The Framework of Home Remote Automation System Based on Smartphone

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Abstract

The purpose of this paper is creating a mobile app on a Smartphone device so that the user can control electronic devices; see the amount of flow that has been used in the amount of dollars, so the problem is the difficulty in saving electricity can be resolved. Development and design was done by collecting data using questionnaires to the respondents. Design method using observations, distributing questionnaires and to study literature, and then after that do the design in hardware (microcontroller) made United Modeling Language (UML), database design, code implementation and creation of user interfaces on IOS and Android. The result of this research is the implementation of a remote home automation application in mobile which can help users in order to control the home and determine the cost of electricity that has been used in every electronic device so that the optimization can be achieved.

Keywords— Arduino, Automation, Home remote system, Microcontroller

1. Introduction

Recently, technological developments have given huge contribution to improve the quality of human life and welfare. This technology can be used to monitor and control the use of electrical energy and electronic devices at home to facilitate the user [1]. Nowadays, Automation technology in controlling electronic devices and electrical energy is one of the major applications [2, 3]. In the previous research, the electrical installations for conditions controlling of lives equipment are still relatively simple which is using a conventional close-range control principle (manual) or can be called a control without distance [4]. A few issues involved when designing a home automation system are: it should be measurable so that new devices can easily be integrated into it. It also should user friendly interface so that the device can be easily set up, monitored and controlled [2]. The established methods of home automation utilize an electrical device called microcontroller for controlling task.

Microcontroller is used as a support tool for controlling the electric current, as example, the control system with SMS (Short Message Service) on the mobile phone as a remote control system automatically. The concept of electric current controlling using this technique is easy, however the process will spend much data storage since there will be a lot of SMS sent from the GSM module data transmission due to the electric current is updated in every second [5]. Therefore, in order to reduce the data storage, the control system of electric current is made by using an online space that connects to Smartphone via internet. Smartphone is chosen because this phone has many features, such as accessing the mobile web, has an operating system, QWERTY keyboard and a touch screen. In other words, the Smartphone is a small computer which has the capabilities of a phone and computer in the same time.

In the Smartphone, the technology which is applied known as Mobile Web Application [6]. Mobile Web Application is the easiest application to learn, to be

standardized, most available, and the easiest to be distributed. Mobile web application is also the only platform that is available and capable to be run on all mobile devices, using a standard set and the same protocol with a web desktop that is designed for Smartphone [7]. Therefore, taking advantage of the Mobile Web Application system, it is expected to facilitate electronic devices control system greatly that can be controlled by a Smartphone. This paper proposes an automation system in controlling the electronic devices and electrical energy that is connected by a microcontroller and controlled by Smartphone in two different operating systems, namely Android [8] and iOS. This system is proposed to cover the problem which is encountered by the user such as the difficulties to obtain the information regarding the current usage in each room and the problem to control the electronic devices manually from the outside.

This paper is arranged into 5 sections, first section is introduction which explained the problem background and current issues in home automation. Next Section is the framework of the system and followed by experimental result in Section 3. This paper is ended with the conclusion and suggestion for the future work in Section 4 and 5 respectively.

2. Framework of the System

Generally this research is divided into two main tasks, namely controlling devices and providing current information. The controlling and providing information task are conducted by combines the Arduino microcontroller which connected to a router in the house and can be accessed by smartphone using the smartphone internet. The providing information task will helps the user to see the amount of electrical charge used in a media room with a smartphone in daily, weekly, and monthly period in the amount of Indonesian Rupiah. The block diagram of the system is shown in Figure 1.
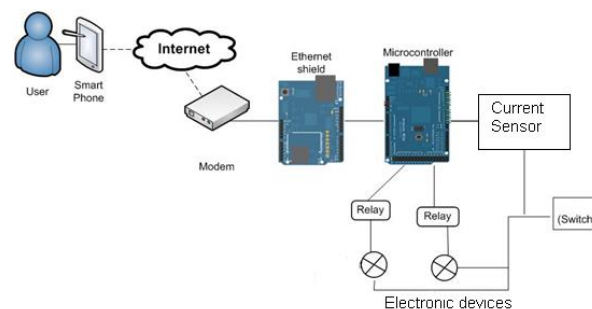

