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Monitoring and control of home garage access using IoT-based smartphones

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ABSTRACT

Technological developments are increasing to help facilitate human work, including developing control of equipment using smartphones. The system built in this study utilizes the Internet of Things (IoT) and the blynk application as a controller for the garage door opening and closing system using a smartphone to make it easier for owners to open and close the garage door without having to get out of the vehicle and do it manually. The system is built using the NodeMCU ESP8266 microcontroller which is connected to the blynk application to control the opening and closing of the garage door. Ultrasonic sensors are used to monitor the condition of the vehicles in the garage, while servo motors are used to open and close the garage door. This home garage access prototype using an IoT-based smartphone has succeeded in being able to open and close the garage door using the blynk application with a duration of 10 seconds when opening or closing the garage without having to do it manually. In this system, the user can monitor the condition of the garage for the presence or absence of vehicles by using the application.

1. Introduction

The development of the world of technology has led to an increase in the need for tools that can assist all human activities. In everyday life, humans have been assisted by various tools to facilitate work and needs that have many positive benefits. The need for facilities and infrastructure is growing so that it demands the use of technology that can help humans, including in the framework of security, efficiency and effectiveness [1].

Currently, many people use a remote control to control the garage door to open the garage door when they want to enter or remove the vehicle [2]. As development it is possible to build a system that can be used for remote control that is able to control DC motors [3], so that garages and house gates can open and close. Currently mobile phones are developing very quickly and it is possible to be integrated as a communication medium in a garage door control system [4].

With the development of the Internet of Things (IoT) [5], the internet can be used to support control systems for gates and garage doors, including using the internet which connects the control system to a cellphone [6]. IoT allows users to manage and optimize electronics and electrical equipment using the internet. This makes it easier between computers and electronic equipment to exchange information so that internet users are increasing with various internet facilities and services.

Based on research by Ben Candra S [7], the challenge of the Housing Complex Portal Prototype with the RFID System resulted in limiting people's access to entry by using an RFID card which functions to access the latch located at the entrance post in a housing complex.

Based on research by Febriyanto [8], regarding the Design of an Automatic Train Doorstop Using the Atmega16 Microcontroller, it produces a message reminder controller that there is a train that will pass by using a buzzer as a sensor source responding to the presence of a train that will pass through the doorstop.

Based on research by Bagas Lantip Trengginas [9], regarding the Design and Build of an IoT-Based Automatic Parking System on the UPB Campus, it produces a web-based parking information system to display vehicle activity data and determine parking locations. If the Chancellor and Lecturer attach the membership card, the display on the web page and the LCD will display "Empty Rectorate Front Parking". If Students and Guests attach membership cards and e-KTPs, the display on the web page and the LCD will display "Empty Mosque Front Parking". If the capacity of the parking area in front of the rectorate exceeds 10 vehicles, the web will display "Front of the rectorate is full". If the capacity of the parking area in front of the mosque exceeds 10 vehicles, the web will display "Front of the Mosque Full".

2. Method

In this research, we will design an automatic doorstop control system in an IoT-based garage. Control is used to regulate the opening and closing of the garage door at home for the home owner's vehicle so that it does not take time to open and close the garage door. The existence of an automatic doorstop can regulate the process of opening and closing the garage door more efficiently, assisted by a communication system that can open the garage by accessing it using a smartphone [10] when approaching the house and when closing the garage door, on the other hand, it can be accessed by pressing the close button on smartphone application.

By utilizing the HCSR04 sensor [11] or the ultrasonic sensor module which is usually used for distance measuring devices. In the HCSR04 there is a pair of ultrasonic transducers, one of which functions as a transmitter whose job is to convert electrical signals into ultrasonic sound wave pulse signals with a frequency of 40KHz and the other functions as a receiver [12] whose job is to receive ultrasonic sound wave signals.

This system is operated automatically and manually [13]. For an automated system, this tool is equipped with a cellular communication system and controller via a smartphone connected via an internet connection. NodeMCU ESP8266 [14] will receive commands and display via I2C [15], LCD [16], LED [17], and smartphone. If the condition of the garage gate is open or closed, it will provide a notification on the smartphone via the Blynk application [18].

In a manual system, when the load in the form of a garage door and gate is closed, through this application on a smartphone you can monitor the condition of the gate and garage door again and take action to activate and deactivate it manually.

With this the author creates a prototype tool that can carry out work simulations on monitoring and controlling access to home garages using an IOT-based smartphone, by utilizing several components which include using a servo motor [19] as a driver for opening and closing garage doors and utilizing WiFi [20], as an interconnection between Blynk tools and applications.

2.1. Research Tools and Materials

In this study there were several tools and materials used to support the experiments so that the tools could work according to the author's wishes, the tools and materials used can be seen in Table 1. The hardware has been arranged according to the build frame design. The framework for this system has a display as shown in Figure 1. In Figure 1. it can be seen that the system has two core parts, namely the open door garage and the closed door garage. This prototype has dimensions as described in Table 2.

