

Designing IoT-Based Smarthome System With Chatbot

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Abstract – Smart home system aim to maximize surveillance, monitoring, and security. This system is integrated with telecommunications and control systems from the microcontroller to create the Internet of Things (IoT). Nowadays, home appliances are integrated with the Smart System that connected to the internet. On the other hand, messenger applications now integrated with chat bot with Artificial Intelligence to make user easier to communicate. This trend made a possibility to implement a system where a home appliance can be operated by only using a messenger application. In this research, a Smart home system designed with a client-server system based on Raspberry Pi as microcontroller and Telegram Messenger as interface that perform the control communication. The process separated into three stages: design, implementation, and result. The design consists of designing the server, interface, and Smart Home control system. To test the performance, the Messenger Bot are compared with other direct controller application. The result show that the Telegram Messenger application is suitable and more convinient for being the IoT controller.

Keywords: Internet of Things (IoT); Chat Bot; Smart Home System; Applications

I. INTRODUCTION

In the current era of technological advances, especially smartphones are growth rapidly. This is supported by the increasing of smartphone users that continues to increase every year. The growth of smartphone users also has a big influence on the increasing of internet users in Indonesia. According to survey from the Indonesian Internet Service Providers Association (APJII) from 2019 to Q2 of 2022, the number of Indonesian internet users reached 196.7 million users compared to the number of Indonesia's population at 266.9 million persons (Irawan et al., 2021). This means, the number of the internet users reach 73.7% of total population. The survey data also reveals that the average internet access in Indonesia use smartphone. The statistics are as follow: 160.2 million persons use smartphone. 2.2 million persons use computer, and 67.2 million people use both of the devices.

According to Jamalul Izza, the Chairman of APJII, the increasing in the number of internet users in Indonesia was due to the increasing of fast internet infrastructure with the existence of the Palapa Ring. The digital transformation has become even more massive because of the policy of 'Working from Home' since the Covid-19 pandemic hit Indonesia on 2020. Another factor was driven by APJII programs, such as the Mandiri Internet Village, which supported by around 500 association members (Pertiwi, 2020).

Currently, smartphones are an important thing that cannot be separated from various human activities. In today's society, where the mobility is increasingly high, smartphones have become the personal assistants that act as the primary tool. From purchasing of transportation tickets to help monitor our health, the smartphone become all-

in-one devices that facilitate all the activities. In addition, this increase is also supported by the advancement of the hardware that enable more advanced tasks. The example of the advancement in technologies is shown by the rise of Internet of Things (IoT). Through IoT, the physical devices in our surroundings are now able to communicate via internet. As a result, the IoT devices can now be integrated to our smartphones more easily to carry the task of controlling electronic devices such as fans, lights, doors, cameras, and many more.

Another advancement in technology is shown by the rise of chatbots, the integration between Natural Language Processing (NLP) and messenger applications. The example of chatbots varies from auto-reply messages in WhatsApp to bots that mimic human interaction like shown in Line or Telegram. This chatbot can also perform series of tasks, such as relaying messages to another user, do simple requests to some website, match random users, or create a schedule for the user. With these technologies, it is possible to implement a system where a home electronic device can be operated easily only by using a chat application.

Some researchers proposed the design of a system to create a controller via messenger application. Purnawan & Rosita create a module to communicate by using ESP8266 connected to Telegram application (Purnawan & Rosita, 2019). The research shows that the application is very suitable as remote control and monitoring for the home electronic device. Another research conducted by Siswanto (Siswanto et al., 2020), create a design by using NodeMCU module as the microcontroller and sending the notifications to Telegram application with the goal to increase the efficiency and security value of home.

Other than modules mentioned before, there are several other modules such as Raspberry Pi, Arduino, ESP32, NodeMCU Lua V3, and many more. For this experiment, Raspberry Pi module is chosen because the implementation is easier rather than other modules. Another factor is because Raspberry Pi can be considered as mini-PC, therefore it can be programmed more complex project such as databases, artificial intelligence, or image processing than any other modules.

Based on the research above and the problem mentioned before, this paper focuses on creating a Telegram chatbot to operate various objects at home. The Raspberry Pi module will be used as the microcontroller for monitoring and controlling system. Then, the research was conducted on several home appliances, namely lights, fans, and doors for the experiment.

II. METHODS

2.1 Literature Review

A smart home is a reflection of a technology-based home where the embedded technology appliances are being managed and controlled automatically and remotely from anywhere and anytime. The settings are relying on an internet connection and a smartphone for the remote controller. A smart home system then allows the residents to control various functions such as controlling the temperature, power, and access the home security functions.

