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IMPLEMENTATION IOT APPLICATIONS FOR ELECTRICITY LOAD MONITORING AND CONTROL

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ABSTRACT

Human activities are strongly dependent on the use of electricity, making it a daily requirement. The basic electricity rate is currently rising, making electricity conservation necessary. In order to solve this problem, a centralized power load monitoring and control system that can be handled remotely utilizing Internet of Things (IoT) technologies is suggested in this study. The research project involves creating and putting into use a prototype system. An Intel Core i3 laptop, 4 GB of RAM, Windows 7 64-bit, the Arduino IDE program, and a Tools Set were the tools used in the study. A Microcontroller NodeMCU E12 WiFi, Relay Driver, LED indication, and PIR Sensor made up the components employed. The research method was broken down into eight stages, including a review of the literature, the formulation of a problem and an objective, the collecting of data, the design and use of media, the implementation of the results, the drawing of conclusions, and the preparation of a report. The functionality of each system component was tested, and the overall system performance was assessed, in order to examine the research findings. The results show that input, process, and output are the three essential components of the IoT application architecture for monitoring and regulating electrical loads in rooms. Four PIR sensors in the input area indicate the presence of people in the space. A microcontroller integrated with the NodeMCU 12E WiFi device is used in the process step. LED indicator lights in the output portion show the amount of load present in the space. Hardware and software components make up the implementation of the IoT application for tracking and managing electrical loads in rooms. The NodeMCU 12E microcontroller and a PIR sensor make up the hardware component, while Cayenne, an IoT service, and the Arduino IDE serve as the software components. The IoT application has overall performed well and according to design in monitoring and regulating the room's electrical demands.

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1. INTRODUCTION

The use of information and communication technology has now become an effective and efficient way to convey information to the public. We can get various technological advances easily; even information is one of the basic needs besides clothing, food, and shelter. The use of information

technology has positive impacts such as facilitating long-distance communication, obtaining information, and human work. Almost all organizational activities today have been entered into by information technology applications.[1] Information technology is the synthesis of computer and telecommunications technology with additional technologies such as hardware, software, databases, network technology, and other telecommunications devices.[2] Information technology is also employed in organizational information systems to deliver data that can support each institution's or agency's operational activity.

Electricity has become a major need in everyday life. Almost every day, human activity is inseparable from the use of electricity. Even when our gadgets are running low, we go as soon as possible to find a power source. Currently, electricity seems to have become a basic human need, in household activities, public services, offices, and even educational activities. The process of teaching and learning in the world of education can also be disrupted if there is not enough electricity. Currently, the basic electricity tariff is increasing. The basic electricity tariff is increasing, resulting in increased electricity costs as well. This increase in electricity costs encourages us to save electricity so that spending on it is not wasteful. The largest consumption of electric power occurs in electric heaters and air conditioners (AC). You may reduce your energy consumption by shutting off the air conditioner when no one is using the room and setting the temperature of the air conditioner to a comfortable level, such as between 25 and 27 C. You can also keep the blower clean to ensure that the air conditioner operates at its best. Continuously using room air conditioners when no one is in the room can waste electricity. Furthermore, even when not in use, the lights are left on. Electricity costs can increase. These kinds of incidents frequently happen because people forget to switch off the lights and air conditioning or because they wish to turn off the AC but cannot because the remote is missing. The use of electric power by electrical loads such as lights and air conditioners in each room needs to be monitored and controlled. Lights and air conditioning can be turned off when the room is not in use without having to go into the room one by one. The existence of a centralized electrical load monitoring and control system is expected to overcome the wasteful use of electric power. This study's goal is to develop, put into use, and evaluate Internet of Things (IoT) applications for tracking and managing electrical loads in rooms.

This research was conducted at the PT PLN Mande Cianjur service unit, where the control process carried out in this unit in the process of controlling the electrical load in the area still uses traditional methods. Where every recording of the electric load in the area is done manually. Saving electricity needs to be done in various ways so that the wastage of electricity can be overcome. One of the savings methods proposed in this study is a centralized electricity load monitoring and control system that can be done remotely. The remote system will use Internet of Things (IoT) applications.

