Monitor and Control-Based Raspberry Pi for Designing Smart Home through Internet of Things

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Abstract: Almost all service devices connected to the internet in this modern era. They were in the form of a form of rapid technological development and advancement. The type of this technology known as Internet of Things (IoT) that could been embedded in smart home systems. Sensor and actuator devices that implemented in the house could been controlled through the android application. The objective of this study was to develop the accuracy of monitoring and controlling the home electronic equipment through the controlled device using sensors to generate a status as a sign. The result of this study was that the controlled device status was able to generate feedback data to the Android so that the device was on or off. The average time to obtain the feedback was 4 seconds.

Keywords: Internet of Things, Smart Home, Controlling, Monitoring.

1. INTRODUCTION

The internet of things or IoT was a sophisticated, modern and future technology from which all devices were connected to the internet (Chilipirea et al., 2016) (Singh et al., 2018). The connected device was through an intermediary sensor and actuator. Not all devices were used in IoT. The device must maintain comfortable living condition within a home, like thermal comfort, visual comfort, and hygienic comfort [1]. The smart home networks were currently influencing the people for a quality life style [15]. Many device was used to IoT, such as Frugal Labs IoT Platform (FLIP) in its IoT-enabled smart home [7]. The application of IoT was very broad in various fields e.g., agriculture, mining industry, transportation, agriculture, and smart home (Nath, Bajpai and Thapliyal, 2018)(Li et al., 2018). Monitoring and controlling were carried out easily from a distance and created various savings in both electricity costs and human resources through IoT. In addition, electricity consumption measurements were also done so that electricity savings were easy (Mahmud, Ahmed and Shikder, 2019)(Orsi and Nesmachnow, 2017; Zualkernan et al., 2017).

Many smart devices were able to implement to IoT. Smart device, e.g., sensors and actuators, was able to connect into rasberry pi, ubuntu, and the other operating system. Patru (Pătru et al., 2016) used single entity like Brillo Operating system on an edition board. The use of this operating system through smart home concept was easily adapted to a real house seen on three classes: the first class was smart home applications, the second was smart home technology, and the third class was frameworks to develop and operate applications.

Although IoT brought significant advantages over traditional communication technologies but these implementation were still very rare. One of the solutions was to make a fully automation home which was a costly solution for most of the households (Risteska Stojkoska and Trivodaliev, 2017). The comprehensive approaches to user on the IoT in smart home consisted of five potential factors, three positive motivations, compatibility, connected-ness and control, negative hindrance, and cost that was significant determinant of technology acceptance behavior of the users (Park et al., 2017b). IoT for smart home did not only use to monitor and control the devices at home, but it was also implement the botanical and integrated system with emotional detection with cognitive intelligence of home users (Chen et al., 2017). Moreover, IoT was also able to manage personal data, security, and privacy solutions to protect user (Shouran, Ashari and Kuntoro, 2019). These smart devices were susceptible to attacks due to the lack of sufficient security consideration or poorly management (Nobakht, Sivaraman and Boreli, 2016). Intrusion Detection and Mitigation framework, called IoT-IDM, was able to identify and address potential attacks in smart home environments.

This study concentrated on the accuracy of monitoring and controlling. The accuracy of monitoring and controlling was very important in smart home. If the command was "'turn on" the device, there must be feedback from the controlled device that was really on, If the command was "'turn off" the device, there must be feedback from the controlled device that was really off.

2. METHOD

2.1 Diagram of System

Designing a series of systems was a simplest way to explain how the tool works. Smart home controlled with monitoring and controlling electrical equipment connected to internet using android. It was easier for the writer to analyze how the circuit works as its sensor functions in general. The system circuit was too easier for readers to understand about the designed tool. The diagram of the control system of the smart home remotely was seen below by monitoring sensors current using android and placing sensors and actuators, also called things in the home, to inform measure lamps and air conditioner, on or off condition

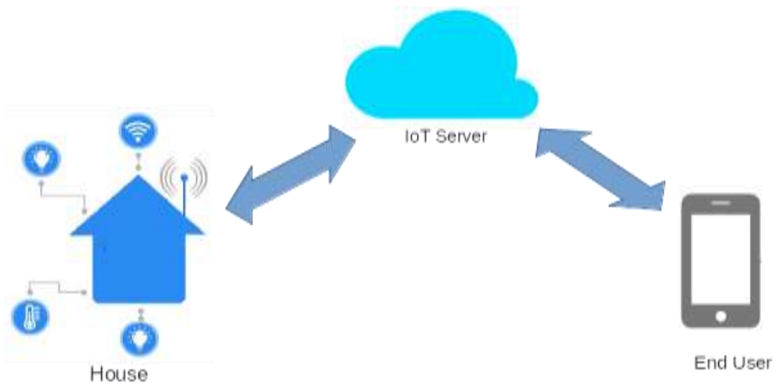


Figure 1. Illustrative diagram

The data from sensors and actuators were sent through a mode of transmission – wired connection from microcontroller/arduino as central procesing unit and raspberry pi. User interface was used to control and get the value of sensors. Raspberry pi was a small single computer with 256 MB RAMs and it was able to handle more tasks between rasberry pi and arduino connected via USB port

Raspberry pi connected to the IoT server use Node.js. Node.js was an open source server environment. It was free and run on many platforms like windows and linux. Install node.js was applied on raspberry terminal by typing :

curl -sL https://deb.nodesource.com/setup_14.x | sudo -E bash -
sudo apt-get install build-essential nodejs
sudo npm install blynk-library -g
sudo npm install onoff -g
add blynk library master in arduino skethc and open scripts folder use raspberry terminal, run file blynk-ser.sh by typing ./blynk-ser.sh.

