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Design of a Temperature Control and Object Motion Detection System in the Server Room Using IOT-Based Wemos D1

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Abstract

Servers play an important role in managing information and managing network traffic within an agency. It contains various types of network devices that must be kept on every day to provide the best service. This leads to the importance of maintaining server presence, such as paying attention to room humidity, regulating temperature and monitoring server room movements to keep it under control. The air temperature in the server room is set within 20 - 25 degrees Celsius with a relative humidity of 40 - 55%. In this context, the concept of the Internet of Things (IoT) emerges as a potential solution by connecting physical objects via the internet. This research designs and builds an IoT-based temperature control and object motion detection system using a DHT22 sensor to measure the temperature in the room and a PIR sensor to detect human movement. Hardware components such as Wemos D1, Buzzer, Relay 2 channel 5v, and others are used to control the system via a smartphone. The software used includes the Arduino IDE. This system aims to monitor and control room temperature and object movement detection systems intelligently, prevent overheating, reduce the risk of loss and combine the advantages of IoT technology to create a temperature control and motion detection system that is responsive to room temperature and the movement of objects in the room.

Keywords: *Server, DHT22 Sensor, PIR Sensor, Wemos D1, Arduino IDE, IOT.*

1. Introduction

Servers play an important role in managing information and managing network traffic within an agency. It contains various types of network devices that must be kept on every day to provide the best service. This leads to the importance of maintaining server presence, such as paying attention to room humidity, regulating temperature and monitoring server room movements so that they remain controlled, have good performance and are safe. Judging from the Directorate General of Taxes, Ministry of Finance of the Republic of Indonesia Number: SE-16/PJ/2011 concerning "Guidelines for Security of Data and Information Processing Devices and Facilities" which is guided by the Telecommunications Industry Association (TIA) 942 and ISO/IEC 27001: 2005: Anex 9 - Physical security that the air temperature in the server room is set within the limits of 20 - 25 degrees Celsius with relative humidity between 40 - 55% [1]. The Internet of Things (IoT) has become a field of research that has begun to be in great demand since the development of internet technology and other communication media. By using IoT a sensor can retrieve data from one place and can be accessed remotely to control objects in another place. It can be used to remotely control and monitor room temperature using electronic devices. In the previous study, namely, researched by Siswanto 2017 entitled "Server Room Control Using DHT 22 Temperature Sensors, Pear Movement with Email Notifications" In this paper, the authors designed a device that can monitor the Server room for 24 hours if the temperature in the room exceeds Once specified, the application will send information to the Administrator or server room staff via E-Mail (Electronic Mail), this device is equipped with a PIR Sensor (Passive Infrared Receiver) which can detect motion when someone enters the Server room without Administrator permission. [2].

2. Theoretical Basis

2.1. Temperature and Humidity

Server room is a room used to store servers, network devices (routers, hubs) and other devices related to daily system operations. Server room temperatures that are too low cause wasteful electricity consumption and temperatures that are too high can result in fast damaged components such as hard disks. The position of the temperature measurement greatly determines the validity of the room temperature data, preferably 18º-27ºC for the hard drive. Rooms that are too humid can also damage components. Cooling settings for special server rooms for humidity should be 40% RH - 60% [3].

2.2. Microcontroller

A microcontroller is a computer on a single chip, which includes a microprocessor, memory, input/output (I/O) lines and other complementary devices. The speed of processing data on a microcontroller is lower when compared to a PC. On PCs the speed of the microprocessor used today has reached the order of GHz, while the operating speed of the microcontroller generally ranges from 1 – 16 MHz. Likewise, RAM and ROM capacities on PCs can reach the order of Gbytes, compared to microcontrollers which are only around the order of bytes/Kbytes [4].

