Design of Integrated Electricity Monitoring System for Smart Home using Mobile Application and Website

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Abstract. Smart Home is a technology that allows its users to access the appliances inside their home through a network systems. It is accessible using platforms. This paper designed a monitoring and controlling electricity usage using integrated database system with android and website platform. Monitoring system electricity usage calculated based on power consumption of the equipment i.e. TV, lamps, fridge and air conditioner. The electricity usage will be shown in user mobile application and website. Controlling systems can be done through users account in mobile application and website to switch on or switch off the expected equipment. Using test case, all features in mobile application, website and database perform good result as expected designed.

Keywords: Smart Home, Electricity Monitoring Systems, Android, Website,

1 Introduction

Internet of things (IoT) is a physical object or a thing that inserted by sensors, electronic device, software and network connectivity that allow things to collect and do the data switching [1]. IoT is start growing in many countries, such as Indonesia as a developing country. IoT is really needed along with the times to help human's activity and needs which are growing. One of the IoT product is smart home, it monitors and controls needs a program to allow access from far distance so that it is expected to minimize the use of energy and costs. To manage it, a program is designed to have some features, like allowing users to supervise and control all devices that connected in smart home through a specifically designed website or mobile application. So the users can control the energy usage by using these features.

Smart house is interesting and attract to be developed and implemented. Some reasearch makes some autonomous funtion using cloud, design an architecture for electrical consumtion in automated metering, smart meter using networking and IoT, automatic system for smart house using brainwave, analysis of security and realibility of smart house system, designing a DC distribution for smart house, automatic system for smart house using machine learning algorithm, and also control system with software and hardware [2]-[15]. The similarity for those smart home researches are green technology for saving energy consumption.

Based on the previous research, done by Zulfikar Rukiansyah about house electricity monitoring system based on internet of things and successfully done and can make it easier for user to supervise electricity at home without checking manually [16]. There are some deficiency

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in the previous research like, the system is only working to monitor data, the juornal also said if the research continues, the system might allow users to control devices [16]. Based on the research, there will be an upgrade on the existed system by adding some support features, such as remote control where the user can control connected to system and internet devices from afar in smart home, also the automatic switch-mode to decide which energy source will be used by smart home.

2 Design

Figure 1. is global design for smart home. One house is installed with several sensors to monitor and control electricity usage. The smart home has two power source, the electricity from State Electricity Company (PLN) and the battery. The smart home is utilized with solar panel and battery as second source if the PLN source is outage. Also it is can be used to to supply electrical equipments in the house. All the battery and the electrical usage is monitored using sensors and saved in database. The data can be displayed in website and mobile application, in this case is Android. Some features that must exist are (1) monitor power supply, the PLN source and batteries, for all rooms in the smart home and (2) control the swith between PLN source and batteries for all electrical equipment using website and Android.

Figure 2. is the architecture of system design for website and mobile application. For monitoring is shown by blue line and for controlling is shown with red line. The electrical equipment that has been installed with sensors will be read the data by processor and saved in the database. The database is connected with internet. It is can be accessed with website and Android. The update condition of all electrical equipment will be displayed in website and Android. Also, all the changing condition updated by website or Android will be noticed as data change in the database.

The database used in designing this system uses the firebase database. Firebase is a noSql based database, unlike MYSql, Firebase has its own database structure. In this case, firebase is used as data storage and processing in real time. The database used contains informatiom about source control, namely the status of what energy source is being used and also the status switch to enable disable the power source modifier feature used by smart home. The database also contains information about the room and devices in it as well as the active status of the device.

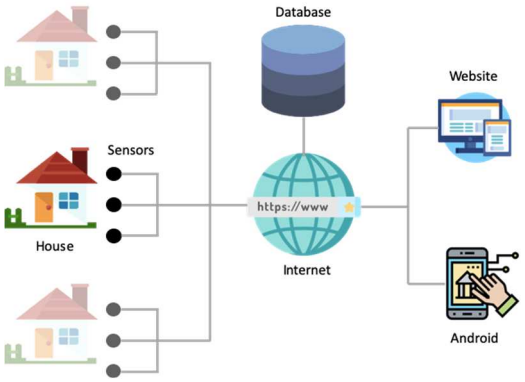


Figure 1. Smart Home System Design

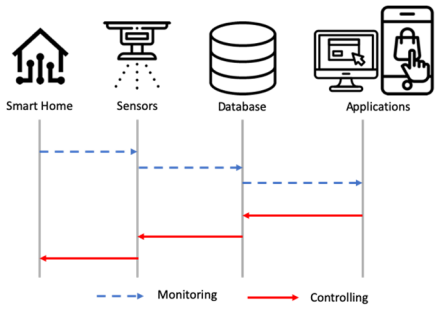
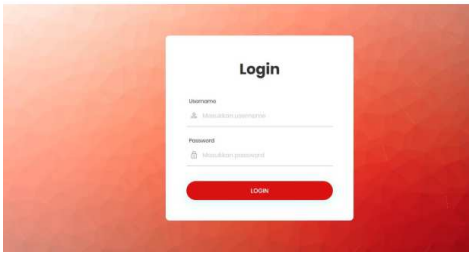


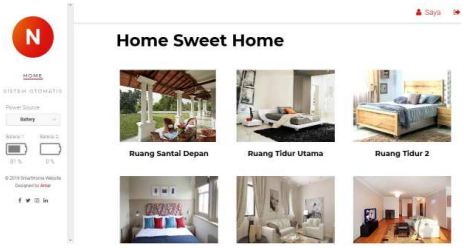
Figure 2. Architecture Design

2.1 Website Design

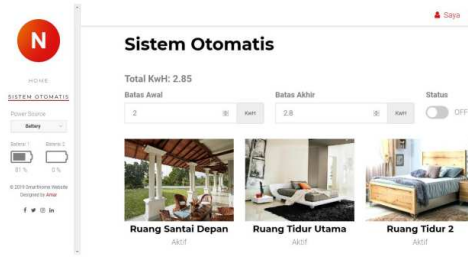
The design of the user interface has been designed according to the design that has been prepared. There are layout designs of the user interface: (a) login menu, (b) main display / home, (c) 9 layout of the room menu display and (d) automatic system. Figure 3. is the sample of feature of website.



