Simulation of Design and Implementation of Smart Socket Prototype Controlled by Android Application

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Abstract. Internet of Things (IoT) is one of the emerging technologies at the moment. IoT allows use to control and monitor the use of electric power in rental homes via smart phones. One of the IoT support devices for monitoring power consumption is Smart Socket. Because of its usefulness, the author tries to design a prototype Smart Socket to calculate electric power in a rental house. The method used to create a Smart Socket is an experimental method. For communication needs used HTTP protocol and IoT Platform. The results show that smartphones can be used to control the Smart Socket and retrieve information about the total power consumption of each socket. While Smart Socket can do the calculation of total power consumption and send it to IoT Platform. Smart Socket successfully created and works well.

1. Introduction

Internet of Things (IoT) is one of the emerging technologies at the moment. With IoT, one can enable or disable an electronic system remotely [1]. In the IoT system, many variations of data are read, collected, and transmitted in an efficient and secure manner [2]. One of the proper modules to be used as the basis of an IoT device is the ESP-12E due to its economical price, low power consumption capability and integrated with TCP / IP [3]. The device is equipped with WiFi capability with satisfactory function [4]. With the WiFi feature, the ESP8266 module can connect to the internet.

One part of IoT is a smartphone. Smartphones are used to be the control and monitoring center of an electronic device. One of the most widely used operating systems on smartphones is the Android operating system. Android is an operating system for linux-based mobile devices that includes middleware and applications [5].

In general, a rental house has only one kWh-meter, to calculate the power consumption. Meanwhile, the use of electricity from each occupant of the rental house is not the same. However, the fees paid from each rental resident are the same. This causes the injustice and inconvenience of other rental residents. With IoT, rented house owners can monitor the power consumption of each room of the residents so that it can be used as a reference to quote the rental price per month per room. This calculation system will reduce the sense of injustice if payment is generalized.

One of the IoT support devices can be implemented for monitoring power consumption is the Smart Socket. Smart Socket designed to disconnect or connect the flow of electric current. Because of its usefulness, the author tries to design a prototype Smart Socket for the calculation of electrical power in a rental house, which aims to provide a solution to the problem of electricity use inequality between residents of rental homes.
2. Research Methods

2.1. Circuit and Working

In the schematic design and PCB design described the arrangement of components and pathways used to create a prototype smart socket. The design is done using Eagle software. Schematic design and design of smart socket prototype PCB is shown in Figure 1.

![Schematic project](image1)

Figure 1. Schematic project.

2.2. Work Principle

The working principle of the smart socket prototype is illustrated by using the block diagram shown in Figure 2. In the block diagram it is explained that the smart socket prototype is divided into 2 modes of work i.e. config mode and running mode. In config mode, local communication is performed between the prototype smart sockets will be access point. In running mode smart socket prototype will retrieve data from Cloud Storage and calculate total power consumption in socket. Android application is used to control relay at smart socket and take the total power consumption information on each socket.

![Work principle of devices](image2)

Figure 2. Work principle of devices
2.3. Algorithm

2.3.1. Smart socket. The smart socket prototype algorithm is illustrated using the block diagram shown in Figure 3.

![Smart socket prototype algorithm](image)

**Figure 3.** Smart socket prototype algorithm

2.3.2. Android application. The android application algorithm is illustrated using the block diagram shown in Figure 4.

![Android apps algorithm](image)

**Figure 4.** Android apps algorithm.

2.4. Hardware aspect

2.4.1. ESP-12E Wi-Fi Module. The module is best suited for Internet of Things (IoT) at its low cost, low power consumption capability as it requires 3.3V power, built in Wi-Fi module, integrated TCP/IP protocol stack, easy to flash and erase firmware and is usb powered [3]. As the IoT application module it can deploy in home automations, home appliances, industrial wireless network, sensor networks fields [4]. Table 1 shown ESP-12E Wi-Fi module specification.

| Parameters          | Specification                        |
|---------------------|--------------------------------------|
| Microcontroller     | ESP8266                              |
| Memory              | 32 bit                               |
| Processor           | TenSilica I. 106                      |
| Processor Clock     | 80 ~ 160 MHz                         |
| RAM                 | 36 Kb                                |
| Storage             | 4096 byte                            |
| Built-in Wi-Fi      | 2.4GHz supports 802.11 b/g/n         |
| ADC Pin             | 1 (10bit Resolution)                 |
| GPIO pins           | 10                                   |
| Operating Voltage   | 3.0 ~ 3.6 Volt                       |
| Operating Current   | 80nA (Average)                       |
| Operating Temperature | -40° ~ 125°C                      |
2.4.2. **Relay for 220-250 volt, 30A.** A relay is a switch that is operated by using electricity. Relay is an electromechanical component consisting of 2 main parts namely electromagnet (coil) and mechanical (switch switch). Relays use the electromagnetic principle to drive the switch contacts, so that a small electric current can conduct higher voltage electricity. In Figure 5 is shown the shape and symbol of the relay.

