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IoT-Based Smart Home Controller Using NodeMCU Lua V3 Microcontroller and Telegram Chat Application

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Abstract. The house is a valuable asset that needs to be guarded, not infrequently some people experience undesirable things happening in the home environment, these things include fires and theft. Anticipation is not just enough by manually such as locking the door, or preparing fire extinguishers, in addition to the manual way of anticipation can be added by automation, namely by installing devices that can monitor the condition of the house and also can control electrical equipment in the house. The automation tool intended in this study is an IoT-Based Smart Home Controller Using the NodeMCU Lua V3 Microcontroller and Telegram Chatting Application. The use of automation systems like this is an option to be implemented because it saves power and the price is relatively cheap. This device / system uses 2 NodeMCU Lua V3 microcontrollers and several sensors (fire sensors, motion sensors, temperature and humidity sensors) and also this role utilizes the 4 Chanel Relay Module which functions as a switch to turn off or turn on electrical equipment in the home. The control function of the smart home controller device also utilizes the Telegram chat application bot that is planted on an IoT-based system device with the function of receiving commands from users through the Telegram chat application to monitor the condition of the house and also controls the relay module used as a switch of equipment.

Keywords: IoT, Internet of Things, Monitoring, Controller, NodeMCU, Bot, Telegram, Smart Home, Arduino

1. Introduction

The development of technology is now increasingly fast so that the emergence of a new technology spoil people. Even the phrase automation is often heard in the ears of many people, this indicates that the decrease in human intervention in terms of doing routine activities in daily activities. Automation of the system has now penetrated into the house, and is known as the 'Smart Home' system. System automation that will be discussed here is the installation and configuration of electronic equipment that is integrated with the Telegram chat application that serves as a tool to manage / control all the needs of an electrical installation and control of devices that use electrical energy (such as TV, AC, Refrigerator , etc.) in the home environment. For example: if a homeowner in general has a house where the method usually turns on the lamp using the help of conventional / general switch, and usually turns on or turn off the lights manually, then if the homeowner uses system automation, the lights can be turned on automatically with a timer or use a motion sensor (the lamp will automatically turn on itself if the sensor detects the presence of humans or dies when there are more people) or the homeowner can turn on the lamp remotely by using the remote control via a smartphone or even through internet site services. This can also apply to all electrical appliances at home. Even though you are already using system automation, electrical equipment can still be activated or deactivated manually. Not only that, homeowners can also make systems in a room by designing memory



programs or electrical installation habits that work, so just by pressing one button then the lights / electrical equipment will be active in accordance with the program that has been made. This is usually used for rooms that have lots of lights but homeowners do not want to have a lot of switches so this system is very flexible following the wishes of the homeowner.

Various studies have been carried out to monitor the condition of the house [1] and control of home electrical appliances [2]. Furthermore [3] has conducted research on IoT-based temperature monitoring monitoring systems, but the microcontroller used is not NodeMCU, the Arduino UNO microcontroller and its web-based control system are used, not using the telegram chat application, there are also previous research studies on the making of electrical equipment control systems. home, but the user interface and user experience that is used uses the Blink application to control the device. [4]. There is also previous research on iot smart fish farm design with Raspberry Pi and Webcam controls. This study discusses the monitoring system of fish farms where the system was built using the Telegram chat application as a control tool for monitoring the system, the system built using Raspberry Pi as a microcontroller, is different from the one used in this study [5]. There is also previous research on the design of home security systems using relays. This research focuses on controlling electrical home appliances. However, in this study the system built is an automatic control system (no need to do manual control of the tool) and also the system built does not use a NodeMCU Lua V3 microcontroller [6]. There is also previous research on fire spot detectors for early detection of fires. This study discusses the fire detection system. The system is automatic (not controlled manually) and only uses Buzzer as the output media when a fire occurs. The system built uses the Arduino Mega microcontroller, different from the one used in this study [7]. There is also previous research on the internet of things on room security systems, case studies of raharja college server rooms. The study discusses the server room monitoring system that uses motion sensors and camera modules as input. The system built uses Arduino Mega as a microcontroller and uses Web media as the controller of the built system. Web media is a media controller that is quite fast and effective. However, this media is considered ineffective because the user cannot know if the sensor in the server room detects movement because the user must first open the browser to see the detected movement [8]. Based on the background above, the author wishes to create an IoT-based Smart Home Controller by using the NodeMCU Lua V3 Microcontroller and Telegram Chat Application. This is an effort to facilitate users in monitoring the condition of the house and facilitate users in saving electricity as well as facilitate users in controlling electronic home appliances so that their use is more effective.

