 | 84.77 |
| 20 | 13.8 | 167 | 1.45 | 87.73 |
| 24 | 15.2 | 195 | 1.6 | 85.96 |

According to table 3, we can analyze that input voltage of inverter, as DC's quantity can be converted into AC's quantity; so that efficiency reaches 92%. From transformer testing in table 4, we have a result that testing of a series of parallel 6 LED lamps 7W (total load 42 W) produces the average efficiency 85%. However, when output current from the transformer is 1.45; it only produces 87.73%. It shows that the amount of efficiency could not be maximized because of deficiency of iron and steel.

**Testing of SMS Gatteway Communication**

The attachment wavecom uses serial cable in microcontroller. The port that is used in microcontroller is USART0 with bautrate 9600. The result of SMS Gateway's notification is


Figure 4. Dispatch result of SMS Gateway

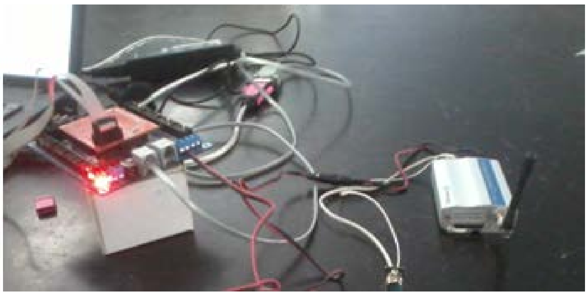

Figure 5. Testing of Wavecom and Microcontroller communication

Wavecom will only send a short message when PIR sensor detects human object passes the secure area during 22.00-05.00. Its content is sent from number 085655227455: "Security System has detected motion in the corridor."

**Extrapolation of Power Usage: Before and After Implementing Energy Management System**

This system uses the battery rate of 12 V 45Ah. Battery 12 V has a voltage of 12.7 V for using within 10 hours and is stepped up to 220 V. The amount of energy usage before using this system based on PLN supply is:

Total energy = 7 w x 10 hours x 6 = 420 Wh

The amount of energy used after the application this system based on solar cell supply is:

Total energy = 168 Wh + 147 Wh = 315 Wh

The amount of energy saving is the difference of the energy before and after energy management.

Saving = before management – after management

*Saving = 420  Wh – 315 Wh = 105 Wh*

The ratio of energy is a comparison between post management and pre management

$$\text{The Saving Ratio} = \frac{\text{after management}}{\text{before management}} \text{ x } 100\%$$

$$\text{The Saving Ration} = \frac{315 \text{ Wh}}{420 \text{ Wh}} \text{ x } 100\% = 75\%$$

The saving ratio is derived from = 100 % - comparison ratio

The saving ratio = 100% - 75 % = 25 %

**CONCLUSION**

Conclusion of this research are:

- Solar cell has a good performance at 12.00 with voltage production of 19.27 volt and the amount of efficiency around 21.6 %. The most important factor from supplying system is sunlight intensity which is received by solar cell to fill the accumulator tank. If there is reduction of it, the solar cell's output voltage is only 5.81 volt.

- Buck converter as a voltage stabilizer, could afford the efficiency of 99,6 %. Inverter as a transformer from DC voltage to AC voltage could afford the maximum efficiency up to 92% to convert from 10 Vdc to 10, 69 Vac.
- When PIR sensor detects motion, short message will be sent as a notification in 30 seconds; it is exceptional with each provider
- By using this lighting management system, the energy usage within 10 hour (17.00-03.00) is only 420 Wh. Thus, the energy saving up to 105 Wh or equivalent of 25% of the total energy.

**REFERENCES**

[1] Batarseh Issa, *Power Electronic Circuit*, 2007
[2] Ismail, Baharudin, "Design and development of unipolar spwm switching pulses for single phase full bridge inverter application", *Jurnal Universities Sains Malaysia*, 2008
[3] Majhi Bijoyprakash, "Analysis of Single Phase SPWM Inverter",*Jurnal Department of Electrical Enggineering National Institute of Technology, Rourkela*, May 2012
[4] Mark Hankins, *Stand-Alone Solar Electric System*, 2010
[5] Rashid Muhammad H, *Power Electronic Device Circuit and Application*, 2007
[6] William Hart, Daniel, *Power Electronics*,2011