Table 1. Tools and materials

Tools	Materials
PC or laptop	WiFi ESP8266 Module
Arduino Software	HCSR-04 Sensors
Blynk Software	Servo Motors
	PCB Board
	Step Down Travo
	LCD (Liquid crystal display)

Fig. 1. Automatic door latch control system

Table 2. Prototype dimensions

Explanation	Dimension (cm)
Home container	15x12x7
Garage container	7x15x5

2.2. System Design

This study designs a system that is used to determine a clear path to provide an overview of the form of the system to be made, so there will be a system plan that is initiated in advance what the design system will be made of. Therefore, in order to facilitate reading or understanding of this system, a block diagram can be made in Fig. 2.

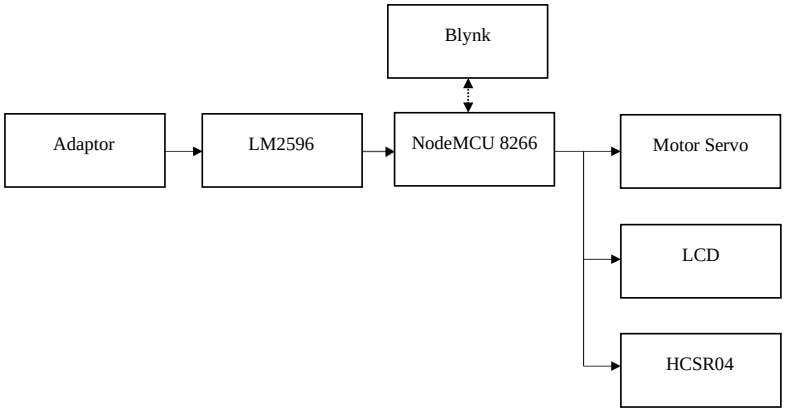

Fig. 2. Block Charts

In designing this hardware, the type of microcontroller used in this system is NodeMCU ESP8266. The hardware design consists of designing the minimum system circuit, designing the NodeMCU ESP8266, designing the Liquid Crystal Display (LCD) circuit, designing the HCSR-04, and designing the servo motor. After that, you will get the whole set of tools. The whole series of tools can be seen in Fig. 3.

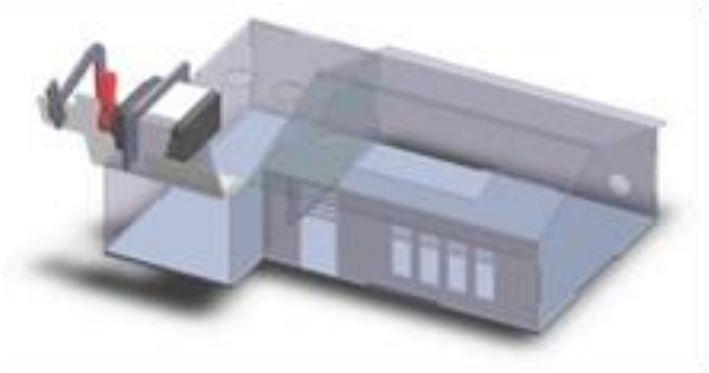

Fig. 3. 3D Design

2.3. Algorithm

This system is an IoT system that is connected to wifi first. Wifi has an internet connection connecting this system with Blynk as a control and monitoring application. MCU nodes control sensors and servo motors. As described in Fig. 4, the garage door unscrewing system. The servo motor moves to open and close the garage door within 10 seconds. After the servo motor stops moving, the ultrasonic sensor detects conditions inside the garage. Furthermore, the results of conditions in the garage are displayed on the LCD or Blynk via the internet.

