The Application of Smart Home System to Manage Electric Prepaid Type R1 KWH Meter Using LattePanda Single Board Computer

Z Ariffin¹, M Safi’i²*, W H Pamungkas³, Y Servanda⁴

¹,² Departement of Information Technology, Mulia University, Balikpapan, Indonesia
²,³ Departement of Information System, Mulia University, Balikpapan, Indonesia

*Corresponding author e-mail: safii@universitasmulia.ac.id

Abstract. The software industry encourages large investments in technology, researchers make a simple concept in the process of digitizing home electrical switches to save and optimize the time of use of electricity on any electronic devices that are connected to electricity. The making of the system has been designed with the electric switch countdown time activated so that the user can set the length of time the electricity is used as needed to save the prepaid electric pulse-type R1. Another capability of this electricity management software is that it can calculate the use of kilowatt-hour quickly based on the basic electricity tariff that educates for the importance of 1 kilowatt-hour. From the results of testing and developers using microprocessor technology using laser markers making smart home software can manage electricity savings precisely and easily on R1 prepaid electricity meters.

1. Introduction

A common problem with electricity usage at this time is the excessive use of electricity and cannot be controlled properly. That is because of the lack of awareness of electricity users means the utilization of every 1 kilowatt-hour (kWh). In general, houses are rarely equipped with appropriate monitoring tools for measuring electricity usage by the owner. The use of electrical energy for each occupant of the house is usually different even though the number of electronic goods carried is equal. This, of course, can lead to wasteful use of electricity that is not in accordance with the time and needs.

At present, the State Electricity Company (PLN) has provided innovations in the form of prepaid meters for electricity usage in homes so that the amount of electricity used can be known and limited. That innovation is not enough to be a solution for homeowners because every family member has different needs in the use of electricity.
Various studies on monitoring restrictions on energy use and electric power have been carried out. Research on control and monitoring tools based on the power checkpoint system shows good results. The specified power checkpoint will activate an alarm if the power used is equal or exceeds the predetermined power checkpoint [1]. Another related research is the prototype of the digital kWh meter application, using the microcontroller ATMega 8535 for the scope of the room. The tool function is to measure the electric power used in two different rooms, at the same time, and see the number of usage rates in both rooms [2]. However, both of these studies conducted power calculations only based on the consideration of the value of the electric current with the amount of electric voltage is assumed to be constant at a predetermined value.

2. Methods

The experimental research methodology is a study that seeks to find the effect of certain variables on other variables under tightly controlled conditions. Experimental research is a systematic method for establishing relationships that contain causal phenomena.

In experimental research is the core method of the research model that contains quantitative approaches. In the experimental method, research must conduct three requirements, namely control, manipulation, and observation. In experimental research, researchers divide the object or subject being examined into 2 groups: the treatment group that receives treatment and the control group that does not get treatment.

In this hard work experiment, this research measures the relevance of the functions of the electronic components adjusted for the software engineering instructions that were developed. namely universal serial bus (USB) relay switch as an electronic circuit switch and a switch or socket, these components are integrated with software that is developed with a customized value of floating applications using visual basic 6.0 by applying it to a mini-computer so as to facilitate the construction of applications on electrical condition of the house. The mini computer used is a 32 gigabyte capacity latte panda with processor specifications: Intel Cherry Trail Z8300 Quad Core 1.8 GHz, Default operating system: Windows 10 (without license) [4], 2GB DDR3L RAM, 32GB internal memory, USB: 1x USB 3, 0, 2x USB 2.0, Video output: HDMI and MIPI-DSI (Mobile industrial Processor interface-Display serial interface), WiFi Communication 802.11 b / g / n, Ethernet 10/100 Mbps, and Bluetooth 4.0 , Assistant ATMega32u4 processor (Arduino Leonardo), GPIO 2 GPIO for Intel chips and 20 GPIO for Arduino 5V / 2A power supply [2]. Researchers used an experimental method to explore the universal serial bus control function which is the input and output port of the electronic relay circuit to the home electrical switch. In the construction of the device researchers recommend that Lattepanda as a brained computer to facilitate the Visual Basic 6.0 program can work into a prepaid electrical management application system that has a pretty good data communication feature and is equipped with Arduino Leonardo which is embedded on the Lattepanda motherboard so it does not cover the possibility of developing Processor-based will be even better, on the priority of researchers making a minimalist construction of the system that will be applied more effectively in the home electricity management settings.

Electricity regulating software system on electric panel meter type R1 with a capacity of 900 Watt. At kilowatt-hour, the state electricity company has provided electricity tariff regulation of 1352 per region.

