Analysis of Electricity Use Efficiency in Smarthome with SMS and IoT Microcontroller Technology

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Abstract
Smarthome technology in everyday life is increasingly widespread with developments in its application media. Of course, each applied media has a different circuit arrangement but still has the same purpose. This research aims to analyze the efficiency of energy use of Smarthome technology in turning on house lights using GSM modules and IOT Microcontrollers. Both media allow users to set the schedule of lights on and off using a Smartphone. In addition, the ability to control lights directly via SMS and applications on Smartphones provides user flexibility in lighting management. The implementation of smarthome media in this research contributes to energy efficiency and user convenience in managing lighting devices at home. Experimental results show that this system is reliable, responsive, and provides smarter control of home lights by using IoT Microcontroller technology in this case Node MCU ESP 8266 and smartphone applications. Similarly, the GSM Module can control home lights with the support of SMS commands using cellular networks. Thus, this research provides a solution in comparing the level of electrical energy efficiency and also the economic level of the two smarthome media.

Keywords: Smarthome, IoT, Esp 8266, and GSM

Introduction

In the era of digital and connectivity that continues to grow, *Smarthome* is one of the concepts used to make human work easier. Related to that, it encourages people to continue to try to find ways to modify their homes into homes that have high utility [1]. In today's era, the design of home automation systems is nothing new. With the many facilities available on the market today, home automation systems can make it easier for their owners to maintain and provide comfort for everyone who lives in it [2].

Everyday there are many problems that occur in using technology that sometimes we cannot avoid, such as forgetting to turn off the house lights. These problems can be overcome by utilizing current technology, one of which is by using a *GSM (Global System Mobile) module as a remote light control tool.* [3] *we can also implement an automatic light control system using the NodeMCU* microcontroller and the *Blynk application*. [4].

Theoretical Basis

Internet of Things (IoT)

Internet of Things (IoT) is a concept/scenario of an object that has a network without requiring human-to-human or human-to-computer interaction where now IoT is developing from the

convergence of wireless technology, *Internet of Things* (IoT) refers to a network of interconnected physical devices embedded with sensors, software, and other technologies that enable them to collect and exchange data with other devices and systems over the internet. These "things" can include everyday objects such as household appliances, vehicles, wearable devices, industrial machinery, and more.
According to [5] the Internet of Things is a concept that aims to expand the benefits of continuously connected internet connectivity that allows us to connect machines, equipment and other physical objects with network sensors and actuators to obtain data and manage their own performance, thus allowing machines to collaborate and even act based on new information obtained independently, as illustrated in Figure 1 below:

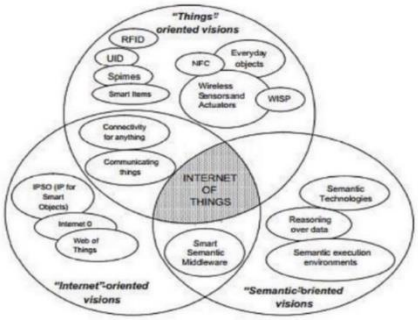

Figure 1. Internet of Things [6]

Smart Home
Smart Home is part of IoT where all everyday objects that we encounter are 'smart' due to the integration of technology in the form of a versatile microcontroller. In this case, smart home, IoT comes in the form of items that are often found in most homes. A smart home can be defined as a home that combines smart objects and devices that can transmit information and are equipped with the ability to connect to the internet. Integration on smartphones or gadgets is one example of the application of the Internet of Things (IoT) [7].
Smart technology adopted by homes not only functions to turn on or turn off various household devices or devices in the house remotely, but must also be able to monitor the surrounding conditions (house) and the activity patterns of its occupants, for example: the room temperature usually chosen by the occupants of the house, the time to turn off the lights, and so on.
Smart Home is a combination of technology and services applied to the home environment that aims to improve the security, efficiency and comfort of its occupants. Smart home systems generally consist of monitoring devices, control devices and automatic devices that can be accessed using a computer [8].

NodeMCU
NodeMCU is a microcontroller with more features completely comparing with other microcontrollers such as *Arduino* and *NodeMCU ESP8266*. [9] microcontroller has more *input / output pins*, to make it easier to build the system. In addition, *WiFi* is equipped with faster speeds Two low-energy bluetooth modes to make a great tool *WiFi* or Bluetooth role is needed, no components to use so it does not take up much space and of course cost-effective between them.

