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Smart Panel System using Internet of Things

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Abstract

Technological developments that require humans to constantly innovate, utilize electricity in the community, assist the public about the dangers that exist. Electrical energy becomes very dangerous if the user process is not equipped with a good protection system. Conventional overload protection devices, such as MCB, can cut off electricity only from load points and cannot cut selective loads. Today's internet technology can be used not only for communication between individuals but also for communication between objects. By using the internet, devices can send data to each other and send requests to other devices. The Internet-based Smart Panel Is designed to protect components, and monitor the remote use of electrical energy and control equipments via a smartphone. This tool uses NODEMCU and ESP12 for wireless communication. The PZEM004T sensor module is used as a current load reader.

Keywords: Internet of things, Experimentation, Prototypes and demonstrators.

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1. Introduction

The development of technology requires people to constantly innovate, utilize electricity, and provide assistance to the community in relation to the danger of short-circuit exposure. Electrical energy can be dangerous if it is used without a good protection system. Conventional overload protection devices, such as MCBs, can cut off electricity only from load points. They cannot cut selective loads. Protection system that cuts off electricity selectively releases the load, increasing the flow of electricity so that all loads do not totally die. The internet is a technology that allows several devices to communicate each other without using cables. By using the internet, each device can send data and also send requests to other devices. One of the uses of the internet that has become a trend is IoT (Internet of Things) [1-2]. IoT is a system where physical objects can be connected to the internet through sensors [1]. IoT (Internet of Things) technology combines all electrical components and provides devices that are able to communicate each other and provide demand for other devices. In addition to being able to connect between Internet of Things (IoT) technology devices, it can also connect a device to a Smartphone or computer so that it can be monitored and controlled remotely [2].

2. Related Research Studies

Previous research has focused on Low-cost IoT energy systems which have been designed and applied that can be used in many applications, such as electricity billing systems, energy management in smart grids and home automation [3]. Research on A system for energy monitoring system (Watt On) has been proposed for use per room in the house that is efficient, intuitive, and economical (cost-effective) [4]. Lipi Chhaya, dkk Has researched solutions for three smart grid hierarchical networks such as home area networks, areas of the network environment, and wide area networks using prototype development and testing [5].

3. Tools Schema

The design of an IoT-based Smart Panel requires components supported by NodeMCU 12-E which is a derivative module for the development of the platform of the Internet of Things (IoT) ESP8266 type ESP-12 family. The ESP8266 module is an inexpensive and effective platform to use over the internet. It can send data simultaneously to many modules. The PZEM-004T module is a multifunctional sensor module that measures power, voltage, current, and energy provided in the electricity. This module is equipped with an integrated voltage and current (CT) sensor. This tool is specifically designed for indoor use and the installed load is determined by the value of the permitted power specifications.

To make it easier to understand the working principles in the process of designing and manufacturing an Internet-based Smart Panel, a System Diagram block was made as provided in Figure. 1. From the block diagram, green arrow lines can be drawn to describe the process of uploading data, while the orange arrow lines are downloaded data flows. The remote monitoring and control system will work as long as there is an internet connection. If the connection is lost, only the protection system from the smart panel is working. The monitoring system starts from the main smart panel which is used to read values that have been used by the PZEM-004T sensor, which are then sent to the web server via NodeMCU 12-E.

The web server functions to store and display data that has been read from a smart panel so that it can be accessed through a web browser or an android application. In addition, the web server also functions for the remote control feature . Smart panel receiver executes commands from the main smart panel that communicates via the NodeMCU 12-E module. The protection function works from the transmitter's smart panel that reads the load value and compiles the load value which reads more than the agreed point setting value. The transmitter's smart panel will accept the receiver's smart panel to work selectively according to requests from the user.

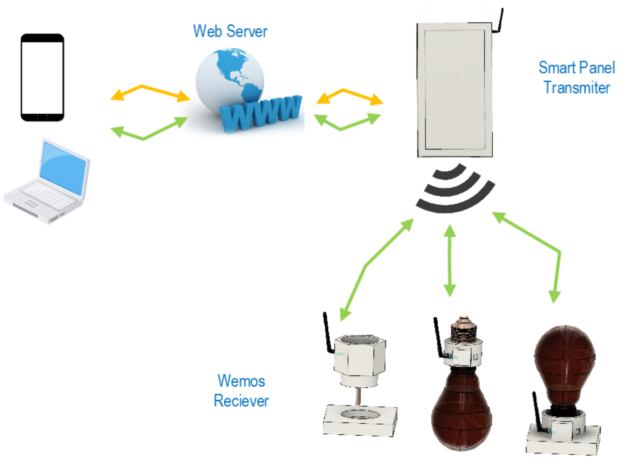

Figure 1. Tools schema

4. Result

Testing is done after planning and design, this process is to ensure that all parts of the system can work properly. System testing is also to find out how the performance and the success rate of the system. The following is a system test for each section.