2. Design

2.1 Block Diagram System

In making tools / systems to monitor and control home electrical appliances, a tool / system design will be built to make it easier for writers to build the system / tool. Making tools are divided into 2 function blocks. General description of the work system and the division of system blocks from this study is shown in the following figure.

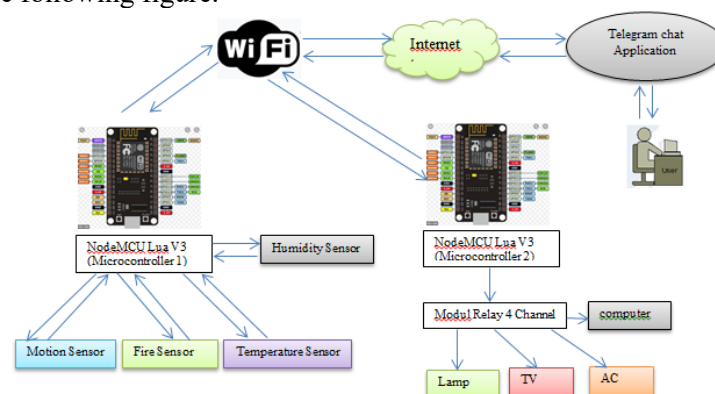


Figure 1. Block Diagram System

The smart home controller system that was built in this study is a system used to control household

electronic equipment and also to monitor the condition of the house. This control and monitoring can be run by the user through the Telegram chat application media as HMI (Human Machine Interface) media. The system was built using a NodeMCU Lua V3 microcontroller that is connected to the Telegram chat application server via a WiFi network that is connected to the internet. Smart home controller that is built is divided into 2 parts, the first part is in charge of monitoring the condition of the house, and the second part is in charge of the system to control electrical home appliances. Home condition monitoring system uses 3 sensors as input media, including sensors fire sensor (Flame Sensor), motion sensors, and also temperature and humidity sensors. Whereas in the electrical control system home appliances the controlled electrical appliances will be simulated by using 2 lamps as output .

2.2 Design of NodeMCU with Relay Module and several sensors (Electrical Equipment Controller Circuit)

This circuit is a prototype of the electrical equipment controller circuit and the condition monitoring circuit of the house, the two series are combined into one then the writer adds a battery / power supply with a voltage of 5V 1.5A and also 2 light bulbs that are powered by 220V AC voltage as indicators to find out whether the home electrical control system that has been made works well or not. The series can be seen in the following figure 2.

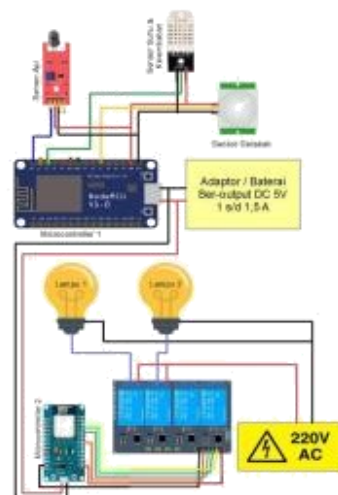


Figure 2. Combination of a home electrical equipment control circuit and a house condition monitoring circuit

3. Results

3.1 Assemble the System

This stage is to assemble the tools / systems that are tasked with monitoring the condition of the house and controlling the house electricity.

