Android-based energy saving control system integrated with Islamic value on lamp switching power

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Abstract. Lighting is one of the major consumers of electricity and it is often found to be inefficient in its use. Therefore, this study aimed to provide solutions to these problems through energy-saving behavior that is integrated with Islamic values on lamp switching power. This study use system design build methods. This design results in the form of hardware and software assembly. The results of the performance test of the integration of hardware and software devices provides informations as follow: first, control system of application has not been able to operate on all mobile platforms. Second, the connection range of the control system is able to operate according to its standard frequency range. Third, the connection access of control system is able to pass through the barrier which has a small inhibitory. Fourth, the success of the control system in executing input is high.

Keywords: control system, lamp switch, Android, software, hardware

1. Introduction
Electrical energy has become a basic needs for human’s life, because it is an energy that supports all activities. Various household appliances, offices or public buildings are operated using electricity. Therefore electrical energy has a vital and strategic role in our daily life. However, the problem of electrical energy arises when we start to talk about electricity supply and the ineffectiveness of electricity consumption or usage. Thus far in Indonesia, the source of electricity is still dominated by the use of fossil fuels. A data from Dewan Energi Nasional shows that the use of alternative source for electricity is very low compared to the use of fossil fuel (Edi et al, 2016). Meanwhile, the amount of fossil fuel supply continues to decline while the demand for electricity continues to increase. The increase in demand has even doubled due to Indonesia’s economic growth (Otomo and Wildian, 2013). Therefore, the electricity supply in Indonesia itself is now in a state of caution, because the remaining fuel reserves are not widely available (Edi et al, 2016). Another typical problem for electricity is that it’s consumption is often found to be inefficient, especially in the lighting sector. For example, the lamp stays on even though it is no longer needed, due to user negligence in terms of switching power from on to off. In fact, lighting is one of the relatively large consumers of electricity. The lamp usage, can reach around 30% of the consumption of electricity used in daily life (Otomo and Wildian, 2013).

The complexity of the above problems eventually led to a crisis of electricity. As a result, alternating power outages can occur in various areas. This problem certainly requires a solution. One important
thing in choosing a solution to the problem of electrical energy is that saving electricity is much easier and cheaper than generating it. In some previous studies, energy savings are generally carried out in two ways, first, by increasing the efficiency of technology, and second, by changing the behavior of its users. This study tries to combine the two, namely applying technology that combines electronic engineering, informatics, and architecture to make efficient use of electrical energy based on energy-saving behavior that is integrated with Islamic values. In this case, the concept promoted is smart building and Islamic values. According to Mannan and Muchlis (2012) the principles of smart building have many similarities with the values of Islamic teachings, such as expediency, efficiency, and preventing waste.

In this study, smart building is a design for a lamp switch control system in every room using Android with WiFi, as a control or media that connects the interactions between devices, and the user is a voice command that recites prayers or du'a in accordance with the function of the room. For example, the bathroom lamp will turn on when the user recites du'a upon entering bathroom, and will turn off when recites the du'a upon leaving bathroom. And another example, the bedroom lights will turn off when the user recites the du'a before going to sleep, and will turn on when recites the du'a upon awakening from sleep. This system has a control distance of approximately around 60 meters, so this system is expected to make it easier for users to control the lamp on and off, without having to interact directly with the power switch. This system can overcome the difficulties in controlling more than one lamp switching power, because all of them will be controlled in one control device. This system can also minimize inefficiencies in the use of electrical energy, so that the available energy can be utilized in the long run. In addition, this system has more value, which is a media liaison between the Creator and His servant.

2. Basic Theory

2.1. Android

Android is a Linux-based operating system on mobile devices that includes operating systems and applications. Android provides an open platform for developers to create their own applications. Features like browser, MMS, SMS, GPS, and many more on Android make it very easy for users to get good information, position, and communication. Some of the advantages of Android, including: (a) Some application can run on multitask (b) There are always notifications for incoming SMS, e-mail, miscall, indicated by a flashing indicator light (c) Easy access to Android applications, and (d) Android phone integrated with Google services. Some disadvantages of Android include: (a) Requires a simultaneous or continuous internet connection (b) Advertisements appeared most of the time when accessing the Android application.