All sensors and actuators enclosed in to specially design. The sensors was located close to the lamps and fan. Actuators/Relays were used for lamp switches and fan.

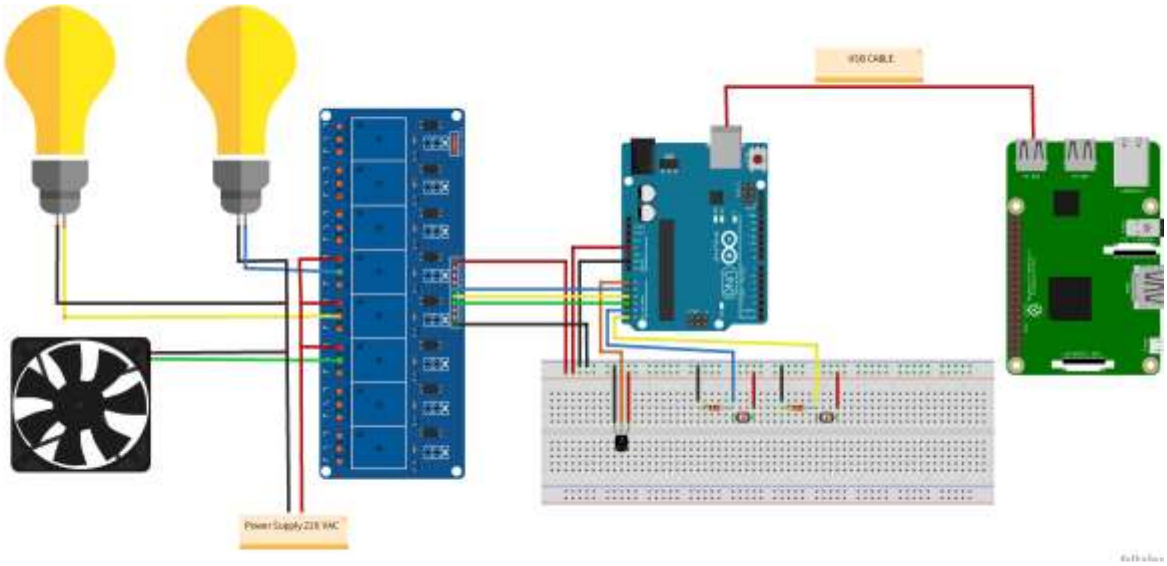


Figure 2. Circuit design sensors and actuators hub

2.2 Principles of System Work

Light Dependent Resistors (LDR) was used. Figure 3 was the picture of the output voltage obtained through voltage division and not converted into the other unit, just volt.

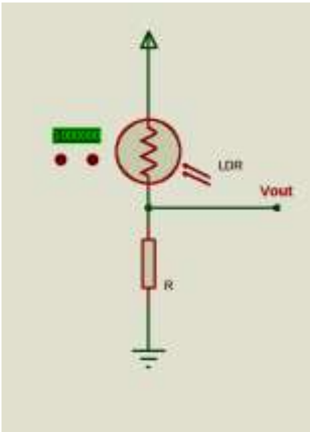


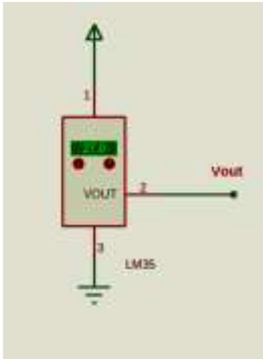
Figure 3. LDR diagram

Value of resistor was 220 ohm , relation LDR resistance was in equation 1

$$Vout = \frac{Vs \times R}{(R_{LDR} + R)} \quad (1)$$

Figure 5 as schematic connection diagram of LM35 temperature sensor. LM35 had linear relationship between output voltage and temperature rise, every 1oC increased by 10 Mv.