2.3. Wemos D1

Wemos D1 R1 is a board that was developed based on ESP 8266 which is a Wi-Fi communication IC designed to resemble Arduino Uno, but in terms of specifications, it is actually far superior to Wemos D1 R1, one of which is because the core of Wemos D1 R1 is ESP8266EX which has a 32″ processor. beet. (Compare with Arduino UNO, which has 8 bit AVR core). This board is a standalone microcontroller that can be easily programmed using the Arduino IDE [5].

2.4. DHT22 Sensors

The DHT-22 temperature sensor is a digital relative humidity and temperature sensor. The DHT22 sensor uses a capacitor and thermistor to measure the surrounding air and output a signal on the data pin. DHT22 is claimed to have good reading quality, judged by the fast response of the data acquisition process and its minimalist size, as well as the relatively low price [6]. DHT22 is a sensor measuring temperature and relative humidity with an output in the form of a digital signal and has 4 pins consisting of a power supply, data signal, null and ground [7].

2.5. PIR Sensors

PIR sensor (Passive Infrared Receiver) is a sensor used to detect the presence of infrared rays from an object. As the name implies, the PIR sensor is passive, which means that this sensor does not emit infrared light but can only receive infrared radiation from outside. PIR sensors can detect radiation from various objects and because all objects emit radiation energy, for example when a movement is detected from an infrared source with a certain temperature, namely humans trying to pass through another infrared source, for example a wall, the sensor will compare the infrared radiation received every unit of time, so that if there is movement there will be a change in the reading on the sensor. The PIR sensor consists of several parts, namely, Fresnel Lens, Infrared Filter, Pyroelectric Sensor, Amplifier, Comparator [5].

2.6. Buzzer

Buzzer is an electronic component that functions to convert electrical vibrations into sound vibrations. Basically the working principle of a buzzer is almost the same as a loudspeaker, so the buzzer also consists of a coil attached to the diaphragm and then the coil is energized so that it becomes an electromagnet, the coil will be pulled in or out, depending on the direction of the current and the polarity of the magnet, because the coil mounted on the diaphragm, every movement of the coil will move the diaphragm back and forth so as to make the air vibrate which will produce sound. The buzzer is usually used as an indicator that the process has been completed or an error has occurred in a device (alarm) [2].

2.7. Relays

Relay is a switch that is operated electrically and is an electromechanical component consisting of 2 main parts, namely electromagnet and mechanical. Relays use electromagnetic principles to drive Switch Contacts so that with a small electric current (low power) they can conduct electricity with a higher voltage. For example, a relay that uses a 5V and 50 mA electromagnet is able to move the armature relay to conduct 220V 2A electricity. This relay module can be used as a switch to run various electronic equipment [8].

2.8. Arduino IDE

The Arduino IDE is an editor used to write programs, compile them, and upload them to the Arduino board. Arduino Development Environment messages, text console, toolbar with buttons for common functions, and a series of menus. Software written using Arduino is called sketches. These sketches were written in a text editor and saved with a file with the .ino extension. This text editor has facilities for cut/paste and search/replace. The message area contains feedback when saving and uploading files, and also indicates if errors occur. open standard of mobile devices [9].

2.9. Blynk

Blynk is a platform for Mobile OS applications (iOS and Android) which aims to control Arduino, Raspberry Pi, ESP8266, WEMOS D1, and similar modules via the Internet. This application is a place for creativity to create graphical interfaces for projects that will be implemented using only the drag and drop widget method. It's very easy to set everything up and can be done in less than 5 minutes. Blynk is not tied to any particular board or module. From this application platform, we can control anything remotely, wherever we are and at any time. With a note that it is connected to the internet with a stable connection and this is what is called the Internet of Things (IoT) system [10].

2.10. Internet of Things

The internet of things basically connects all devices that have an on and off button to the internet. These devices can be cell phones, coffee grinders, washing machines, lamps, smartwatches, and almost anything imaginable. Parts of a system can also be controlled, such as doors

on housings, drills on oil rigs. The term Internet of Things is often referred to as today's technology, namely technology that utilizes mini-sized computer devices and can be connected to local networks or the internet. The device used is designed to use small power, so that the device can only execute simple commands. The Internet of Things has been widely applied to Smart Homes [11].

