Internet of things for automatic garage doors using ESP8266 module

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Abstract. The purpose of this study is to design garbage door gates by utilizing the technology of the Internet of Things (IoT) by using the control of microcontroller. The methodology used in this research is the design of prototype by following the stages and procedures of Research and Development. Making the control system is done through three stages, namely: software design, hardware manufacture, and integration of software and hardware. The software created includes a motion control program through the control of the microcontroller ESP8266 module connected to Arduino Nodemcu. ESP8266 will get orders from smartphones that have been installed android garage door controllers. The design results show that the design of Automatic Garage Doors designed miniature can be used effectively to perform the task up to a distance of ± 100s.

1. Introduction
Humans are always trying to create something that can ease their activities by utilizing technology. Technological devices are designed to enhance the quality of human life [1], because of technology makes everything done easier. These results encourage the development of technology that has generated many tools as tools to facilitate human activities, even replace the role of humans in a particular function [2].

The existence of technology that developed today makes people want to do things easily, one of which is the utilization of IoT (Internet of Things). IoT is a concept that aims to expand the benefits of continuously connected internet connectivity [3].

Even of opening and closing the garage door which is generally still done manually. One of the problems that happens when the owner of the house lazy to get out of the car to open or close the garage door it can be done by controlling using Android smartphone via Wi-fi network. Therefore we need a control device that can control garage door wherever and whenever desired. Wi-fi is short for wireless fidelity is a wireless data transmission medium that can be used to communicate or transfer programs and data with very fast capabilities.

The purpose of this research is to design a control tool that uses android smartphone as input to open and close garage door by utilizing Wi-fi network for its control instruction so that it can be done anywhere as long as it is within range of Wi-fi signal network and arduino nodemcu microcontroller ESP8266 as its processor and DC motor as the drive of the garage door in order to open and close automatically.
2. Methodology
The design methodology in this research is Research and Development (R & D) method. R & D method is the stage of product design that is done to test the effectiveness of the product [4]. The design stage uses modification Borg and Gall model consisting of stages: research and information collecting, planning, preliminary form of product development, preliminary field testing, main product revision, operational field testing, and final product revision [5].

The manufacture of control systems is done through three stages of system flowchart design, hardware manufacture, and integration (integration) software and hardware.

3. Result and discussion

3.1. IoT Principle as garage door rotator
Garage is a house or part of the house in the form of a closed room commonly used to store vehicles such as cars, and the other and the garage door is a door located in the front position of a building, this door serves as a liaison between buildings and roads. In addition as a liaison door garage also serves as a safety. The door is used for both human and vehicle exits [6].

There are many benefits are gained from IoT, work done to be fast, easy, and efficient [7]. IoT is a concept where an object has the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction [8]. IoT has evolved from the convergence of wireless technologies, micro-electro mechanical systems (MEMS), and the Internet [9].

Furthermore, to order the garage door movement using Arduino Microcontroller. Arduino microcontroller is a micro-sized computer in an IC chip (integrated circuit) consisting of processor, memory, and programmable interface. So called microcomputer because in IC or microcontroller chip consist of CPU, memory, and I / O which can be controlled by programming. I / O is also commonly referred to as GPIO (General Purpose Input Output Pins) which means: pins that can be programmed as input or output as needed [10].

Arduino Uno is a series developed from ATmega328 based microcontroller. The Arduino Uno has 14 feet of digital input / output, of which 6 feet of digital can be used as a PWM (Pulse Width Modulation) signal. PWM signal serves to regulate the motor rotation speed. The Arduino Uno has a 6 foot analog input, a crystal oscillator with a clock speed of 16 MHz, a USB connection, an electrical connector, an ICSP header foot, and a reset button that serves to repeat the program [11].

IoT utilization procedure programming is used by using IDE software. IDE is a software that has been prepared by arduino for designers to perform various processes related to arduino programming. This software is available for free and can be obtained directly on the official Arduino page. The IDE also supports various popular operating systems today such as Windows, Mac, and Linux [12].

