IOT-BASED HOME AUTOMATION USING NODEMCU ESP8266

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Abstrak

Home automation didefinisikan sebagai teknologi otomatisasi yang berfokus pada majemen rangkaian serta peralatan elektronik di rumah, kantor dan lainnya. Home automation merupakan bentuk perkembangan dari Internet of Things (IoT) yang memungkinkan komunikasi serta kontrol melalui perangkat selama terhubung ke internet. Penelitian ini bertujuan untuk merancang prototype Home Automation pada perangkat penerangan seperti lampu, sensor cahaya untuk mengaktifkan lampu, dan beberapa lampu yang dikontrol menggunakan perangkat mobile. Metode penelitian menggunakan metode prototype, dimana pengembangan sistem difokuskan pada hasil masukan dari pelanggal yang akan dievaluasi untuk pengembanagan perangkat lunak. Adapun tahapan dalam penelitian ini dimulai dengan menganalisis kebutuhan perangkat, studi literatur, perancangan sistem, perancangan hardware, perancangan antarmuka pengguna pengujian dan sampai pada hasil. Output dari penelitian ini akan dibuat dalam bentuk prototype dimana semua komponen akan tempatkan berdasarkan layout yang sudah digambarkan pada perancangan. Sistem ini dapat menolong pengguna dalam mengontrol peralatan yang ada di dalam rumah dari mana saja dan kapan saja,termasuk memanfaatkan sensor cahaya untuk memberikan inputan agar menyalakan atau mematikan lampu tersebut..

Kata kunci: Home Automation, Prototype, IoT, Arduino, NodeMCU8266

Abstract

Home automation is an automation technology that manages circuits and electronic equipment in homes, offices, and others. Home automation is a form of Internet of Things (IoT) development that allows communication and control through devices connected to the internet. This study aims to design a Home Automation prototype on lighting devices such as lamps, light sensors to activate lights, and several lights controlled using mobile devices. The research method uses the prototype method, where system development is focused on the results of input from customers who will be evaluated for software development. The stages in this research begin with analyzing device requirements, literature study, system design, hardware design, user interface design testing, and arriving at the results. This research output will be made in the form of a prototype, where all components will be placed based on the layout described in the design. This system can help users control the equipment in the house from anywhere and anytime, including using light sensors to provide input to turn the lights on or off.

Keywords: *Home Automation, Prototype, IoT, Arduino, NodeMCU8266*

INTRODUCTION

The internet has become an essential part of various life activities. (Lasera & Wahyudi, 2020). One of the impacts of the rapid development of the internet is the Internet of Things (IoT) (Malik et al., 2019). IoT can be defined as a computational scheme interconnected with digital devices, a mechanism of transmitting data over a defined network without human involvement at any level (Muktiawan & Nurfiana, 2018; Singh et al., 2020). IoT allows users to manage and optimize electronic devices by using the internet. (Junaidi, 2015). IoT technology offers connectivity of system devices and services in various fields, such as agriculture, building management, health, energy, transportation, and even home management, often known as Home Automation. (Jain et al., 2019)

Home automation is an automation technology that manages electronic devices and

equipment in the home, office, and others. (Santoso et al., 2021; Soleh & Susilo, 2016). Home Automation allows for the management of lights (lighting), temperature (temperature), washing machines, etc. (Mowad et al., 2014). This procedure is possible through the presence of electronic sensors such as temperature sensors, humidity, gas concentration, etc. (David et al., 2015)

The existence of covid-19 has caused the role of technology to be increasingly important. Social distancing, which requires many business processes and activities, is done with the internet. (Komalasari, 2020) Home Automation can help facilitate human tasks by utilizing the internet.

Previous research on Home Automation (Harahap, 2018) proposed an automatic clothesline prototype using water sensors and LDR sensors based on Arduino microcontrollers to overcome weather uncertainty by applying the Fuzzy Logic Controller (FLC) method. (Gitakarma, 2018) created a Home Automation System (HAS) to control Bluetooth-based electrical devices using an android application to make it easier for elderly and physically disabled people in the family (Santoso et al., 2021) and implemented NodeMCU in Home Automation with the Blynk control system using DHT11 sensors to monitor temperature and humidity and MQ2 sensors to detect smoke or gases that could potentially cause fires as well as relays to control electronic devices from anywhere.

