Automatic Electric Outlet Using Internet of Things and Web Service

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Abstract. Internet of Things ("IoT") is a term that refers to the ability of objects to be connected to the internet, so the objects can send or receive data through it. This research proposed using IoT to develop a smart home system can control devices on it. By using this smart home systems, users can control and monitored devices remotely. IoT could be applied by using a minimum system of devices such as Atmega, Raspberry Pi, Arduino Uno, etc. This research used ESP8266 minimum systems as a gateway device between devices/sensors and server, server used to record data and information. The data communication is using wireless transmission media with a frequency of 2.4 GHz. The results is obtained a socket device can be controlled from the internet which has 4 ports and each them can be controlled separately. This devices is equipped with PIR sensor to detect human attendance in order to control automatically.

1. Introduction

The use of energy more effectif and efficient in a building or a house are an important subject in Internet of Things (IoT) research[1],[2]. According to Indonesian Ministry of Energy and Mineral Resources (2017), national electricity consumption continues to show an increase as electricity access increases or electrification and changes in people's lifestyles. The data shows that Indonesia's electricity consumption in 2017 reached 1,012 Kilowatts per Hour (KWH) / capita, up 5.9% from the previous year. In this year, the government is targeting public electricity consumption to increase to 1,129 kwh/capita. The data shows, the electric usages is continues to increase every year. In order to get less energy consumption, we could create an automated devices in the building[3],[4]. Therefore, to obtain users can monitored and controlled devices remotely need gateway used to communicate between devices to the internet[5],[6],[7]. To develope an IoT, we can use a minimum system such as Atmega, Raspberry Pi, Arduino Uno, etc and sensors used to interact directly to devices[8]. All of devices in the house, could connected to the internet such as AC, TV, lamp, house security, etc, therefore all of them can controlled remotely using smartphone. This research is develope an Internet of Things (IoT) tools based on ESP-8266 using PIR sensors, on/off control in electric outlet and gateway. Communication between the gateway and internet using wireless transmission with frequency of 2.4 GHz. The on/off status that appear in the dashboard are saved on the database server. User can use android or web to control remotely.
2. Experimental

Generally, Automatic Electric Outlet System are using an Internet of Things and Web Services, so it can control an online outlet from anywhere and anytime through internet connection. System will retrieve the data from the API Server which is connected to the database server, its function is to read the status on the database whether the port is on or off. The system could send and receive the message on realtime because it is directly connected to the database server. Figure 1 is describing the general architecture of the system.

![Figure 1. General architecture of Automatic Electric Outlet System.](image1)

2.1 System architecture

2.1.1 Hardware Prototype

The hardware are consist of WeMos ESP-8266 as a microcontroller that can control the actuator, an adapter as a power supply, relays module as an actuator, LED as an indicator, PIR module as a sensor, transistors and resistors. All of them are described as MySocket Device in figure 1. PIR module is a Passive Infra Red sensor, it can sense an appearance of human in several distance and send the information to microcontroller. Relays are an actuator used to turn on or off an AC circuit through microcontroller. ESP-8266 is a wireless microcontroller, used to read the sensor message and instruct the actuator to apply its command.

![Figure 2. MySocket Device hardware design](image2)
2.1.2 Flowchart Control Device
Flowchart when controlling the device on an account such as turning on or off the socket in Figure 3.

![Flowchart](image)

**Figure 3.** Basic flowchart of the system

3. Results and Discussion
To test the system that has been made, a test is performed on this system. In this test there are 2 parts, namely hardware testing and software testing. ESP8266 microcontroller device is the brain of connected hardware. For the test results can be seen in Table 1.

| No | Case / Form tested                  | Test Scenario                                      | Expected results                                      | Test result |
|----|-------------------------------------|----------------------------------------------------|-------------------------------------------------------|-------------|
| 1  | Turn on ESP8266                     | Connect the appliance plug to the socket           | ESP8266 will live and emit wifi                      | Succeed     |
| 2  | Configure ESP8266 Connection        | Connect wifi from ESP8366 then enter wifi information for the main connection | ESP8266 is connected to the main wifi for internet connection | Succeed     |
| 3  | ESP8266 can be connected to the server | The device can receive messages from the server | The device runs a server command                      | Succeed     |
| 4  | ESP8266 will reset the configuration if it does not detect possible connections | If the configured wifi cannot be found or die if the device cannot be connected to wifi, or the main wifi turns off. Then the tool will reboot and can be reconfigured | Succeed     |
3.1. Hardware testing
Hardware is the main component of this system because without the hardware, this system will not work properly. The hardware that will be tested is, ESP8266 connection, Relay, PIR Sensor, and the electric current at the socket.

3.2. Relay
This hardware is a command executor from the ESP-8266 microcontroller. The command from ESP8266 will be run by this Relay so that it can cut off the electricity to the socket. Relay testing results in Table 2.

| No | Tested UI Form | Test Scenario | Expected Result | Test Result |
|----|----------------|---------------|-----------------|------------|
| 1  | Turn on Port 1 | Press the on button in the application on port 1 | The relay will turn on and the power supply can be connected to the port 1 socket | Succeed |
| 2  | Turn on Port 2 | Press the on button in the application on port 2 | The relay will turn on and the power supply can be connected to the port 2 socket | Succeed |
| 3  | Turn on Port 3 | Press the on button in the application on port 3 | The relay will turn on and the power supply can be connected to the port 3 socket | Succeed |
| 4  | Turn on Port 4 | Press the on button in the application on port 4 | The relay will turn on and the power supply can be connected to the port 4 socket | Succeed |
| 5  | Turn off Port 1 | Press the off button in the application on port 1 | The relay will turn off and disconnect the power on the port 1 socket | Succeed |
| 6  | Turn off Port 2 | Press the off button in the application on port 2 | The relay will turn off and disconnect the power on the port 2 socket | Succeed |
| 7  | Turn off Port 3 | Press the off button in the application on port 3 | The relay will turn off and disconnect the power on the port 3 socket | Succeed |
| 8  | Turn off Port 4 | Press the off button in the application on port 4 | The relay will turn off and disconnect the power on the port 4 socket | Succeed |

3.3. PIR Sensor
This device is a feature that makes motion detection or motion sensor. If a motion is detected, the relay on the specified port will turn on. The results of PIR Sensor testing can be seen in Table 3.

| No | Tested UI Form | Test Scenario | Expected Result | Test Result |
|----|----------------|---------------|-----------------|------------|
| 1  | Detect Motion for port 1 | Motion is detected and turns on the relay on port 1 | When motion is detected, the relay on port 1 will turn on | Succeed |
| 2  | Detect Motion for port 2 | Motion is detected and turns on the relay on port 2 | When motion is detected, the relay on port 2 will turn on | Succeed |
| 3  | Detect Motion for port 3 | Motion is detected and turns on the relay on port 3 | When motion is detected, the relay on port 3 will turn on | Succeed |
| 4  | Detect Motion for port 4 | Motion is detected and turns on the relay on port 4 | When motion is detected, the relay on port 4 will turn on | Succeed |
4. Conclusion

Research has been carried out and resulted in the conclusion that in making Automatic Electric Outlet devices using ESP8266-based Webservice that implements Internet of Things has been successfully carried out and implemented. The main function is to make the user can control the socket can be controlled (turned off and turned on) from wherever and whenever. So that users can be flexible to regulate electrical equipment connected to this device and can save electricity consumption.

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