ISSN : 2460 – 7223 ©2020



$+10.0\, mV/^{o}C$

Figure 4. LM35 Temperature sensor diagram

Users were able to control and monitor remotely through Blynk app as it was shown in Figure 5. There were three buttons that were used to control the lamps and fan. One terminal was monitoring the lamps and fan were on or off. The time difference between the button and feedback from the sensors to the terminal was seen in the terminal. To get good measurement results, sensor calibration was done at first (Setyawan et al., 2018)

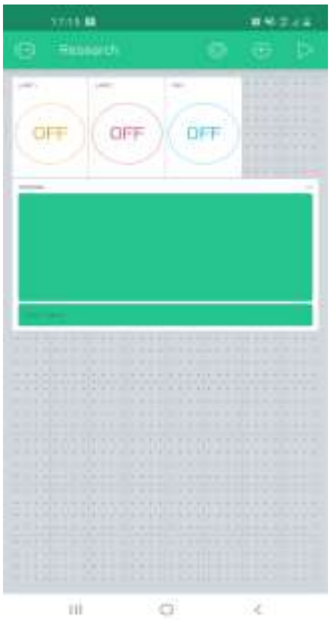


Figure 5. Blynk app

2.3 System Control Algorithm Design

Flowchart of smart home control system with internet feedback regulated the running of the system starting from on system. The senders inform through microcontrollers to android so that the command run.

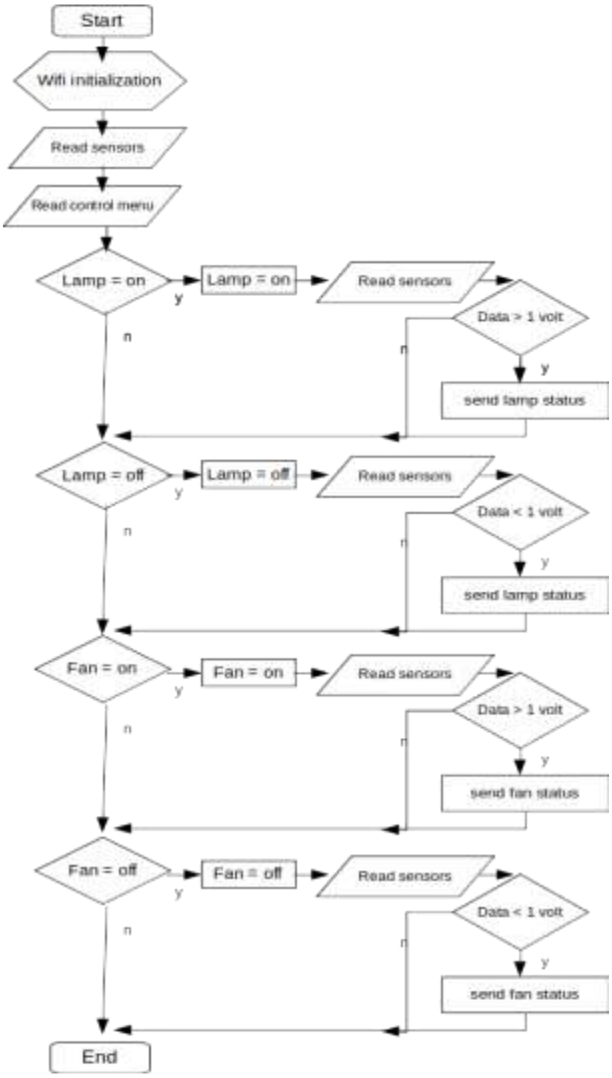


Figure 6. Flowchart of system

3. RESULTS AND DISCUSSION

3.1 Application testing

This test was done to test and identify that the applications had been made and connected. This test was done by sending orders through the SmartHome by pressing the button on through Android that contained commands for turning on or off. In testing this, SmartHome android application provided some instructions to connect with system. The following instructions included:

1. Press the CONNECT button - to connect application with the system.
2. Press the DISCONNECT button - disconnect application connection with the system
3. Press the "Lamp1" button - for turn on the lights.
4. Press the "Lamp1" button again - for turn off the lights
5. Press the "Lamp2" button - for turn on the lights.
6. Press the "Lamp2" button again - for turn off the lights
7. Press the "Fan" button - for turn on the Fan.
8. Press the "Fan" button again - for turn off the Fan.

If the users immediately press the button for turning on or off without pressing the connect button first, then a notification appeared.

3.1 Application testing

To get accuracy of monitoring and controlling smart home electronic equipment with feedback from controlled devices via sensors with on status, the form of a measurement was prepared as it seen below

Table 1. Accuracy of monitoring and controlling

No	Contolling	Time feedback (second)	Monitoring
1	Button Lamp 1 on	4	Lamp 1 on
2	Button Lamp 1 off	4	Lamp 1 off
3	Button Lamp 2 on	4	Lamp 2 on
4	Button Lamp 2 off	4	Lamp 2 off
5	Button fan 1 on	4	Fan on
6	Button fan 1 off	4	Fan off

$$timeaveragefeedback = \frac{(Totalsum of\ All\ Time\ Feedback)}{Number\ of\ Item}$$

$$timeaveragefeedback = \frac{(4+4+4+4+4+4)}{6}$$

$$timeaveragefeedback = 4\ second$$

Each test performed has a Time Feedback of 4 seconds. starting from pressing a button to getting data feedback from the sensor stating that the device being controlled is really on or off

4. CONCLUSIONS

Design of a control system through the internet using the Android system was able to control three electrical equipment e.g., two lams and fans. Testing the system worked properly, command “turn on or off” to electrical equipment was run in just a few seconds and feedback from system to android Status was on or off going was around 4 seconds.

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