Figure 1. Block Diagram of the Smart Automation Home

Figure 1 shows a block diagram of the Smart home which has detailed as follows:
The Arduino Microcontroller ATmega.
The Ethernet Shield.
Measuring tools power, and
The device relays.
While the devices that support the data supplying to be sent and to be received are: Modem to transfer the data, electronic tool to see what the results are in the User command and Smartphone to send data and receive data. In the system above, the primary device of system will be activated with the support of the incoming power supply with AC voltage 5 Volts which is converted into DC. The Smartphone send commands in the form of data through a web server by using the internet which is received by a microcontroller. In order to connect to internet, the devices are equipped with a microcontroller Arduino ethernet shield which is be paired with an ethernet cable

connected to the modem to connect to the internet. The data which is received by the microcontroller is forwarded to the mobile web application system and release the information such as increases of current consumption, command "turn off" or "turn on" the electronic device, and dim the lights.

2.1 Microcontroller *Atmega2560*

Microcontroller *Atmega2560* is known as Arduino Mega is one of the devices which have many features to simplify the users and integrate to the other features. Microcontroller *Atmega2560* is worked properly when it is connected to the 5 volt voltage. It has reset pin to reset a program to the initial setting. This device has 54 digital input/output where 14 is used to PWM output and 16 is used as analog input. The *Atmega2560* is 8-bit microcontroller with RISC (Reduced Instruction Set Computing) based, where the instruction setting is reduced in term of size and complexity of addressing mode. One instruction has 16-bit and the most part is executed in 1 block cycle. Each pin in *Atmega2560* is connected to the others device as the output. It receives the data from the web server and then processed by microcontroller and sends it back through the pins to the other devices. It also receives the input from the connected devices which will be processed in microcontroller and sends it back to the web server. The configuration of pin I/O in smart home system is given in Table 1.

Table 1. Configuration of Microcontroller *Atmega2560* Pin

Pin	Microcontroller *Atmega2560*
Reset	Arduino Board Reset System
3.3v	Output voltage, provided by Arduino Board for certain component
5v	Output voltage
GND	Ground
Vin	Input voltage 5-9 Volt
2,3,4,5,6,7,8,9,15	Relay
A0, A1, A2	Current Sensor