Based on the author's search results, there is very little research on IoT in Papua due to very limited internet infrastructure constraints (Wayangkau et al., 2020). This research has urgency as one of the pioneers in implementing such research in Papua. This research can provide an overview of how to maximize the existing infrastructure to implement IoT and Home Automation and help people use the internet to facilitate routines.

Based on this background, the author designed a prototype of Home Automation where lighting devices such as lights outside the house can automatically turn on when conditions are dark and turn off when conditions are bright using light sensors. The author added several components, such as a relay to control the lights in the house and a camera module for monitoring. For the user interface, the author uses the blynk application. The author also added a notification feature to the user interface so that when the light is dark or bright, the notification will appear to notify that the light will be turned on or off. The system is expected to make it easier to control the equipment at home from where we are and at any time.

RESEARCH METHODS

The Internet of Things (IoT) is a concept/scenario in which an object can transmit data over a network without requiring human-to-human or human-to-computer interaction. IoT also provides efficient data storage and exchange by connecting physical devices through electronic sensors and the internet. IoT is closely related to machine-to-machine (M2M) communication in the manufacturing and electricity, oil, and gas industries. Products designed with M2M communication are often considered intelligent or "smart" systems. (Muktiawan & Nurfiana, 2018). (Wadhwani et al., 2018)
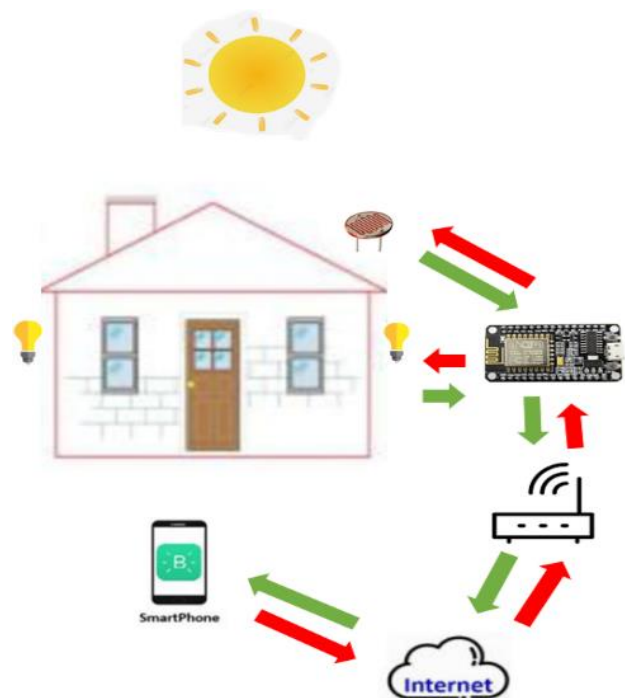

Figure 1. IoT scheme for Home Automation

Home automation is an automation technology that manages electronic devices and equipment in the home, office, and others. (Santoso et al., 2021; Soleh & Susilo, 2016). Home Automation allows the management of lamps (lighting), temperature, washing machines, etc., as shown in Figure 1 (Mowad et al., 2014). This procedure is possible using electronic sensors such as temperature, humidity, gas concentration, etc. (David et al., 2015). Home automation consists of two components: hardware as output input and software to monitor and control hardware. (Kholmatov & Darvishev, 2020)

NodeMCU ESP8266 is an integrated chip connecting the microcontroller to the internet via wifi. It offers a complete and standalone wifi

network solution, which allows it to be hosted or as a wifi client. The ESP8266 has powerful onboard processing and storage capabilities, allowing it to be integrated with sensors and other specialized device applications through GPIOs with easy development and minimal loading times. (Hidayat et al., 2018) NodeMCU has also equipped a USB to serial communication chip to program. It only requires a micro USB data cable.