2.2. Smart Building

Smart building is a building that uses the Building Automation System (BAS), also known as the Intelligent Building System (IBS). The concept of smart building combines architectural design, interior design and electrical mechanics. This concept is high in demand, because it uses a system that is integrated with smartphones or other gadgets as a controller for all of their device. In this system, all facility devices allow to be designed and programmed according to needs, desires, and centralized automatic control. The command can be carried out using sound, infrared light, or a remote controller. The concept of smart building is directed to meet 3 criteria: (a) Longevity (b) Energy and efficiency (c) Comfort and satisfaction. Fulfillment of the above criteria uses several approaches, one of which is the interaction between users and buildings. The use of smart building systems is a solution to synergize energy efficiency, comfort, safety and security that transforms buildings into living organisms based on networks, intelligence, sensitivity and adaptability.

2.3. Islamic Value

Islamic values can be interpreted as a concept and belief that is held in high esteem by Muslims regarding some of the main issues relating to Islam. Islamic values can be used as a guide in behavior, both originating from God and the results of human interaction in accordance with the Shari'a. Here
are the basic values of Islam: (a) The value of aqeedah, is the value of several cases that must be believed to be true without any doubt. Aqeedah values provide peace of heart and soul, (b) The value of ibadah, is a value that includes all the words and deeds favored and blessed by God, (c) Moral values, are all things related to the nature embedded in the human psyche that appear by themselves without going through thoughts or considerations, and there is no encouragement from outside. The scope of morals, namely morals towards God, morals with humans, and morals with nature.

Islamic values can be instilled in the personal lives of Muslims through a pedagogical civilizing process, because in Islamic life there are Islamic values: (a) Values that can increase the prosperity of life in the world, (b) Values that encourage to achieve a happy life in the afterlife, (c) Value that can combine the interests of worldly life and ukhrawi.

3. Methodology
This study uses system design build methods, the stages of work are as follow:

3.1. Project planning
The activities of this stage include determining the project theme, studying the literature related to the project theme, studying the desired conditions and conditions that exist at the time of implementation, listing the tools and components needed, and planning the budget.

3.2. Preparation of tools and components
The activities at this stage is the selection of tool and component specifications, and then testing the tool and component parts. Part testing is carried out to find out whether the tools and components are functioning properly or not.

3.3. Hardware design
Hardware design consists of designing mechanical systems and designing electrical systems. The main activity carried out at this stage is to make a block diagram for the entire control system in accordance with the specifications of the tools and components. This block diagram serves as a guide in assembly.

3.4. Software design
Software design must prioritize the principle of efficient work. In this stage, the first step is to create a program flowchart, then the program is compiled in a programming language. After compiling, the program is uploaded to the Arduino main component, the microcontroller. Microcontrollers that have been implanted with the program are then assembled together with tools and other electronic components.

3.5. Assembling
Activities at this stage are assembling tools and components based on hardware design and software design. During assembly, tools and components must be ensured to be installed in the correct place and position.

3.6. Testing
At this stage the whole design results are tested. The testing activity is intended to see the accuracy of the design of the control system that has been made, to ensure the performance of the device can function properly. Testing must be done thoroughly and carefully, in order to obtain a reliable control system.

3.7. System optimization
The last working stage in the system design build method is system optimization. This activity is intended to improve the performance and effectiveness of the control system design that is made.
4. Result and Discussion

The results of hardware assembly in the form of mockups and control system circuits consisting of Arduino, Wifi Shield, relays, and external antennas. While the results of the assembly of software in the form of display control system applications on Android-based smartphones and Arduino program listings. Furthermore, when implementing a control system, the results of the software assembly are integrated with the results of the hardware assembly. In this study, the mechanism used to justify the accuracy of the overall system is by testing the performance of hardware and software that has been integrated as a device. Tests carried out directly in each experimental room. Based on the test it can be seen the response of the output (experimental room’s lamp) to the input (voice commands or prayers). Linearity between output to input shows the accuracy of the structure of the hardware assembly results, and the functioning of the application and software assembly program results. The following results are the results of testing the integration of hardware and software devices.