2.2 Software Development

In software development, we use provided framework Arduino, namely arduino 1.0.3, which is written in C language, while for mobile application we use Titanium software with multi platform in JavaScript language and for the web server, we use PHP languages to be connected to the database. This database uses MySQL programming for the efficiency. The process of the smart home automation is shown in Figure 2 below.
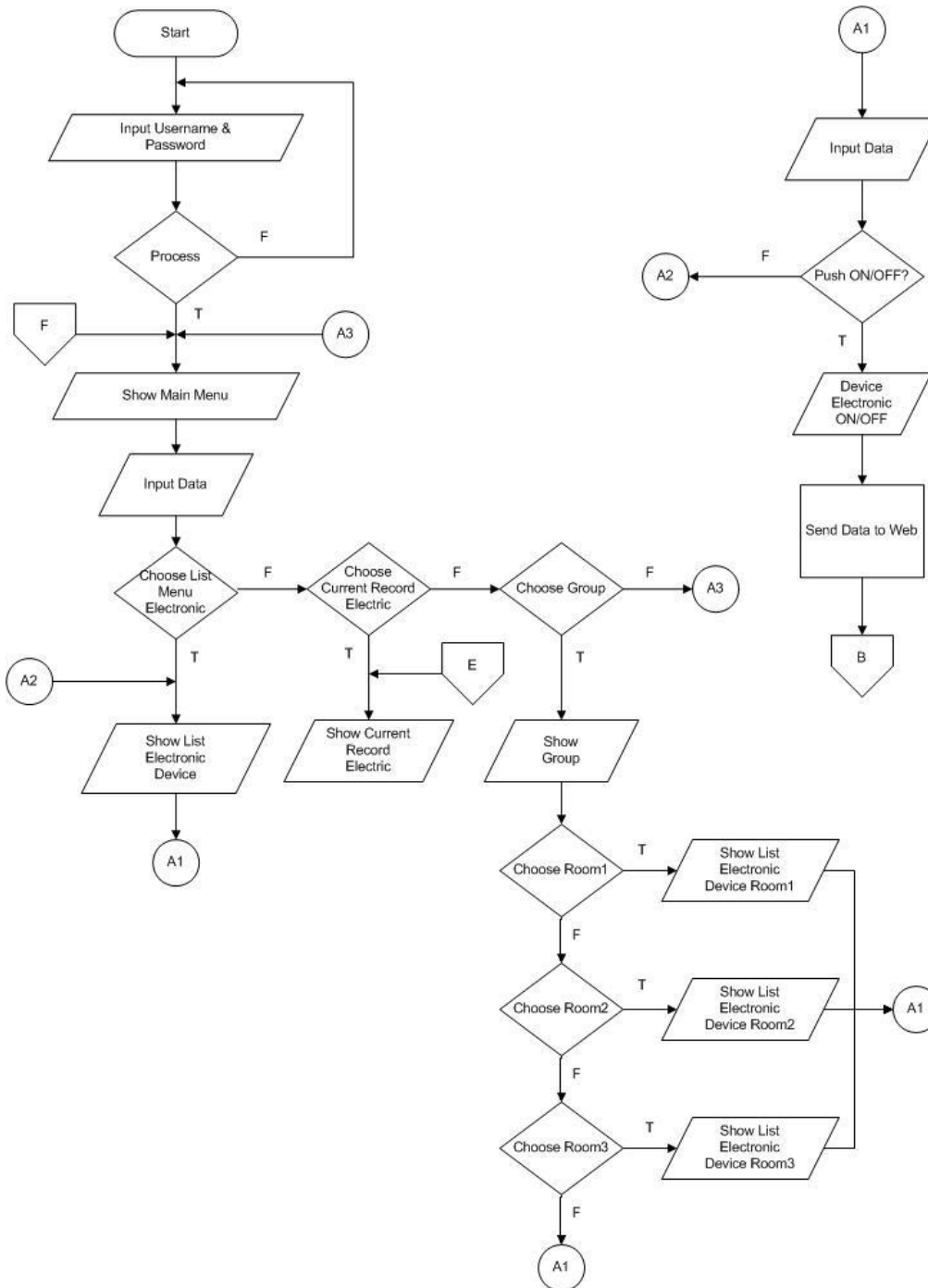
Figure 2. Flowchart of the Smart Automation Home