![Relay Devices and Symbol](image)

**Figure 5.** Relay devices and symbol.

2.4.3. **Smartphone with OS Android 5.0 (Lollipop).** Android is an operating system for linux-based mobile devices that includes operating systems, middleware and applications [5]. Android provides an open platform for developers to create an app. In addition, android is an open source operating system that is freely distributed and used by any vendor. This resulted in Android continues to grow rapidly both in terms of technology and in terms of the number of devices that exist in the world. On Android there is Davilk Virtual Machine (DVM) and Java Virtual Machine (JVM). DVM is a low-cost, specially designed Android-designed low memory machine running on embedded systems. While JVM is a machine that is in a machine that mimics its host machine and is used to run java code written on Android [5]. On android there are four main components on the android of activities, service, broadcast receiver and content provider.

2.5. **Software Aspect**

2.5.1. **Arduino IDE software.** Arduino IDE software is used to write down the code to run a system. The Arduino IDE software is open-source, it makes it easy to write the code and upload it into the microcontroller board. Coding on Arduino IDE Software written using Javascript language or C / C + language.

2.5.2. **Cloud Storage.** Cloud storage is an information technology architecture in which storage resources are available as services accessible via the internet. Cloud storage basically uses internet-based services to support business processes. One of cloud storage owned by Indonesia is made by Telkom Indonesia, which is ANTARES Platform. Cloud storage technology provides services to its users in 3 levels: infrastructure as service, Software as service and Platform as service.

2.5.3. **Android Studio Software.** Android Studio is an IDE for application development on the Android platform. Android Studio is designed in such a way as to make it easier for developers to develop Android apps using Javascript. Android Studio also provides a complete library to access the various features that exist on the smart phone, such as sensors, cameras, GPS and the others. Android and Android Studio Software developed by Google. Android Studio software is a development of the Eclipse IDE Software, and is based on the IDE Java IntelliJ IDEA. Android Studio is planned to replace Eclipse IDE in the future as the official IDE for Android app development.

3. **Experimental Result**

PCB is made using 2 layers, the top layer and the bottom layer. To connect between top and bottom layers used through holes. After PCB is made, installation of components using soldering equipment is
done. The components used are components with legs, SMD components and ready-made modules. After all components are installed, the PCB section is connected to a 4-socket terminal using a jumper as shown in Fig 20.

![Image](image1.png)

**Figure 6.** Smart socket prototype hardware

### 3.1. The Test Results of Android Apps

In android applications that have been designed to be tested. The smart socket android app is designed to monitor total power on the smart socket and disconnect and connect the power supply on each available socket. Figure 7 shows the interface display on main activity and setting activity. Android applications that have been created. In the picture is shown some conditions that is when opening the application, at the time of taking the total data power consumption and when turning on the socket.

![Image](image2.png)

**Figure 7.** Main activity & setting activity on Android Apps.

To retrieve the total power information and send the socket status information, the destination server address is required. To input the destination server address can be done on the activity settings, by pressing the selection button on the top right of the main activity. Fig 21 shows the interface display activity settings.

### 3.2. The Test Results of Smart Socket Prototypes

In Running Mode, ESP-12e module will be enabled to Wi-Fi client. Running Mode will run if at the time of Config Mode has been done. At the start of Running Mode, the device will read the data on
EEPROM memory. The read data is the information ssid and Wi-Fi password, as well as the destination server address. Then the ESP-12E module will authenticate and connect to the specified ssid and password. Figure 8 and 9 shows serial monitor readings in Running Mode.

Figure 8. Serial monitor at Running Mode.  
Figure 9. Serial monitor when get server data.

Once connected to an access point, the smart socket prototype has access to connect to the internet. With the internet, the prototype will retrieve the data socket information and send the total power consumption information on each socket. This can be seen in the monitor series shown in Figure 9. Socket status information will be directly applied to each socket. While the power information will be calculated in accordance with the use of the socket. Figure 10 shows one of the conditions in the smart socket prototype after it has been implemented according to the data sent through the server.

Figure 10. Devices when socket 1 & 3 are on and 2 & 4 off.

3.3. Data on ANTARES Cloud Storage Server
The data sent and retrieved on smart android apps and smart socket prototypes are stored on the server. The server used is cloud storage, or server that is used only to store data only. Cloud storage used is made by Telkom Indonesia is ANTARES. The data that is sent and retrieved for the needs of the smart socket prototype is stored in the project. In a project is divided into several devices that function as a division of functions between power monitoring and socket control. Figure 11 shows the socket status data that is sent in the smart phone application to be picked up by the smart socket prototype.
4. Conclusion
Design of smart socket prototype to calculate electric power consumption in rental house has been successfully done. The smart socket prototype works well to monitor power consumption in each rental home room and disconnect or connect the electrical current in each room remotely via a smart phone.

References
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