4.1. Compatibility test result

Compatibility test is carried out by running the applications that are designed on several Android devices with different mobile platforms and different operating system (OS) versions. This refers to the opinion of Kumar and Cauhan (2014), that the compatibility of application can be measured through testing on various mobile platforms that have different OS versions, different screen sizes, and different resolutions, or testing applications when interacting with other applications that have a different operating system. The results of compatibility test for applications show that applications that are designed can only run on two mobile platforms, namely Oppo with the Oreo operating system and Xiaomi with the Lollipop, Nougat, and Oreo operating systems. While for the other 4 mobile platforms the application can be installed and displayed, but cannot be operated or run. It can be informed here, that Android can be assumed as a software, where the software consists of supporting programs that have different specifications on each operating system. This means that if the features and software architecture of the Android operating system are incompatible and not comprehensive with the application designed, the application's performance and function will be constrained. As a result, applications that are designed cannot be run or operated on several mobile platforms. The more types of mobile platforms and operating systems that an application can run, the better the compatibility level.

4.2. Connection test result

In this study the control system of switching power lamp in each experimental room uses the Wireless Fidelity (WiFi) accessed via WiFi Shield. WiFi Shield is a wireless LAN device that can be used for data communication with a frequency of 2.4 GHz. This type of frequency has a connection range of around 90-100 meters. Therefore, to find out the performance of the WiFi Shield connection range when it is running, a connection range was tested in each experimental room with varying control distances and unobstructed conditions. Connection test results show that WiFi Shield can still be connected at a distance of 20, 40, and 60 meters. The results of this test also show that distance does not affect response time. This is shown from the average response time of the control system, which is not much different for each connection range, therefore it can be said that the transmission process tends to be stable. These results prove that the WiFi Shield signal's range is able to operate according to its standard frequency. In addition, the frequency produced by WiFi Shield (2.4 GHz) is a frequency that is commonly used by almost all wireless devices. This means that there are many supporting devices for signal amplifiers on the market. In this study to overcome interference in the transmission process due to signal deficit, an external antenna is used, because the better the signal quality, the better the connection.

4.3. Penetration test result

In its application, there are several factors that can affect signal transmission, one of which is a barrier. According to Saharuna and Nur (2016), even a human existence can be said to be a temporary barrier, which can affect the signal emission from WiFi devices. Therefore to find out the performance of WiFi Shield when there is a barrier, a penetration test is conducted. The barriers used in this test are mica and plywood. According to Jubilee (2009: 20), the effect of these two barriers on the quality of
signal transmission is relatively small. The penetration test results show that the two barriers (plywood and mica) do not hamper the WiFi Shield connection access. The average response time between the two barriers also has a small difference. The average response time of plywood is smaller than the average response time of mica. The difference in response time is due to differences in particle density between the two barriers. The barrier made from mica has higher density than plywood. This means that the denser the particles in a material, the worse the penetration.

4.4. Lamp control test result
Lamp control testing is carried out using voice commands. Voice commands in the form of prayers or du’a are recited with good pronunciation. This test is intended to see whether the application that has been designed can translate voice commands from various sources (male and female) properly. The results of this test can be said to have a very high success rate. Based on the results that have been carried out on this test, the number of failures is very small compared to the number of successes in both the command to turn on and turn off the lights. The main cause of failure in the light control test lies in the execution of voice commands in the form of prayer. In this case the recitation of prayer must be in accordance with the rules of the makhrij al huruf. The aim is to avoid mistakes in reciting letters. Mispronounced letters will affect the meaning of the verse (Alam, 1995: 22-23). In addition, prayer must be said completely, clearly and may not be repeated. The light control test involves the work process of the system from beginning to end. Starting from giving input in the form of voice commands (prayers), then Google Voice will translate voice commands (prayers). An error in pronouncing the voice command will cause a translation failure. The next process involves the work of a smartphone and WiFi Shield for sending web addresses and translating codes according to the web address sent. The final part of the process is the execution of the input (prayer/voice commands) through the output response (lights on/off) according to the control of the electronic switch (relay).

5. Conclusion
Based on the results and discussion, the conclusion is as follows: (1) In this research, an Android-based energy saving control system is integrated with Islamic values on the light switch with the concept of smart building. The resulting control system is very user friendly and has more value on the input, which is in the form of recited du’a that are pronounced with good pronunciation. (2) The control system test results provide the following information: (a) The control system application has not been able to operate on several mobile platforms, (b) The connection range of the control system is able to operate according to its standard frequency, (c) Control system connections are able to penetrate barriers that have relatively small inhibition, (d) The success rate of the control system in executing input is relatively high. Some recommendations that can be used as a follow-up to the research are: (1) The application that created using App Inventor cannot run on several mobile platforms and operating systems. Therefore it is recommended to further develop application makers for Android. Another application maker that can be used to create applications on Android is Android Studio.

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