Generally, system development is carried out using Unified Modeling Language (UML), which is analyzed using the following steps:
1. Use Cases Diagram
2. Activity Diagram
3. Sequence Diagram
4. Class Diagram
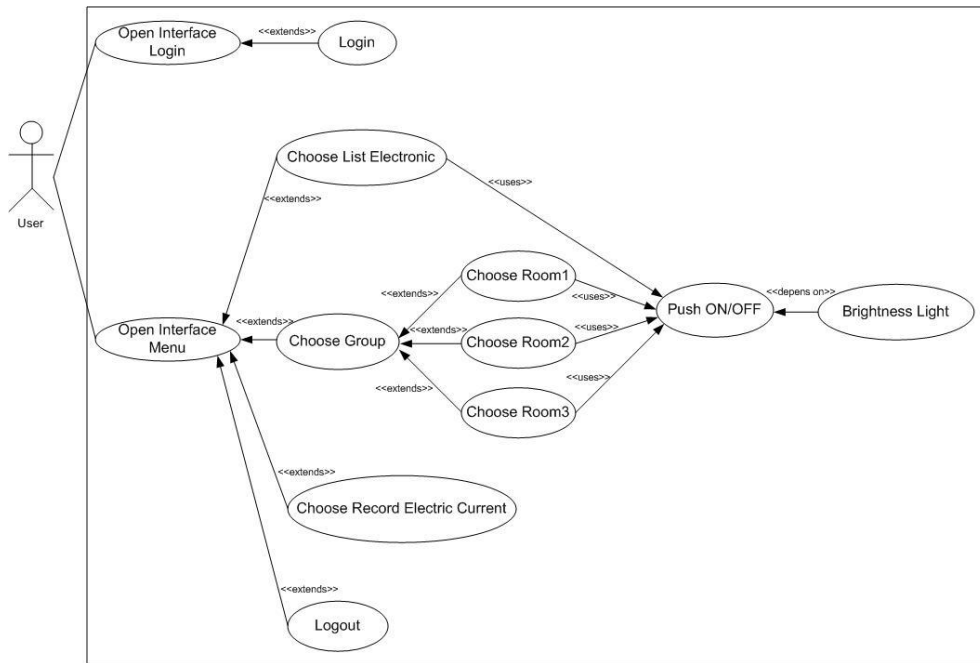"Use case" diagram is given in Figure 3

Figure 3. User "Use Case" Diagram

2.3 Operating Procedure

The operational procedures are carried out to run the application. First of all, the user is required to log in to fill the username and password, which is obtained from the administrator. If the username and password is entered incorrectly it will exit the error message. If it is successful, the user will enter the "Main Menu", in the main menu there are four options namely "Electronic List", "Group", "Electric Current Record" and "Logout". If the user selects "Electronic List" it will show a list of electronic devices installed. From this option the user can also turn off and turn on the lights and set the overcast condition with keys already available. Then if the user selects the option "Group" the user will see the option groups available based on user group and can perform control on existing electronic devices. Then if the user selects the option "Record Electric Current", the user can see the number of flows that have been set as Rupiah. And if the user selects the option "Logout" then the user automatically back to the login form application.

3. Experimental Results

Basically several types of the device can be used as a relay switch of electronic equipment, for example electric lights, electric motors, and a variety of other electronic devices. In this system, the relay is used to power-down automatically based on the order which is specified by the value of the output, which has been processed by microcontroller or controller device. The device is used to adjust the flame relay and the turning off of electronic devices. Relay is connected to the pin on the Arduino Mega (Figure 4) and connected also with the electronic device. This device includes Kit Relay device for electrical appliances AC / DC and pin cables and connectors.
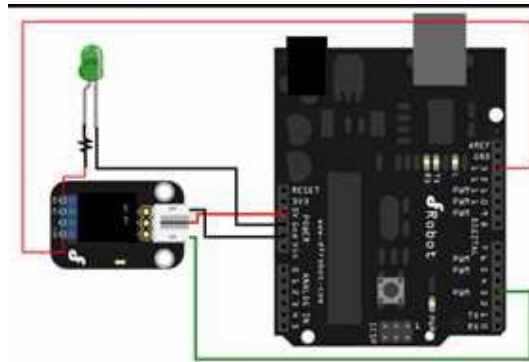
Figure 4. Relay Configuration

A. Testing

Testing is carried out into three parts, namely turn on/off testing, dim testing and current electric record testing. Testing carried out Android smartphones (LG P500 ICS 4:04) and virtual iPhone. First, before the testing is conducted, it is executed to see how long the smartphone takes log time level to arrive in the Main Menu. The time is measured based on how long this application takes time to login and reverse current that is in the main menu. This test is needed to ensure the user waiting time is not too long, the result of this test is shown in Table 2.