These designers, as control tools held by users, are used by Android-based Smartphones. Android is an operating system that is generally developed for smart phone devices [13]. Andorid excess in between have features that allow people to operate the command on the smart phone [14].

DC motor is an electric motor that requires a direct current voltage supply on the field coil to be converted into mechanical energy motion. The field coil on a DC motor is called the stator (the non-rotating part) and the anchor coil is called the rotor (the rotating part). Direct current motor, as the name suggests, uses an indirect current / direct-unidirectional. The DC motor has an advantage in smoothness of speed change, ease of control, and rapid dynamic response to changes in load torque [15].

3.2. Devices architecture
This research designs miniature of garage controller which in its processing is controlled by Arduino Nodemcu microcontroller. Connection controller that is in the form of ESP8266 module which connected to Arduino Nodemcu. ESP8266 will get orders from smartphones that have been installed android garage door controllers. In the garage drive required stepper motor is connected to the Arduino Nodemcu module. To limit move the stepper motor is installed two limiter switch.
3.3. Software modeling
This study designs a garage door control system that is controlled through android-based smartphone. In order for smartphone to give command/insert to Arduino microcontroller, must be made application that can run command in the form of numbers/letters transferred through internet. In making this android based application using App Inventor. App Inventor is a native open-source web application provided by Google and is now managed by MIT. In development phase with App Inventor explain in following steps:

- Install Java applications on the computer.
- Create an Android app design with the existing designer components in App Inventor.
- Create a command in the block editor by setting the selected components of the designer component.

This use case diagram explains the interaction of actors and systems in IoT application of Automatic Garage Door System.

![Devices architecture](image)

**Figure 1. Devices architecture**

![Use-case diagram](image)

**Figure 2. Use-case diagram.**

Activity diagram describes the activity of the IoT system of Automatic Garage Door System.
3.4. User interface

3.4.1. Login. The login page is required to enter the appropriate password. If the password is incorrectly fed will be prompted to input the correct password. Usefulness login here is for the security when the phone is being used by children or people who are not known.
3.4.2. **Main form.** This main page there are several buttons including buttons to open the door and the button to close the door. The IP Address display is the IP Address Wifi in Arduino. For the picture of the lamp to know the door is open or closed in the presence of one of the lights on.

![Main form](image)

**Figure 5.** Main form.

3.4.3. **Change password.** On this page there are several columns to fill in the old password, new password and confirmation, then button to save. The column must be filled in correctly in order to change the password.

![Password form](image)

**Figure 6.** Password form.

3.5. **Testing**

This work tested in order to find out whether Motor Dc work well. Table 1, presents the test results done by input in Motor Dc.

| Input 1 | Input 2 | Rotation  |
|---------|---------|-----------|
| 1       | 0       | Rotate right |
| 0       | 1       | Rotate left |
| 0       | 0       | No rotate  |
| 1       | 1       | No rotate  |
The performance of this model may be discovered by test how far wifi ESP8266 can be connected and able to bring commands from smartphone to microcontroller which will control the miniature gate (table 2). At the same time, the measurement of execution time is done by using stopwatch.

**Table 2. Testing miniature garage door.**

| No | Distance (meters) | Door Condition | Executed Time (seconds) |
|----|-------------------|----------------|-------------------------|
|    |                   | Open           | Close                   |
| 1  | 5                 | Receive order  | Receive order           | 1                       |
| 2  | 10                | Receive order  | Receive order           | 1                       |
| 3  | 20                | Receive order  | Receive order           | 1                       |
| 4  | 30                | Receive order  | Receive order           | 1                       |
| 5  | 40                | Receive order  | Receive order           | 1                       |
| 6  | 50                | Receive order  | Receive order           | 1                       |
| 7  | 60                | Receive order  | Receive order           | 1                       |
| 8  | 70                | Receive order  | Receive order           | 1                       |
| 9  | 80                | Receive order  | Receive order           | 3                       |
| 10 | 90                | Receive order  | Receive order           | 3                       |
| 11 | 100               | Loss connection| Loss connection         | Loss connection         |

Table 3 presents the results of the program listing testing that serves to determine the performance of the minus of the gate controller.