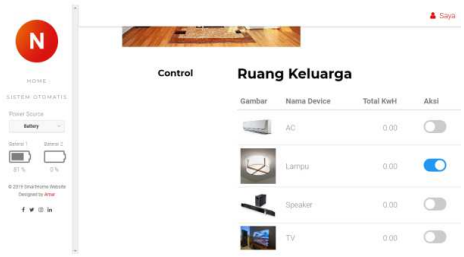
(a) Login



(b) Homepage



(c) Automatic System



(d) Room

Figure 3. Website Design

The function and features of the program to be created are as follows:

a. Login: On the login menu, user data that has been registered in the firebase database can be entered in the firlds available on the login page, so users can access on the next page.
b. Homepage: On the home menu, there is a sidebar on the right side that contains the Navbar (home and automatic system and information about the smart home such as information on the status of the power source being used, info on battery capacity and switches that can change the power source. In the middle section, there is a list of the rooms inside the smart home. The footer sectiom contains information about batery's life.

(a) Register

(b) Login

(c) Homepage

(d) Room 1 (e) Automatic System (f) Room 2

Figure 4. Mobile Application Design.

c. Power Source Switch : This feature allows to change the power source (battery or PLN). In system that have been made power sources come from batteries and PLN.
d. Room page: This page contains a list of devices connected to a smart home and switch button to activate / deactivated the device.
e. Automatic system: In this menu the user will enter the initial and final limits. When Kwh reaches the initial limit, the devices in some rooms will turn off automatically, while when kwh has reached the final limit value, all devices connected in the smart home will die. It aims to save electricity on the smart home.

2.2 Mobile Application Design

Figure 4. is the interface of mobile application. Similar with the freature of website, at the mobile application, the function are:

a. Registration: In this menu users who do not have an account can register to access the application.
b. Login: On this menu users who have successfully registered on the application connected to the database (firebase) can continue to access the application.
c. Main Display: on the application's home menu, there is a choice of rooms, there are devices for each room that can be controlled manually on the user with an on / off button, and in one room, the front lounge can know the kwh is used on each device where watt data is each device taken directly in firebase.
d. Automatic System: In this menu the user can input the initial and deadline to minimize the use of electric power.

3 Discussion

Table 1 and Table 2. are resume of test has been made. For the website and mobile applicatoin test, it tested start with the login page as username and password verification, then homepage to display all features. It can be selected menu for each room to display battery capacity and switch to activate or deactivate the electrial equipment at each room. For counting the electricity usage, the automatic system as a counter system is succeed for the test.

Table 1. Website Feature Testing

Feature	Test	Result
Login	Username and password verification	Succeed
Homepage	Homapage and features display	Succeed
Battery Monitoring	Battery capacity	Succeed
Power Switch	Electric to battery switch monitoring	Succeed
Room (1)	Activate/deactivate equipment using web and database	Succeed
Room (2)	Activate/deactivate equipment using web and database	Succeed
Room (3)	Activate/deactivate equipment using web and database	Succeed
Room (4)	Activate/deactivate equipment using web and database	Succeed
Room (5)	Activate/deactivate equipment using web and database	Succeed
Room (6)	Activate/deactivate equipment using web and database	Succeed
Room (7)	Activate/deactivate equipment using web and database	Succeed
Room (8)	Activate/deactivate equipment using web and database	Succeed
Room (9)	Activate/deactivate equipment using web and database	Succeed
Automatic System	Counter electricity usage	Succeed

Table 2. Mobile Application Feature Testing

Feature	Test	Result
Splash Screen	Welcome Screen	Succeed
Register	Register user into database	Succeed
Login	Username and password verification	Succeed
Homepage	Homapage and features display	Succeed
Battery Monitoring	Battery capacity	Succeed
Power Switch	Electric to battery switch monitoring	Succeed
Room (1)	Activate/deactivate equipment using Apps and database	Succeed
Room (2)	Activate/deactivate equipment using Apps and database	Succeed
Room (3)	Activate/deactivate equipment using Apps and database	Succeed
Room (4)	Activate/deactivate equipment using Apps and database	Succeed
Room (5)	Activate/deactivate equipment using Apps and database	Succeed
Room (6)	Activate/deactivate equipment using Apps and database	Succeed
Room (7)	Activate/deactivate equipment using Apps and database	Succeed
Room (8)	Activate/deactivate equipment using Apps and database	Succeed
Room (9)	Activate/deactivate equipment using Apps and database	Succeed
Automatic System	Counter electricity usage	Succeed

4 Conclusion

Website and mobile applications that have been designed and integrated with Firebase successimal output results and are as expected. The website and mobile application is successful in running a login system, controlling on / off devices, changing power sources, monitoring battery capacity, and carrying out automated system to save electricity.

Acknowledgement

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