Figure 2. *Node MCU Esp 8266*

Relay

The relay module is a very practical module to be used as a main automatic switch for a 4-channel project with a microcontroller-based electronic circuit. This module turns on / off other electronic devices powered by 240 VAC AC power or high voltage DC devices, such as high-power DC motors. It has a maximum current of 7 amps for each channel.

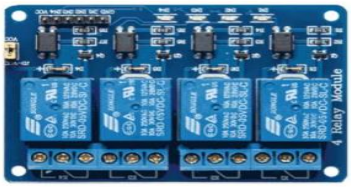

Figure 3. *4 Channel Relay* [10]

GSM Module

GSM (Global System for Mobile Communications), is a standard developed by *the European Telecommunications Standards Institute (ETSI),* created to describe the protocol for second-generation *(2G) digital cellular networks* used by mobile phones. The *General Packet Radio Service (GPRS)* is a packet-oriented cellular data service on the cellular communication system *(GSM) 2G, 3G, and 4G* cellular communication systems. In the application in *smarthomes, the SIM800L V2.0* module is a *QUAD BAND GSM/GPRS module* whose use supports and is suitable for *Arduino* because the advantages of this module are that *the Vcc* and *TTL* serial levels are already 5V so that they can be connected directly to *the Arduino without having to add a 5V regulator and level converter* circuit [11].

Figure 4. *GSM SIM 800L & SIM 800L V2* Module [12].

Methodology

The research method can be seen in the image below.

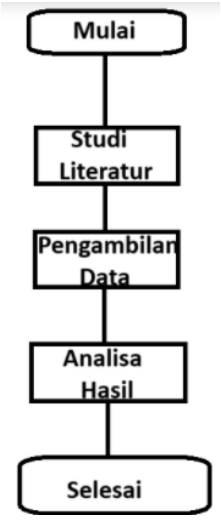

Figure 5. Research Flow

From Figure 5 above, the work process of the research conducted can be seen. The first thing to do is the literature study process, this process is carried out so that we get reference materials related to this research. After that is the data collection process which is carried out by testing turning on the house lights and applying three conditions, namely without using *smarthome*, using smarthome with SMS media and using smarthome with *NodeMCU Esp8266 media for smarthome* application media. Then analyze the results by comparing the use of electrical power from the three conditions.

Figure 6. Tools used in the research

The image above is a test tool used in this study, made like *a smarthome* that is applied in home lighting. In this trial using *the GSM module* and *NodeMCU ESP8266* which functions as a breaker or automatic breaker of electricity to the lamp.

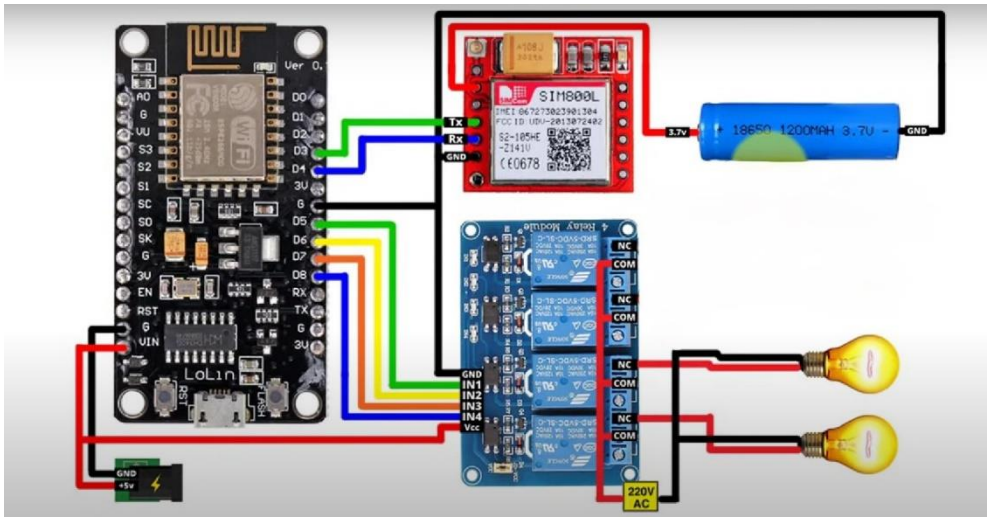

Figure 7. *Smarthome Hardware* Circuit with *GSM Module Media* and *Node MCU Esp 8266*

In Figure 7 above is a series of hardware used in this study, where there are two lights, each of which will represent *the output* of the *GSM* module-based *smarthome media* and *the output* of *the NodeMCU Esp8266* -based *smarthome media*.