3. Results and Discussion

This study uses the prototype method. Which uses the concept of direct monitoring and allows iterative changes to be made until the desired result is achieved. So this prototype method makes it possible to display the view directly.

3.1. Research Equipment and Materials

The materials used for Designing Intelligent Control Systems and Classroom Temperature Controlling using the IoT-Based Wemos D1 are as follows:

1. The hardware used in this study is as follows:
   a. Wemos D1
   b. DHT-22 sensors
   c. PIR sensors
   d. Wi-Fi network
   e. Smartphones
   f. Relay Modules
   g. cooler
   h. Buzzer
   i. Glue
   j. Solder
   k. Tin
   l. PCB board
   m. USB data cable and jumper cable
2. The software used in this study is as follows:
   a. Arduino IDE
   b. Blynk

3.2. System Block Diagram

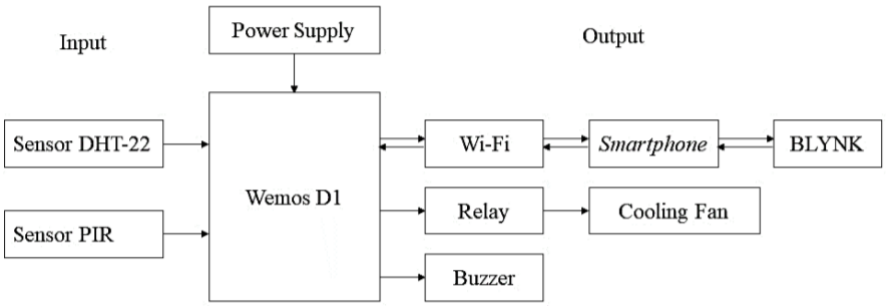

Fig. 1: Diagrams System Block on Wemos D1

The description of the Flowchart above is as follows:

1. The power supply functions as a power source to turn on the tool system.
2. Wemos D1 functions as a processor, receiver and sender of data on the tool system.
3. The DHT-22 temperature sensor functions as the sensor input for reading the temperature value.
4. The PIR temperature sensor functions as an input sensor for reading the presence of moving objects in the room.
5. The Wi-Fi network functions as a medium of communication between the device system and the Android smartphone.
6. The smartphone functions as an output device for sensor readings using the BLYNK application.
7. The Relay Module functions as an electrical switch output to turn on and turn off the fan.
8. The cooling fan functions as an output to cool the room.
9. The buzzer functions as a temperature and movement warning alarm.

3.3. Overall Tool System Range

This circuit is composed of the components needed to design the tool so that the tool can work as desired, which can be seen in the image below:

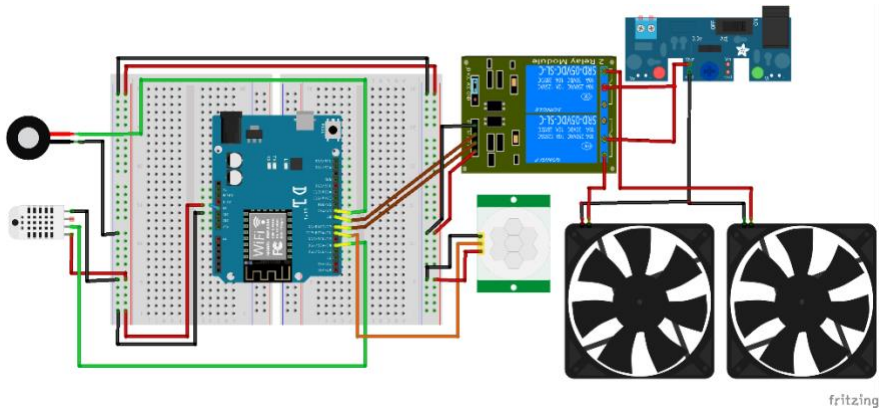

Fig. 2: Overall Series of Tools

The explanation of Figure 2 is as follows:

a. Wemos D1 functions as the brain and controller function in the electronic system.
b. DHT22 sensor functions as a temperature gauge in the room if the temperature is hot then the fan will turn on.
c. PIR sensors serves as a detector when there are humans or animals in front of it and will send an alarm as a danger warning.
d. The 2Chan 5v relay functions as a switch for the cooling fan.
e. The electric current serves as the device's power supply.
f. The fan functions as an air conditioner.
g. Buzzer as a warning alarm.