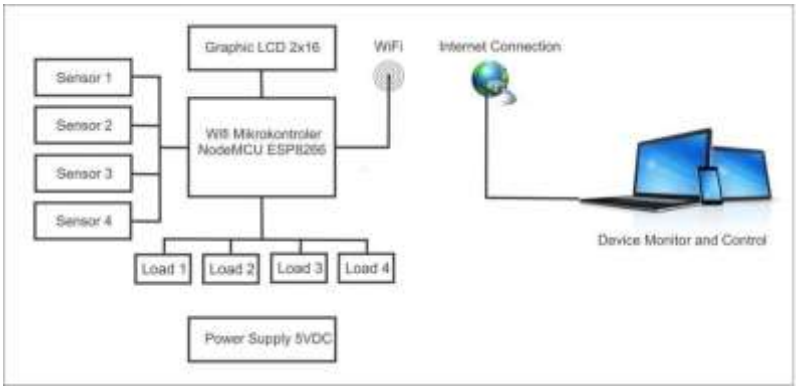
2. METHODS

2.1 System Analysis

System analysis is the process of determining the details of what a proposed system will do (and not how). System analysis stages are carried out to develop existing systems or overcome problems that have not been handled. The web is a collection of static and dynamic web pages that show different types of text, data, photos, video, or a combination of all of them.[3]

2.2 Internet of Things (IoT) method

IoT can be characterized as a single system of networked objects that uses the internet. The various types of things include tags, sensors, people, actuators, and more. The purpose of IoT is to gather data and information from the physical world (environment). This data is then analyzed to make sense of it. IoT is a concept that seeks to increase the advantages of constant internet connectivity. It can share data, control devices from a distance, and interact with real-world objects, among other things. IoT, which allows devices to connect with one another, can be used in any industry. IoT sensors can be used in the healthcare industry to track patient conditions and keep an eye on them throughout the day. The Internet of Things (IoT) can be used in agriculture as a sensor to monitor critical conditions for plants, such as soil quality, temperature, and humidity. To track how much electricity each building uses, IoT can be used in the field of smart buildings. IoT can also be used in a wide range of sectors, such as smart grids, transportation, and automation systems. In the following figure we can see the IoT design in the electric load control system. transportation, smart grid and others. In the following figure we can see the IoT design in the electric load control system. transportation, smart grid and others. In the following figure we can see the IoT design in the electric load control system.[4]



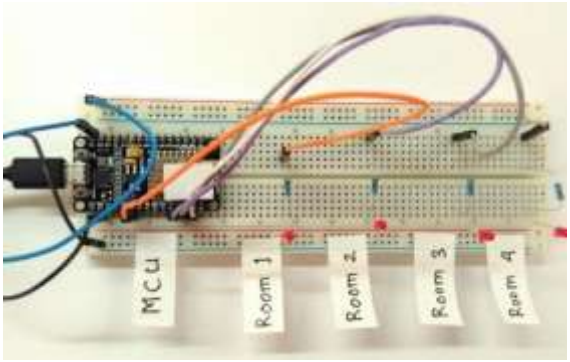
2.3 Electricity Tariff and Charges

The basic electricity tariff, or commonly abbreviated as TDL, is the tariff that the government may charge for customers of the State Electricity Company (PLN). PLN is the only company that is allowed to sell electricity directly to the people of Indonesia, so the TDL is arguably the tariff for electricity usage in Indonesia.

Electrical load is something that must be borne by the power plant. In everyday life, electric loads are described as all forms of electrical equipment that use electric power to function. In the whole system, the total power is the sum of all the active and reactive power used by equipment that uses electrical energy. So in the use of electric loads, the total electric load is the total of all the power consumed by active electrical equipment. Electrical equipment does not use electricity when the electrical equipment is turned off.