Several researches are being conducted to create a controller for the smart home system. Researches from Purnawan & Rosita reveal that by designing a control system by using Telegram application, it was very suitable for remote control and monitoring the Smart Home (Purnawan & Rosita, 2019). The research conducted by measuring the distance from 1.7 km to 151 km in different areas to see the delay. The result shows average delay of 20.66 seconds. Another research conducted by Oktari, by using ESP8266 Wi-Fi module as the microcontroller and sensor control that being monitored by using Telegram application to send and receive the command (Oktari et al., 2020). The result shows that the Telegram application can be used as a remote control of the smart home system. Rukmana created an automatic control system using ESP32 module. The research aims to design a smart home control based on Telegram application (Rukmana et al., 2020). Siswanto (Siswanto et al., 2020) proposed a design by using NodeMCU as the microcontroller for the security system.

Another more advanced research conducted by Findawati (Findawati et al., 2020), proposed a design by using 2 (two) NodeMCU Lua V3 module as microcontrollers and sensors, namely fire sensor, motion sensor, temperature and humidity sensor. This design also utilizes the 4 (four) channel relay module which functions as a switch to turn off or turn on the home appliance. This research also used Telegram as the interface controller on the smartphone.

From this literature review that being explained above, it is possible to build a smart home IoT devices using Telegram application as the controller.

2.2 Proposed Method

2.2.1 System Architecture

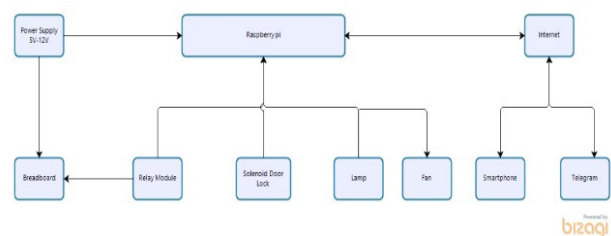


Figure 1. Proposed system architecture

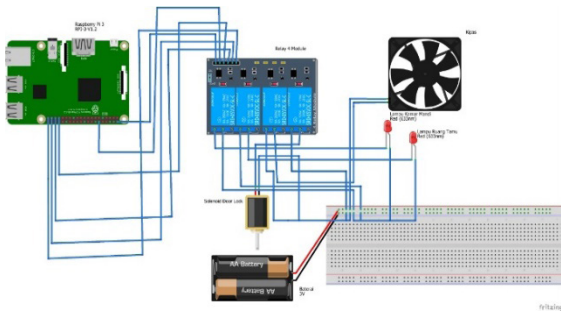


Figure 2. Schematic for the Raspberry Pi microcontroller

The proposed system showed in Figure 1 describe the design of the chatbot controller system. The Raspberry Pi powered by power supply will be connected to the internet, so that it can be controlled with Telegram application. The module connected to Raspberry Pi as follow: Relay Module, Solenoid Door Lock, LED Lamp, and PC Fan. The details of the schemathic showed in Figure 2.

2.2.2 Equipment Used



Figure 3. Raspberry Pi 3 for the microcontroller



Figure 4. Breadboard

The proposed design used Raspberry Pi (Figure 3) as the microcontroller. Raspberry Pi is a mini-module devices with 32 GB memory. This module has a micro-USB for a PC connection, external antenna, USB CP2104 to IC UART, and Wi-Fi with 802.11b/g/n | 2.4GHz. The module consumes approximately 700mA of the power. The programming language supported by this module are Python, C, C++, Ruby, etc. In this research, the Python language is used. Then the module is placed on Breadboard (Figure 4) that used to quickly build and test circuits before finalized in any actual circuit design.

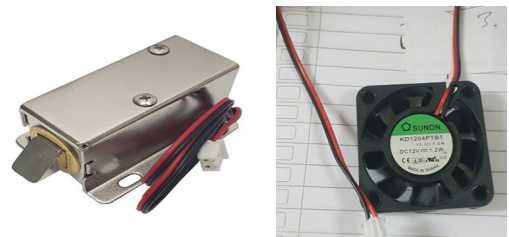


Figure 5. The devices module: Solenoid Door Lock (left) and PC Fan (right)

For the home appliance devices, Solenoid door lock, LED lamp and PC Fan (Figure 5) used to simulate the door, light, and fan in smart home system. Solenoid door lock is an electronic device whose working principle uses electromagnetics. Solenoid door used 12 volts to open and lock the door. All this module then connected by Jumper Wire (Figure 6) to the breadboard. To passed the control instruction from the app to the device module, Relay Module (Figure 6) is used. Relay module will relay the information or command from the Raspberry Pi to the respective devices by utilizing electric power.