4.1. Testing Sensor Data Monitoring

Sensor data testing was carried out to determine the data value of the sensor uploaded to the database so that it can be displayed in the android application. The sensor data displayed can correspond to realtime data on the sensor data uploaded by the smart panel transmitter. The test results of the sensor data that were successfully read by the smart panel transmitter and the circuit image and sensor data monitoring display on the main page of the android application are presented in the following figure:

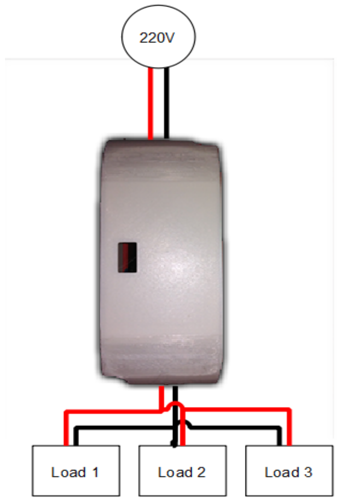

Figure 2. Sensor data monitoring test circuit

Figure 2. Shows a series that is used to test the monitoring system of power, strain, current and total kWh used. The device used for testing is a smart panel transmitter which is connected to a 220V power source from electricity provider (the national electricity company) and then given two connected loads.

Figure 3. Sensor Data Testing

Figure 3. is a smart panel transmitter that has been connected to a 220 V power source from The national electricity company and given two loads, which then is monitored through an Android application with the following results.

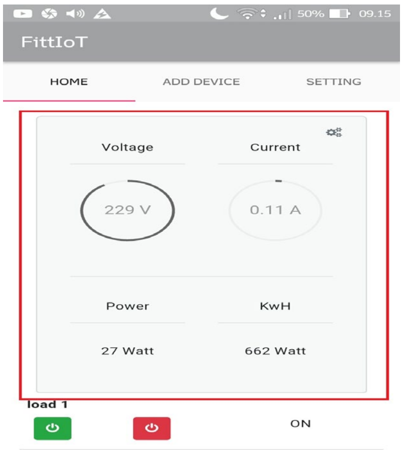

Figure 4. Testing Sensor Data on the main page of the application

The test results of sensor data sent by the smart panel transmitter to the web server are stored in the database and displayed in the Android application. The value of the sensor data can be changed in realtime. The speed at which the sensor data value changes is affected by the speed and stability of the internet connection. Figure 4 is Testing Sensor Data on the main page of the application.

4.2. Remote Control Testing

This test was done to test one of the control features while the system was still connected to the internet network. In this case, the device being tested is a smart panel receiver that is directly connected to the load (Figure 5).

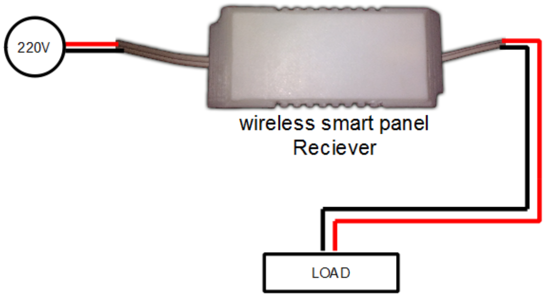

Figure 5. Remote control testing circuit

The circuit was used to test remote control features. Remote control button test results successfully sent control data from the android application to the web server. Figure 6. shows that load 1 has switched from OFF to ON and is compatible with the data in the database.