The blynk application is straightforward (Artiyasa et al., 2020). To connect blynk on boards such as Arduino, Raspberry Pi, Wemos, and NodeMCU only need to enter the auth token code sent via email when creating a blynk account, and then the auth code is entered in the program code and upload it on the board. From this application, we can control anything remotely wherever we are with a record of being connected to the internet. (Santoso et al., 2021)

In conducting this study, the authors applied several research methods, such as collecting data, where the research was carried out, and how to design the desired miniature. The research methodology applied by the author is as follows in Figure 2.
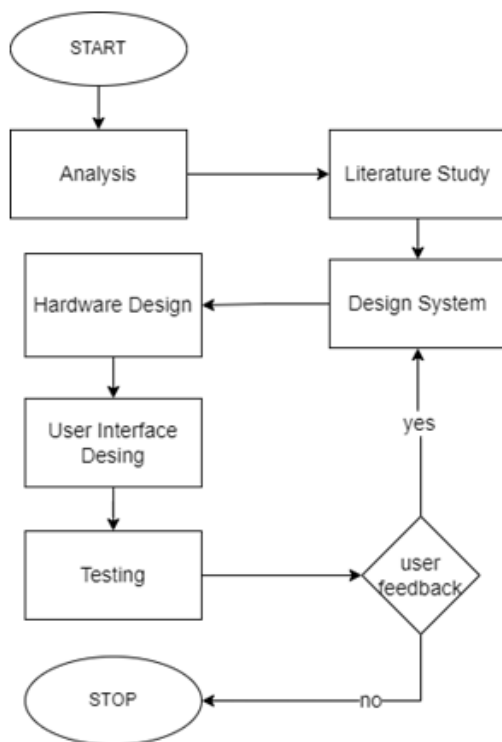

Figure 2. Research Methods

Block Diagram

The design of this system is first planned by creating a block diagram. A block diagram is used at the beginning of the design to be an initial illustration of how the system works. The block diagram as a whole can be seen in Figure 3
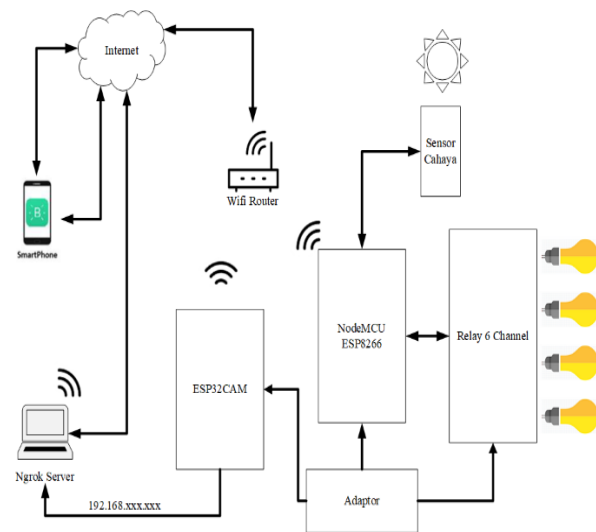

Figure 3. Hardware Block Diagram

Based on the block diagram image above, it can be explained that this system works because when NodeMCU, ESP32-Cam, light sensors, and relays get a power source from the adapter, the devices will turn on. Furthermore, according to the SSID, NodeMCU and ESP32-Cam will automatically search for SSID via wifi or the nearest hotspot, which will later be entered into the program code. After the ESP32-Cam gets power, the device will automatically get an IP from wifi; then, the IP will forward using scraping software on the laptop so that the public can access the device. Furthermore, the light sensor, the light sensor itself can directly trigger the relay to turn the light on and off when it is dark or bright without a program code. However, in this system, a notification program code will be generated on NodeMCU so the blynk application can pop notifications when the sensor detects light or darkness.