The experimental method is done by calculating kilowatt-hour as a control method using the following formula: \( \frac{1000 \times 1}{0.02} = 20 \text{ watts} / 1000 \times 1 \). If the capacity is 20 Watt with an active time interval of 11 hours the lamp will ordain IDR 279.44 per 11 hours or 0.16 kwh / 11 hours. The formula is used as an estimation of time alone, with the development of research software making simulators
using interfacing technology that is milling the use and controlling the automatic shutdown according to its frequency. The treatment system that is developed will calculate the active time of the device with capacity. And the device has no changes or other rules aside from the system development.

3. Result and Discussions

In the calculation of 1 kilowatt-hour (kWh), the researchers took the basis of the prepaid basic electricity tariff of 1352 per kWh according to government regulations on the prepaid 900VA category. Electrical devices in the object of this study are 4 devices, namely 2 units of lights, fan, and refrigerator. Researchers simulate the use of electrical energy in household users of 900VA prepaid electricity. As a result, the average power consumption in conventional use is in the range of IDR 50,000 per 4 days.

Figure 1. A kWh Management System Prototype

In Figure 1, the researcher creates a prototype that combines software with engine driver porting relay board technology designed to drive a conventional switch into a single control on the system to be applied. This device uses a universal serial bus (USB) interface because it is more familiar and very easy to find on many electronic devices [1]. To accommodate more adaptive and flexible innovation and development, the programming mechanism used in this research is interface-based programming.

Interface-based programming is used for software innovations that can control other hardware such as sensors, motors, temperatures, keypads, displays, and other electronic devices. Hardware emulators such as temperature monitoring, electrical voltage, etc. can be easily recognized outputs or system inputs. The entire process of device recognition through analog ports, port addressing and bit reading from a native node or p-processor coded using Visual Basic 6.0 [1].

The ability of independent interfacing programming can be innovated in more detail and structured with a variety of programming languages without limits, for example, HTML. This approach will adapt to a cloud system controller easily by recognizing javascript or CGI with PHP controller programming techniques and support for adjusting port and bit addressing. Smart home software calculates kilowatt-hour electrical energy mechanism simply by turning off conventional switch into a digital controller that is equipped with counters and formulas according to applicable basic electricity tariffs as shown in Figure 2 below.
This device will manage conventional switches via a digital controller to automatically turn off electricity usage after studying user data during running intervals. The formula is the device capacity multiplied by the usage interval multiplied by the applicable electricity voltage rate, this calculation will be converted to the formula of usage per kilowatt-hour of electric power using a total usage of IDR 50,000 or a range of IDR 31,000 including admin fees and applicable taxes. The research results for 48 hours with the results of users can save 30% of the use of prepaid electrical energy using this system.

At each installation, interface is made by using several switches and electrical contact terminals. In Figure 3, a lamp switch illustrates a switch in a home condition while a device driver is an electronic circuit that functions to connect programming to a single board computer and to replace the lamp switch. A switch controller emulator is a form of user interface with the device driver machine and acts as a digital switch.

In this condition, the researchers made a selection mechanism for use, manual and automatic time, based on time intervals, TTL, and the amount of electrical energy per kilowatt-hour on the 9001 R1 electricity meter. The system will calculate using the simulator to get the time usage requirements. The time setup will count the lights to be able to turn off systematically according to the prepaid token electricity supply. This is used to obtain predictions of electricity energy needs and capacity of electricity token capacity for the next few days so that in terms of cost an economic estimate is obtained in prepaid Type R1 prepaid electrical energy expenditure.
Table 1. By using the assumption of using an electric token of IDR 50,000 and the calculation of the maximum savings per 1 hour per kWh, the electrical energy distribution reaches IDR10680.8.

| Electrical devices | Power Load | Interval | Electricity base price | IDR  | kilowatt-hour |
|--------------------|------------|----------|-------------------------|------|---------------|
| 1 Lamp             | 20         | 11       | 1352                    | 297.440 | 0.02         |
| 2 Lamp             | 40         | 5        | 1352                    | 270.400 | 0.04         |
| 3 Refrigerator     | 300        | 24       | 1532                    | 973.440 | 0.3          |
| 4 Fan              | 70         | 4        | 378.560                 | 378.560 | 0.07         |

By using the assumption of using an electric token of IDR 50,000 and the calculation of the maximum savings per 1 hour per kWh, the electrical energy distribution reaches IDR10680.8 or equivalent to 0.43 kWh for 4 units of equipment and obtained electrical energy usage time reaches 4 days of use. Figure 4 shows the calculation used to estimate the electrical energy consumed by 4 units of equipment with routine household usage per day.

4. Conclusion

The application of smart home electricity management software by digitizing an integrated electronic circuit switch as an electric relay driver can manage the use of prepaid electricity economically. The ability of the latte panda as the brain of the system can interact with the electricity needs of prepaid homes more leverage.

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