3. RESULTS AND DISCUSSION

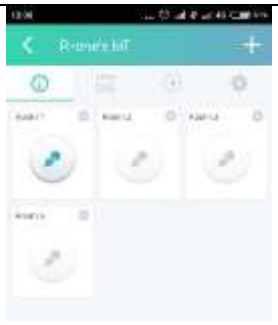
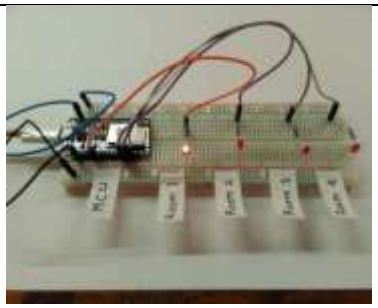
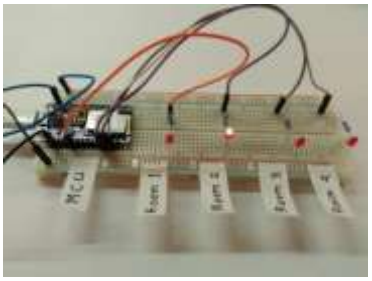
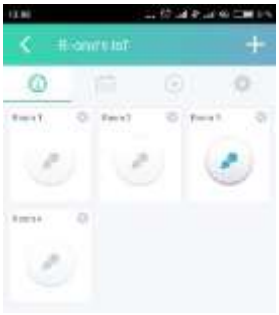
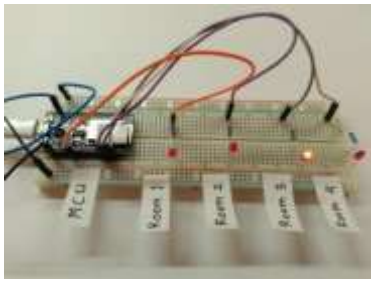
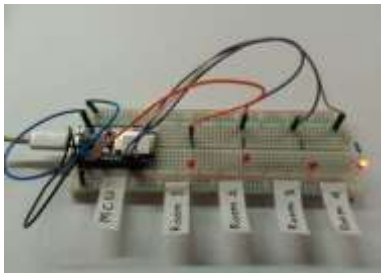
This study uses project research implemented in a prototype to determine the performance of the designed system. The implemented design is the implementation of the load regulation or control system design. In this design the design is tested on a project board with an LED indicator as a substitute for the actual load. The results of the hardware implementation are shown in the following figure.



This load control system is then tested for its performance as a remote controller using the internet network. Performance testing is carried out by activating hardware in the form of NodeMCU ESP 8266 as the main controller. After activating the NodeMCU ESP 8266 device, it will automatically connect to the internet network as long as there is an internet connection or internet access available. The results of testing the internet network connection are shownlike in picture 3.

While the results of testing the performance of the control system are shown in the figure presented as in Table 1.

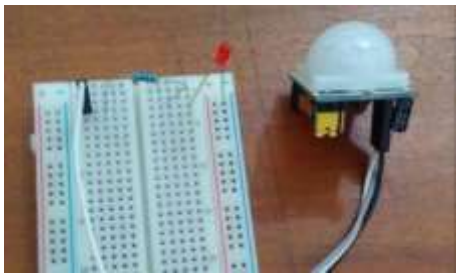
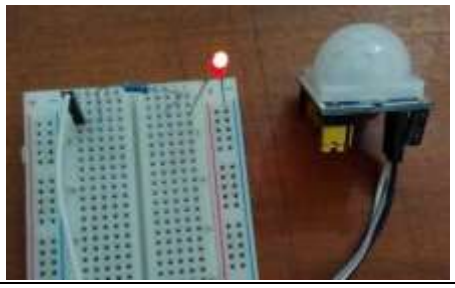
Table 1. Testing the performance of the electrical load control system

No	Software Display	Hardware View	Information
1			Load Room 1 is enabled Load Room 2, Room 3 and *Room 4 is disabled*
2			Load Room 2 is enabled Load Room 1, Room 3 and *Room 4 is disabled*
3			Load Room 3 is enabled Load Room 1, Room 2 and *Room 4 is disabled*
4			Load Room 4 is enabled Load Room 1, Room 2 and *Room 3 is disabled*

3.1. Monitoring system implementation and testing

Implementation of a room monitoring system design to detect whether or not there are people in the room using a PIR (Passive Infra Red) sensor. This sensor is used to find out whether there are people in the room or not. If no one is in the room, the sensor will give a signal to the microcontroller to turn off the load. If there are people in the room, the sensor will give a signal to the microncontroller to turn on the load. The results of testing the performance of the PIR sensor as a room monitoring system are shown in the following table. Testing the performance of the overall load monitoring system to monitor the room is shown in table 2.