**Table 3. Summary of listing test.**

| Input Button | Output Motor Steper | Output Limiter 1 | Output Limiter 2 | Result Door |
|--------------|---------------------|------------------|------------------|-------------|
| Open         | Clockwise           | Close            | Open             | Opened      |
| Close        | Counter clockwise   | Close            | Open             | Closed      |

4. Conclusion

The design of the software is made by analyzing the need for the application to be created. Once the software is completed user can install the application on android smartphone and connected to miniature hardware garage door. The design of hardware made with the need for miniature garage door using tools that are already available and connected to the android application. The benefits of this application can be accessed by users in opening the garage door. Connections used over a maximum Wi-Fi network can be accessed ± 100. The performance of the door can be done by connecting Wi-fi on the smartphone with Wi-fi on the hardware, after which the user can run the application via smartphone.

References

[1] Ramdhani M A, Aulawi H, Ikhwana A and Mauluddin Y 2017 Model of green technology adaptation in small and medium-sized tannery industry *Journal of Engineering and Applied Sciences* vol 12 pp 954–62
[2] Setiawan S 2014 *Miniatur Pengendali Pintu Gerbang Menggunakan Smartphone Via Bluetooth Berbasis Arduino Uno* (Universitas Mercu Buana)
[3] Hidayatullah N A and Juliando D E 2017 Desain dan Aplikasi Internet of Thing (IoT) untuk Smart Grid Power Sistem *VOLT J. Ilm. Pendidik. Tek. Elektro* 2 35–44
[4] Sugiyono 2011 *Metode Penelitian Pendidikan: Pendekatan Kuantitatif Kualitatif, dan R&D* (Bandung: Alfabetha)
[5] Borg W R and Gall M D 1983 *Educational Research: An Introduction* (New York: Longman)
[6] Rizky M 2016 *Pengontrolan Garasi Secara Otomatis* (Padang)
[7] Intranasu 2016 *Cara Kerja dan Manfaat IoT*
[8] Chahid Y, Benabdellah M and Azizi A 2017 *Internet of Things Security 2017 International Conference on Wireless Technologies, Embedded and Intelligent Systems, WITS 2017*
[9] Fajrin N, Taufik I, Ismail N, Kamelia L and Ramdhani M A 2018 On the Design of Watering and Lighting Control Systems for Chrysanthemum Cultivation in Greenhouse Based on Internet of Things IOP Conf. Ser. Mater. Sci. Eng. 288 12105

[10] Faroqi A, Fitriadi A and Adiningsih N U 2017 Sistem Kendali Pintu Rumah Menggunakan SMS Gateway Berbasis Arduino Uno dan Sensor Ultrasonik TELKA (Jurnal Telekomun. Elektron. Komputasi dan Kontrol 3 131–43

[11] Kamelia L, Ramdhani M A, Faroqi A and Rifadiapriyana V 2018 Implementation of Automation System for Humidity Monitoring and Irrigation System IOP Conference Series: Materials Science and Engineering vol 288(IOP Publishing)p 12092

[12] Setiawan I, Andjarwirawan J and Handojo A 2013 Aplikasi Makassar Tourism Pada Kota Makassar Berbasis Android INFRA 1 156–61

[13] Irwansyah F S, Yusuf Y M, Farida I and Ramdhani M A 2018 Augmented Reality (AR) Technology on the Android Operating System in Chemistry Learning IOP Conf. Ser. Mater. Sci. Eng. 288 12068

[14] Sari, Irwansyah F S, Farida I and Ramdhani M A 2017 Using Android-Based Educational Game for Learning Colloid Material Using Android-Based Educational Game for Learning Colloid Material J. Phys. Conf. Ser. 895 12012

[15] Puspita R M, Arini and Masrurah S U 2016 Pengembangan Aplikasi Penjadwalan Kegiatan Pelatihan Teknologi Informasi dan Komunikasi dengan Algoritma Genetika: Studi Kasus BPRTIK JOIN (Jurnal Online Inform. 1 76–81