After creating a block diagram and knowing the functions of each component used, the next stage is hardware design. There are several processes in hardware design, including small design, circuit schemes, and wiring. Figure 4 shows the appearance of the small layout design for home automation
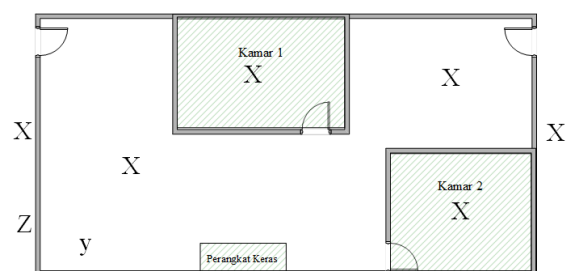

Figure 4. Miniature Layout

Information:
X: Lights
Y: Camera
Z: Sensors

The development of the user interface on the blynk application serves as an intermediary to monitor the system that has been designed. Figure 5 illustrates the user interface design that has been created.
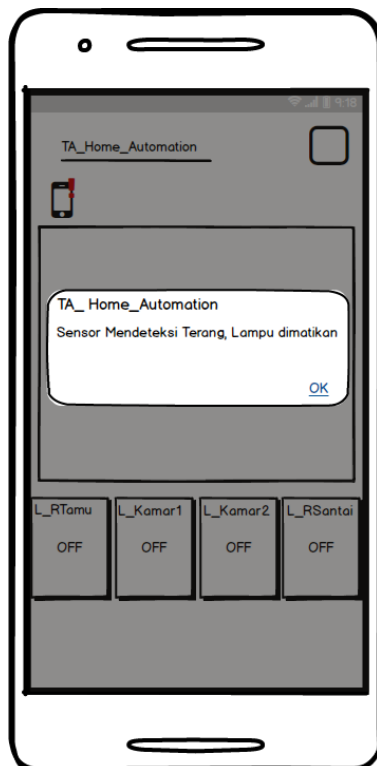

Figure 5. User Interface Design

This research uses a quantitative approach, just an example of this research.

RESULTS AND DISCUSSION

Connection Test

In this prototype connection test, connection testing is carried out using two different networks. It aims to prove that this prototype system can be accessed anywhere (accessible by the public). The connection testing is carried out by testing the connection between the blynk application and the system prototype via a smartphone using the internet network. The blynk application can be accessed publicly, but the public cannot access the ESP32-Cam camera module on the prototype. To be accessible to the public, the author uses Ngrok software to forward the IP on the camera module to the public. Here is a picture of the test results.
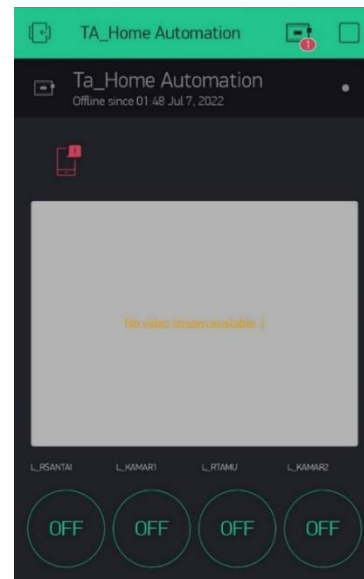

Figure 6. Application Notification When the Device Is Not Connected

Based on the picture above, it can be seen that Figure 6 is a condition where the user interface device display has not been connected to the internet, and Figure 7 is a condition where the user interface device display is connected to the internet.
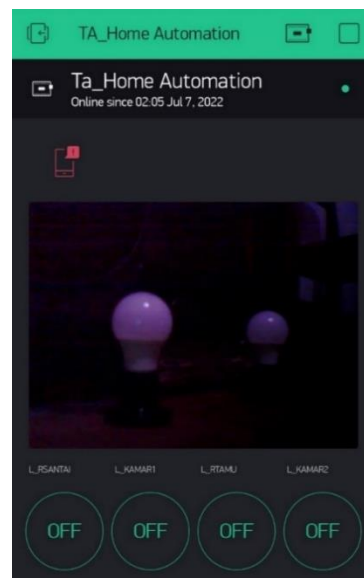

Figure 7. When the Device is Connected

User Interfaces Control Test

In the testing phase, the user interface display will be tested on the blynk application via smartphone, on the Guest L_Ruang button, L_Kamar1, L_Kamar2, L_RSantai, Notification Icon, and camera. This test aims to find out what is by functions have been designed and whether there is a delay on each device.