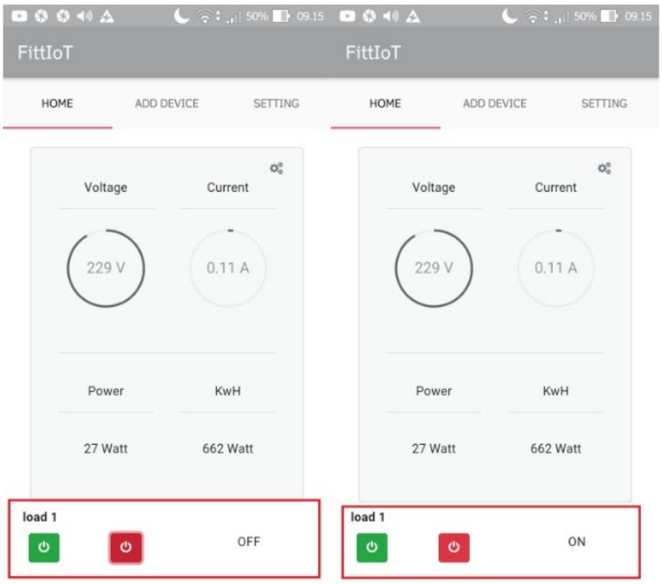

Figure 6. Remote control testing results

The condition of the smart panel receiver is similar to the condition of the data in the database (Figure 7). The response from the smart panel receiver is 5 seconds.

Figure 7. Smart panel receiver when controlling loads in the ON condition

4.3. Testing Protection Data When Overloaded

The test aims to test the feature which turns off the load selectively connected when the load exceeds the specified setpoint limit and to ensure whether the webserver, android applications, and databases respond when there is an overload.

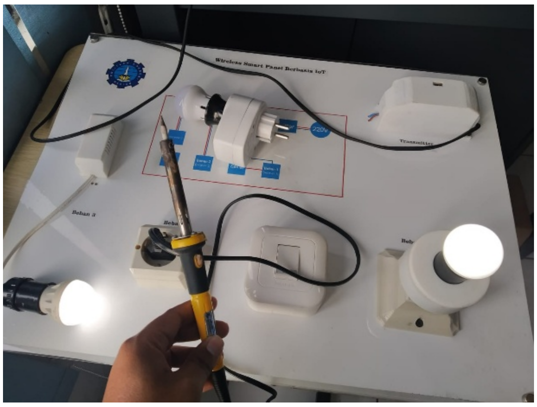

Figure 8. The circuit before overloading

The wiring used to test the smart panel when there is an overload was similar to the circuit testing of the smart panel transmitter monitoring system by connecting the power source from Electricity provider (the national electricity company) then connecting it to two loads (Figure 8).

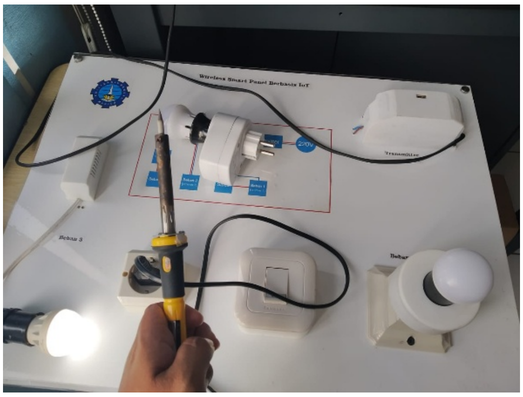

Figure 9. The circuit after overloading

The test result when the load exceeded the specified setpoint value is 30 watts, which can be seen in Figure 9. The light was initially lit. Then, one of them turned off when the smart panel had a load exceeding the specified set point value.

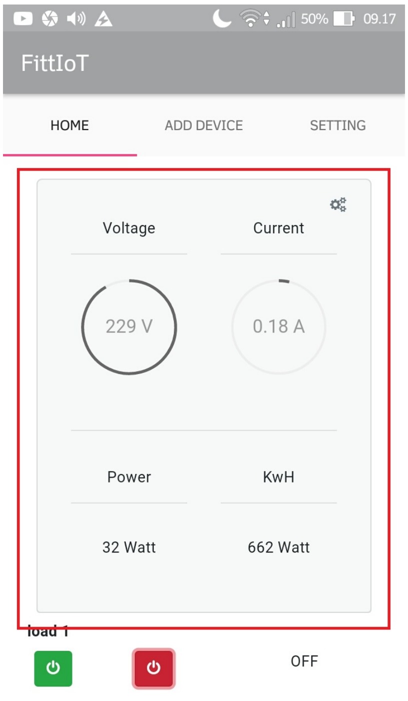

Figure 10. Display on smart panel applications when overloaded

The display on the application interface shows when the load exceeds the specified limit. As Figure 10 indicates. the load read is 32 watts. So, it has exceeded the specified load limit. The series of trials show that the smart panel can selectively cut the load on specified load only.

5. Conclusion

From this study, it can be concluded that the Internet-Based Smart Panel Provides protection by selectively cutting the load by the specified point setting and is able to monitor remotely electrical energy usage and control equipment. The speed of the Smart Panel to turn off the load when overloaded depends on the internet connection.

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