3.4. Flow chart

Software planning starts from making flowcharts (flow diagrams) to facilitate planning and programming on the microcontroller. Making a flowchart (flow chart) also aims to make it easier to understand the work process of this tool. The program flowchart of this Final Project includes tool control systems and work systems. This program can be seen in Figure III.3.

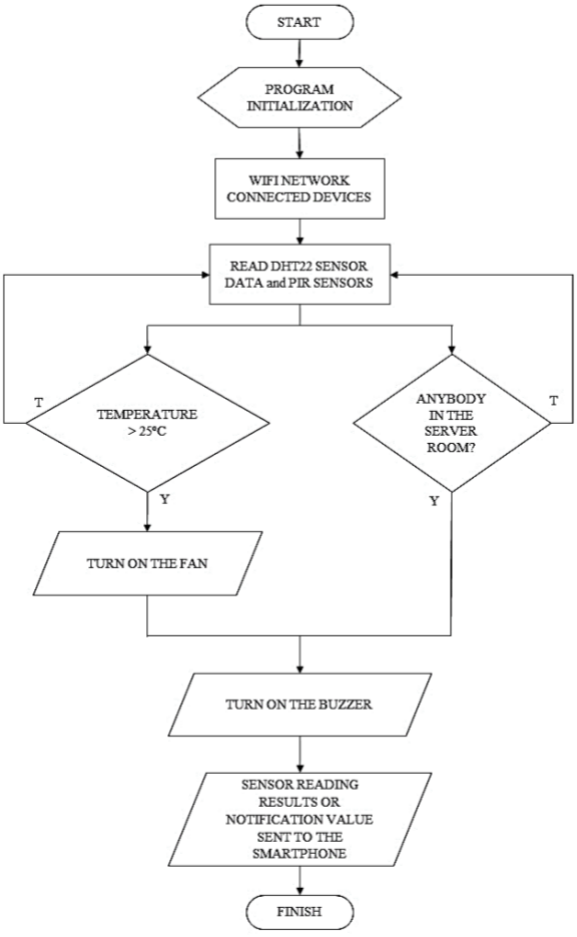

Fig. 3: Flowchart of Temperature Control System and Object Motion Detection

Information:
From the flowchart above it can be explained if the design of this tool consists from a number of channel.

a. Start the program
b. Device Initialization, this means whether the device is installed correctly according to the circuit schematic.
c. Connect Wemos D1 with WI-FI.
d. Furthermore, the DHT-22 temperature sensor will read the temperature value in the room and the PIR sensor detects humans entering.
e. If the temperature starts from 25oC, the fan will turn on and the buzzer will sound as a warning sign that the temperature is rising.
f. If the PIR sensor detects someone entering, the buzzer will sound as a warning sign, if no person is detected, the buzzer will turn off.
g. Finished.

4. Conclusion

After carrying out the design stage and which is then followed by the testing and analysis stage, the conclusions can be drawn:

1. Implementing an effective temperature control system is critical to keeping server room temperatures within a safe and optimal range. Integration with temperature sensors and air conditioning devices enables automatic temperature monitoring and regulation. With remote monitoring and notification features, administrators can respond quickly to temperature changes, avoid potential hardware damage, and ensure stable performance.
2. The application of PIR motion sensors in the server room enables the detection of human or object movement. The integration of these sensors with the system gives administrators the ability to more accurately monitor and observe server rooms. This helps in maintaining physical security and provides early warning against unauthorized access or unwanted movement.

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