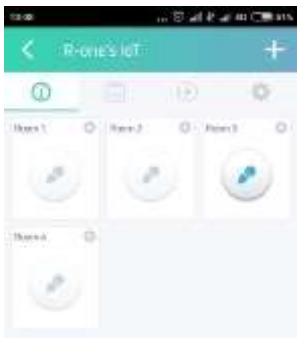
Table 2. PIR Sensor Testing

No.	Hardware View	Information
1		When no person is detected, the LED indicator is off.
2		When detecting a person, it is indicated by a live LED indicator.

And here are the trial results of the performance of load monitoring and electrical control using IoT and Arduino tools which can be seen in the following table.

Table 3. Electrical load monitoring performance testing

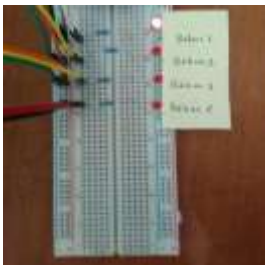
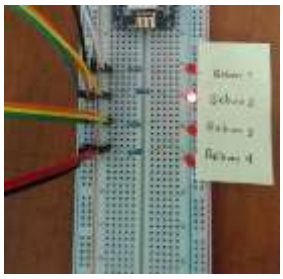
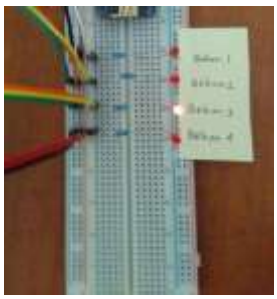
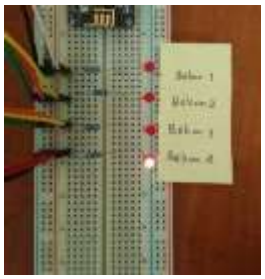
No	Monitor Display	PIR sensors	Information
1			Room 1 PIR sensor detects the presence of people in the room

No	Monitor Display	PIR sensors	Information
2			The Room 2 PIR sensor detects the presence of people in the room
3			The Room 3 PIR sensor detects the presence of people in the room
4			The Room 4 PIR sensor detects the presence of people in the room

3.2. Performance Test of Load Monitoring and Control System in Room

Performance tests are carried out to determine the performance of the load monitoring and control system functions. Can the system that has been implemented function according to its design? Testing is done by looking at the suitability between the design concept and the work function of the implementation results tool on the prototype. The results of system performance testing are shown in the following table.

Table 4. Results of Performance Testing of the Load Monitoring and Controlling System