Table 11. User Interface Display Testing

No.	Input	Output	Button Status	Delay (sec)	Information
1	L_RTamu	Lights On	On	1	match
		Lights Off	Off	1	match
2	L_Kamar1	Lights On	On	1	match
		Lights Off	Off	1	match
3	L_Kamar2	Lights On	On	1	match
		Lights Off	Off	1	match
4	L_RSantai	Lights On	On	1	match
		Lights Off	Off	1	match
5	Notification	Appear	-	2	match
6	Camera	Appear	-	3	match

From Table 1, every button on the user interface displayed during testing by pressing the button to turn off and turn on the lights on the prototype was found to be a delay of 1 second. Then in the test, the notification that appears on the user interface when the sensor detects the presence of light and the rate of light is found to be a delay of 2 seconds. Furthermore, in the camera test to display the image on the user interface display, a delay of 3 seconds was found so that the image could appear on the screen. The delay found in this user interface test is due to the quality of the internet network used. If the quality of the internet network used is not good, the delay found will be greater; on the contrary, if the quality of the internet network used is good, the delay found is minor.

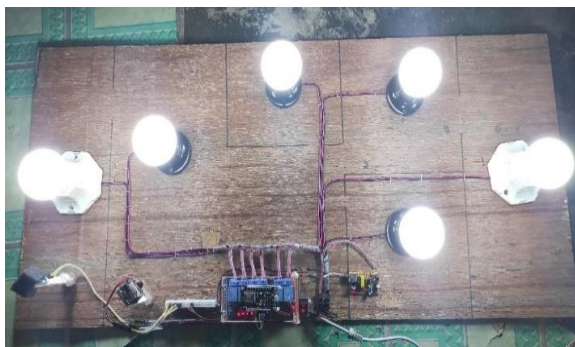Figure 8. Condition When prototype In The Off State

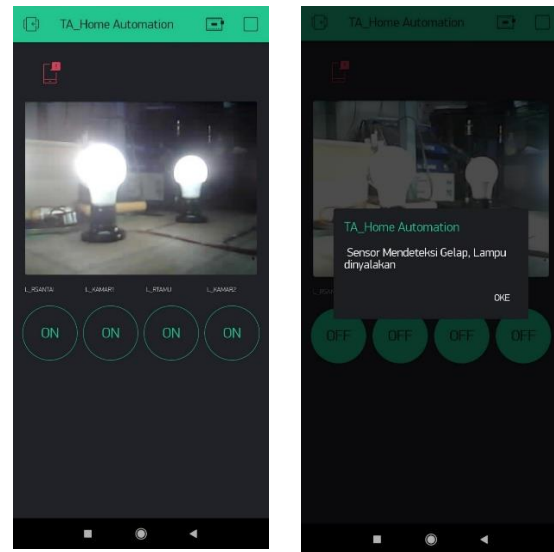Figure 9. Condition When Prototype Is On

Figure 10. When the Button Is Off and The Notification Display When the Sensor Is Dark
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Based on the picture above, it can be seen that Figure 8 is a condition when the button has not been pressed and is in the off condition, and Figure 9 is a condition when the button has been pressed and is in the state. Then figure 10b is an image of the notification display when the resistance of the light sensor increases due to dark conditions, and Figure 10b is a notification image when the resistance of the light sensor decreases due to bright conditions.

CONCLUSIONS AND SUGGESTIONS

Conclusion
After testing, it is known that an IoT-based home automation prototype has been successfully created and controlled via the internet, using the blynk application on a smartphone that can be accessed anywhere and anytime. Some of the devices used are light sensors, lights, relays and buttons, which are connected to each other. In addition, the design of an IoT-based home automation prototype has worked according to the design.

Suggestion
Some improvements that can be made for home automation are not only using lights and cameras but can be improved for other devices, such as motors, electric pumps, and other sensors. Such as temperature sensors, gas sensors, motion sensors and so on. In addition, it can also replace power from electricity to solar cells to provide a more optimal power source. The author can also add security features such as better monitoring quality with multi cameras that can be recorded in real-time.

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