Results and Analysis

Research data collection was carried out in 3 conditions, namely conditions before using *smarthome technology*, conditions after using *smarthome technology with GSM* module media and after using *smarthome technology* with *NodeMCU media. Esp8266*. Data was taken in conditions from morning to evening at 08.00-18.00 where it is busy hours and most likely we forget to turn off the porch lights when going to work. The lamp or load used in this study uses 1 lamp with a position on the front porch of the house and the lamp used is *Philips* 12 *Watt*.

Table 1. Conditions before using *smarthome technology*

Time (WIT)	Lamp Voltage(V)	Lamp Current (A)	LampPower (Watt)
08.00	221	0.06	13.26
09.00	223	0.06	13.38
10.00	218	0.06	13.08
11.00	220	0.06	13.2
12.00	220	0.06	13.2
13.00	219	0.06	13.14
14.00	220	0.06	13.2
15.00	221	0.06	13.26
16.00	218	0.06	13.08
17.00	221	0.06	13.26
18.00	221	0.06	13.26

From Table 1, data analysis can be done that for load control conditions before utilizing *smarthome* When we forget to turn off the porch lights, the power used to operate the lights from 08.00 to 18.00 in a day is 145.32 Watts. And the power usage to operate the lights in a month is 4,359.6 Watts.

Table 2. Conditions for using *a smarthome with GSM* module media

Time (WIT)	Lamp Voltage(V)	Lamp Current (A)	Lamp Power (Watt)
08.00	218	0.06	13.08
09.00	220	0.06	13.2
10.00	7	0	0
11.00	4	0	0
12.00	6	0	0
13.00	7	0	0
14.00	5	0	0
15.00	5	0	0
16.00	5	0	0
17.00	223	0.06	13.38
18.00	220	0.06	13.2

From the results of the study Table 2, it can be analyzed that after the use of *smarthome technology based on GSM* modules in controlling the load can be done automatically when we forget to turn off the porch lights. Different from the research data without utilizing this technology, the lights are on for 11 hours a day when the occupants of the house forget to turn off the porch lights manually. From the results of the study using *smarthome technology*, the power consumption needed to operate the lights in a day is 52.86 Watts. And the power consumption needed in a month is 1,585.8 Watts

Table 3. Conditions for using *smarthome with NodeMCU Esp8266* media

Time (WIT)	Lamp Voltage(V)	Lamp Current (A)	Lamp Power (Watt)
08.00	219	0.06	13.14
09.00	221	0.06	13.26
10.00	7	0	0
11.00	5	0	0
12.00	4	0	0
13.00	6	0	0
14.00	7	0	0
15.00	5	0	0
16.00	5	0	0
17.00	220	0.06	13.22
18.00	223	0.06	13.38

From the results of the study Table 3, it can be analyzed that after the use of *smarthome technology* based on *NodeMCU Esp8266* in controlling the load can be done automatically also when we forget to turn off the porch lights just like using the *GSM module*. From the results of the study using *smarthome technology* based on *NodeMCU Esp8266*, the power consumption needed to operate the lights in a day is 53 Watts. And the power consumption needed in a month is 1,590 Watts. Data collection carried out in load control conditions before and after the use of *smarthome technology*, the level of electricity efficiency used can be identified. To find out the value of the power efficiency level, namely by dividing the power consumption data before using *smarthome with the power consumption data after using smarthome* media then multiplied by 100%. From the power consumption data for one month for conditions before using *smarthome technology* of 4,359.6 Watts, for power consumption data after using *smarthome technology based on GSM* Module of 1,585.8 Watts, and power consumption data after using *smarthome technology* based on *NodeMCU Esp8266* of 1,590 Watts, so the level of power efficiency in controlling the load by utilizing *smarthome technology* is:

GSM Module:

$$\eta = \frac{4.359,6}{1.585,8} X100$$

$$\eta = 274,91$$

From the results above, it was found that the level of energy efficiency produced after utilizing *smarthome technology based on GSM* Modules was 275% or around 2.75 times more efficient than not using *smarthome media*.

Conclusion

The main purpose of *smart home system* is to make the life of elderly and disabled people easier and to save electricity. So the popularity of using smart home system is increasing day by day. Smart home services provide more security than automation. Smart home system reduces stress level by ensuring security to the user even if the user is not at home. Smart home system will become a necessity for everyone. In general, the electrical efficiency level *of smart home based on GSM* Module and *NodeMCU is the same only differs in the hardware* components that make up the circuit.

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