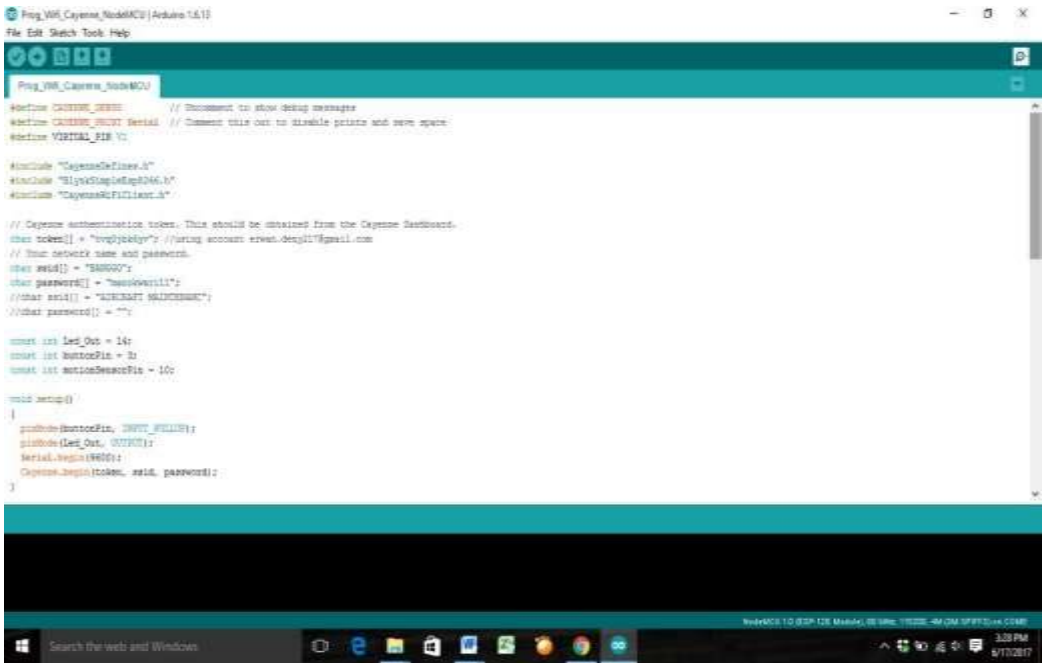
No	Appearance Monitors	PIR sensors	Load Indicator	Information
1				In accordance
2				In accordance
3				In accordance
4				In accordance

Data from system performance testing results show that the implementation of a tool or device in the form of a prototype is in accordance with the design concept. The tools made can monitor room conditions and can carry out load control properly. Monitoring and control results can also be carried out through an application on a smartphone or computer connected to the internet.

3.3 Software Implementation

*Software*or software as an interface for controlling loads implemented using the Cayenne application installed on an Android Smartphone. The interface is designed and built using applications and cloud service providers that are provided free of charge by Cayenne MyDevices. The keyboard as a load controller is designed and built using this application. Designing is done online on the following page, the design is from the application

In addition to applications for designing and creating interfaces, *https://cayenne.mydevices.com/cayenne/dashboard/start* The appearance of this application is shown in Figure 1. An application is also needed to program the NodeMCU ESP 8266 microcontroller. The application used is Arduino IDE 1.6.13. This application is also provided free of charge on the https://www.arduino.cc/ page. The display of the Arduino IDE application is shown in Figure 5.



The Arduino IDE application is used to write program code that will catch the program on the Arduino microcontroller and upload it to the NodeMCU ESP 8266 microcontroller board. The written and uploaded program code is presented in the following table.

Table 5. Arduino Program Code

No	Program Code	Information
1	#define CAYENNE_DEBUG #define CAYENNE_PRINT Serial #define VIRTUAL_PIN V1 #include "CayenneDefines.h" #include "BlynkSimpleEsp8266.h" #include "CayenneWiFiClient.h" char token[] = "tvq0jbk6yv"; char ssid[] = "AERO DEPARTMENT"; char password[] = ""; const int Led_Out = 14; const int buttonPins = 3; const int motionSensorPin = 10;	Initialization
2	void setup() { pinMode(buttonPin, INPUT_PULLUP); pinMode(Led_Out, OUTPUT); Serial. begin(9600); Cayenne. begin(token, ssid, password); }	Arrangement parameter
3	void loop() { Cayenne. run(); }	Operate sub program

4. CONCLUSION

The findings indicated that there were five (five) main components to the design of the Android-based aerodynamics learning materials: the cover page display, the main menu page display, the competency page display, the material page display, and the lift and drag calculation page display (calculator). The four (four) areas that make up the bulk of this media's content are physics of the atmosphere, aerodynamics, theory of flight, and flight stability and dynamics. The implementation of Android-based aerodynamics learning media was built using B4A software with the resulting application file having the extension *.apk. The Aerodynamics Learning Media Application can be installed and run on a smartphone or tablet that uses the Android Operating System version 4.2.2 and above. The performance of Android-based aerodynamics learning media as a whole can run well according to the plan. All buttons on each view can function according to plan.

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