Table 1 show that the system needs maximum 5 seconds to achieve the main menu. Virtual iPhone and Virtual Android using wireless is the lowest time in achieving the main menu, while the highest is the virtual android using EDGE network. So based on the experiments done on two smartphone devices found that the likelihood of a successful login at least 100% on EDGE networks. With a maximum waiting time of four seconds. It can be concluded that the application is already running pretty fast.

Table 2. Login Time Test

Device	Network	Time Request	Results
Virtual iPhone	Wireless (1Mbps)	3 s	Success
Virtual Android	Wireless (1Mbps)	3 s	Success
	3G (Full Signal)	4 s	Success
	EDGE (Full Signal)	5 s	Success

The next testing for this system is "Turn on/off" and dim testing.These testing are carried out using Android smartphones (LG P500 ICS 4:04) and virtual iPhone. The test is done to see how this app can turn on , turn off and dim the electronic device.The result of the "Turn on/off" and dim testing is shown in Table 3 and Table 4 respectively.

Table 3. The Result of "Turn on/off" Testing

Device	Arduino Slot Pin	Electronic Device	Dim
Virtual iPhone	Pin 5	Lamp	ok
	Pin 4	Lamp	ok
	Pin 3	Lamp	ok

	Pin 5	Lamp	ok
Virtual Android	Pin 4	Lamp	ok
	Pin 3	Lamp	ok

Table 4. The Result of Dim Testing

Device	Arduino Slot Pin	Electronic Device	ON	OFF
Virtual iPhone	Pin 5	Lamp	ok	ok
	Pin 4	Lamp	ok	ok
	Pin 3	Lamp	ok	ok
Virtual Android	Pin 5	Lamp	ok	ok
	Pin 4	Lamp	ok	ok
	Pin 3	Lamp	ok	ok

Table 3 and 4 show that the system is able to control turns on/off and dims the lamp correctly. So based on the experiments which is performed on two smartphone devices, it was found that the percentage probability of success in shutting down and turning on an electronic device is 100%.The last testing is current electric record. In this phase the user can view the record of current usage and total payment in daily, weekly and monthly. The result of this testing is shown in Figure 5.
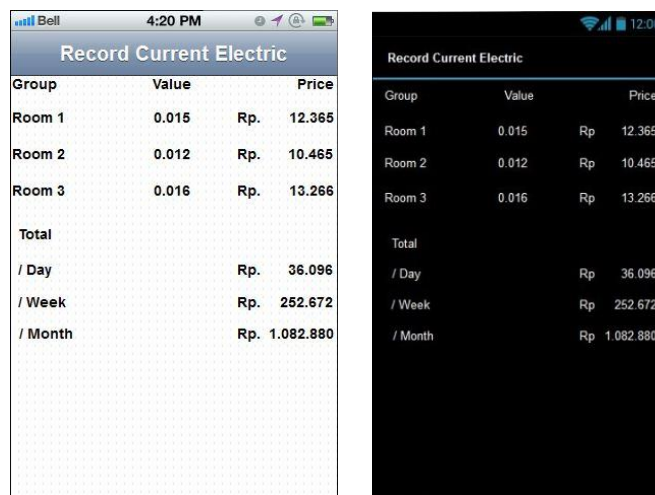

Figure 5. Current Electric Record

4. Conclusion

Based on the study and evaluation of the results analysis in the previous section, this applicaiton can be run in two OS, (Android an iOS). This application is useful for the user to turn off and turn on electronic devices from their smartphone so that can help user to look at the power consumption of electronic devices in the room that had been set in the amount of Indonesian Dolar Rupiah (IDR). This applicaiton is also useful for the user to dim the lights, with the aim of saving the money.

5. Future Works

Useful suggestion based on survey in this research to develop this application in the future such as:

- Give additional features such as security camera
- Provide additional features such as door lock automation
- Develoop the new User Interface to make it more interesting and also more attractive to users
- Provide a brief tutorial mounting hardware, alsa the installation and use of software
- This system is better implemented in new residential or new apartment.

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