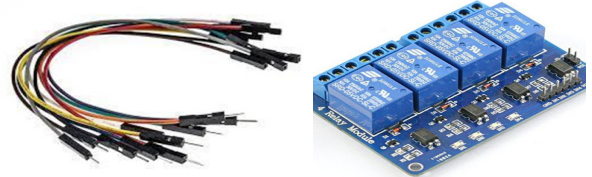


Figure 6. Jumper Wire (left) and Relay Module (right)

2.3 Python

Python is an open-source programming language that usually be used for creating an application or artificial intelligence model (Mark Lutz, 2013). Python is used by at least hundreds of thousands of developers worldwide in fields such as Internet scripting, systems programming, user interfaces, product customization, numeric programming, and more. Python is generally considered to be among the four or five most widely used programming languages in the world today. Python in system development in this study functions as a low-level language that can communicate with hardware and modules in the system design.

III. RESULTS AND DISCUSSION

After building the prototype (Figure 7) of the design, a series of testing process are being conducted. The test is conduct by sending the command to turn on and turn off the devices from the Telegram application to the cloud server to check whether the Raspberry Pi module is connected to internet or not. The application shows the status the devices and list of command that can be passed to the respective devices.

For the connection, first the token for the Telegram application must be obtain for the software development. After getting the token is obtain, the token is being entered to the Raspberry Pi so that the module can communicate to the application.

All the module being tested (Figure 8) by pressing the button of command in Telegram application. The

respective test series are being tested 10 time each to ensure all the command work properly. The following test series are shown in Table 1.

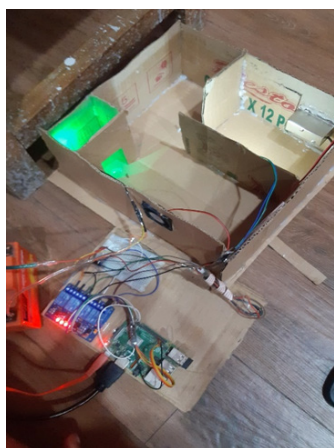


Figure 7. Final Result Prototype



Figure 8. Test light on

Table 1. Series of input for testing process

No	Telegram App Command	Device Response	Feedback Telegram App
1	Turn on all	All devices on	Turned on all open
2	Turn off all	All devices off	Turned off all closed
3	Turn on door	Solenoid door lock open	Turned on the door is open
4	Turn off the door	Solenoid door lock locked	Turned off closed door
5	Turn on fan	Fan On	Turned on fan open
6	Turn off fan	Fan Off	Turned off closed fan
7	Turn on lpkmrmandi	Light 1 On	Turned on lpkmrmandi open
8	Turn off lpkmrmandi	Light 1 Off	Turned off lpkmrmandi closed
9	Turn on lptatamu	Light 2 On	Turned on your lptamu is open
10	Turn off lptamu	Light 2 Off	Turned off your lptamu is closed

While testing were conducted, the speed of command to devices time was also being recorded to be compared with other controller application. The result in Table 2 show that input via App is more faster by 0.33 second than via

Telegram, but not convenient since the app cannot controll all the devices at once.

Table 2. Comparison of average command input speed to the smart home appliance

Input via Telegram	Input via App
0.47 seconds	0.14 seconds

The test also conduct by measuring a signal strength indicator received by the devices. The test ranging from a distance of 1 meter to 10 meters. The test also conduct in outdoor (Table 3) and indoor (Table 4) area.

Table 3. Outdoor RSSI measurement

No	Distance	Shipping Quantity	Received data	RSSI (dBm)	Information
1	1 m	10x	10	64	Data Sent
2	3 m	10x	10	67	Data Sent
3	5 m	10x	10	78	Data Sent
4	7 m	10x	10	88	Data Sent
5	8 m	10x	10	-	Data not sent
6	10 m	10x	10	-	Data not sent

Table 4. Indoor RSSI measurement

No	Distance	Shipping Quantity	Received data	RSSI (dBm)	Information
1	1 m	10x	10	28	Data Sent
2	3 m	10x	10	38	Data Sent
3	5 m	10x	10	41	Data Sent
4	7 m	10x	10	45	Data Sent
5	8 m	10x	10	47	Data Sent
6	10 m	10x	10	60	Data Sent

IV. CONCLUSION

This research aims to create design of smart home system controller by using Raspberry Pi module. The connected home appliance then will be controlled from Telegram application. The result show that all the devices can be operated easily via chatbot system in Telegram application. The delay also quite small by only 0.47 seconds. Therefore, this solution can be an option for the home appliance controller by using Telegram application.

There is still room for improvements in this research. In the future, the security function will be added to improve the security of the controller. The fire sensor and gas leak sensor could be added to create a notification from the chatbot in the Telegram application.

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