a. Assembling House Condition Monitoring System

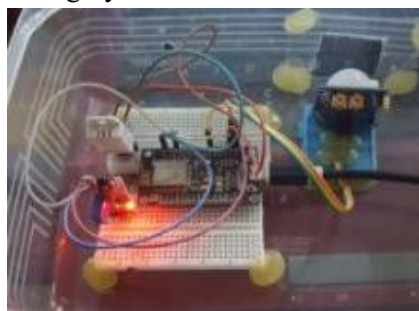


Figure 3. House Condition Monitoring System Assembly Results

In the prototype monitoring system above, the three sensors (Flame Sensor, PIR, and DHT22) are

integrated with the microcontroller 1. Microcontroller 1 is powered by an adapter / battery with a 5V 1 - 1.5 ampere voltage and is connected via a micro USB cable.

b. Assembling a Home Electric Appliance Control System



Figure 4. Results of Assembling a Home Electric Control System

In the prototype picture of the electrical control system of the house above, two lights are seen powered by a parallel 220V AC current, each lamp does not use a conventional switch but directly uses a relay module as the main switch where the relay module is controlled via a microcontroller

3.2 System Testing

In this section, trials are divided into 2 types, the first is a trial of a home condition monitoring system and the second is the home electrical equipment control system.

3.3 Prototype Testing of House Condition Monitoring System

In the prototype testing phase, testing is done in different ways on each sensor. In testing the fire sensor, a match is used as a tool to create a small fire that will be used as a trigger for the fire sensor

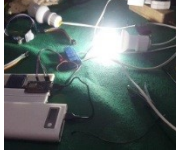
Table 1. Prototype Testing of House Condition Monitoring System

NO	Sensor Tested	Testing Method	Results	Response Time (from the start of the test until the system sends a notification to the Bot chat)
1.	Flame Sensor	Conduct a test by igniting a flame using a match that is brought close to the flame sensor	Success	37 second
2.	Sensor Suhu Dan Kelembababan	Type the "/" sensor" command in the Telegram Bot chat which functions as a monitoring Bot.	Success	55 second
3.	Motion Sensor	Move the palm to the front of the motion sensor (PIR PIR HC-SR501)	Success	5 Minutes

3.4 Testing of Prototype Home Electrical Equipment Control Systems

In testing temperature and humidity sensors, testing is done by typing the command "/" sensor" in the chat bot telegram to trigger the microcontroller to read the temperature and humidity through the dht22 sensor connected to the microcontroller. Whereas in motion sensor testing, testing is done by moving the palm of the hand right in front of the motion sensor (PIR) so that the sensor can read hand movements easily, the motion sensor manages to detect movement, but the system's response time in sending notifications of the movement takes considerable time long, which is approximately 5 minutes

Tabel 2. Testing of Prototype Home Electrical Equipment Control Systems

No	Initial Condition (Tool)	Testing Method	Results	Response Time (from the start of testing until the electrical equipment turns on / off))
1.	Lamp 1 Off	Type the command "/lampu1on" in the Bot Telegram chat that serves as a bot controller.	Successful, Light 1 Turns on 	35 Second
2.	Lamp 1 on And Lamp 2 Off	Type the command "/lampu2on" in the Bot Telegram chat that serves as a bot controller.	Successful, Light 2 Turns on 	51 Second

4. Conclusion

The conclusion of the discussion of the implementation of the IoT-based Smart Home Controller system by using the NodeMCU Lua V3 Microcontroller and Telegram Chat Applications include:

1. The system built can facilitate the user in monitoring the condition of the house in real time (24 hours) anywhere and anytime.
2. The system built can make it easier for users to control home electrical appliances (be it lights, air conditioners, TVs, etc.) in real time (24 hours) anywhere and anytime.
3. This research is the result of the development of previous research in which connections using Bluetooth have not been able to control home electrical equipment or monitor the condition of the house in real time anywhere and anytime.
4. Using Bot telegram chat application as a media access smartphone application has advantages compared to using android applications or using web pages because it can be accessed with multi platforms both Android, iOS, Windows, and Linux, and also this telegram chat application bot can send notifications via directly when the sensor in the monitoring system detects fire or movement.

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