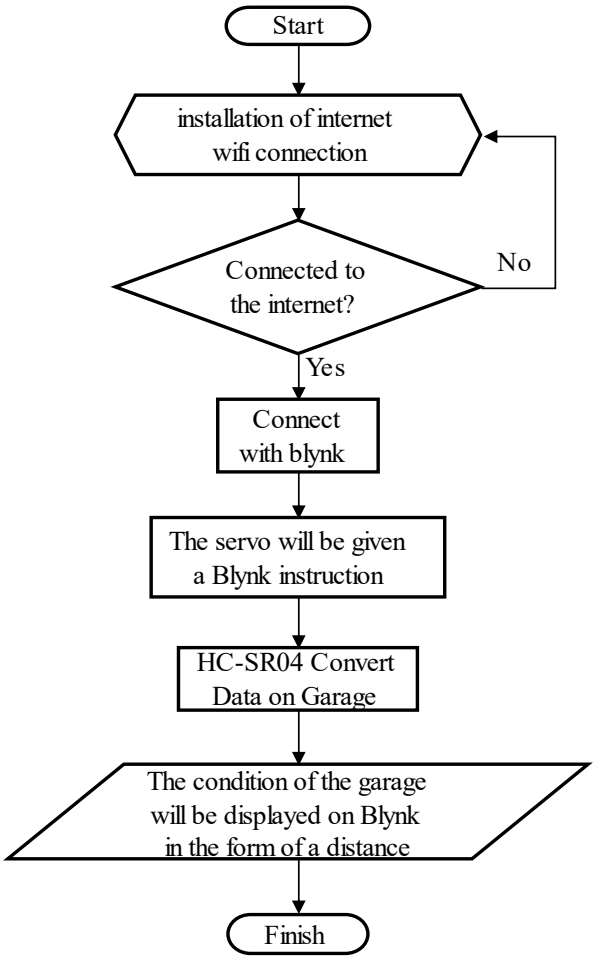

Fig. 4. Flowchart

3. Results and Discussion

The existence of an automatic doorstop can regulate the process of opening and closing the garage door more efficiently with the help of a communication system that can open the garage by accessing it using a smartphone when approaching the house and when closing the garage door otherwise it can be accessed by pressing the close button on the smartphone application.

Testing this sensor will do some value testing. The hardware has been arranged according to the building frame design.

3.1. Blynk Testing

Testing Tests on the Blynk application are carried out by testing the tools on Blynk directly to the system. Blynk for garage doors has a display like Fig. 5. Tools in Blynk have their respective functions and descriptions as described in Table 3.

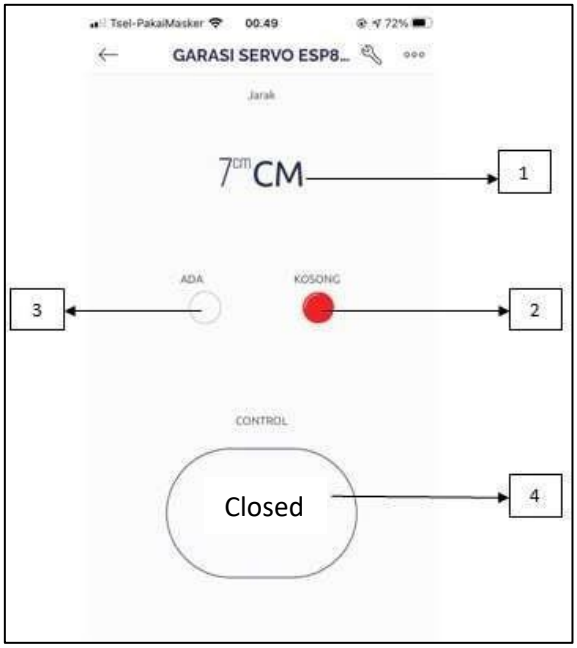

Fig. 5. Blynk view

Table 3. Blynk test

No	Explanation	Function
1	Distance	Shows the vehicle distance
2	LED 1	Shows Identification of empty vehicles
3	LED 2	Shows vehicle identification exists
4	Button	To open and close the garage door

3.2. HCSR-04 testing

HCSR-04 sensor testing was carried out to determine the success of the HCSR-04 sensor which will be used in the prototype. In this test we tested the sensor by getting the results in the first experiment we tested the HCSR-04 sensor without an object in front of the sensor reading 4 cm, the second experiment the sensor read the vehicle at a distance of 3 cm, the third experiment got the sensor readings 3 cm in the presence of a vehicle, and the fourth experiment got a sensor reading of 4 cm in the absence of a vehicle.

Table 4. HCSR-04 test results

No	Condition	HCSR04	Car
1	Closed	3cm	There is a vehicle
2	Opened	3cm	There is a vehicle
3	Closed	4cm	Empty vehicle
4	Opened	4cm	Empty vehicle

3.3. Servo Motor Testing

At this stage of testing the servo motor, the servo test is carried out by going through Blynk. The servo opens and closes the valve for 10 seconds, after which the servo will close the garage door again with the results shown in Table 5.

Table 5. Servo test results

No	Mode	State of Servos	Duration	Explanation
1	Open	14:15:46 Close 14:15:58 Open	12 Second	Opened successfully
2	Close	14:16:00 Open 14:16:10 Close	10 Second	Successfully closed
3	Open	14:16:12 Close 14:16:23 Open	11 Second	Opened successfully
4	Close	14:16:25 Open 14:16:35 Close	10 Second	Successfully closed
5	Open	14:16:37 Close 14:16:47 Open	10 Second	Opened successfully
6	Close	14:16:50 Open 14:17:00 Close	10 Second	Successfully closed
7	Open	14:17:02 Close 14:17:13 Open	11 Second	Opened successfully
8	Close	14:17:15 Open 14:17:25 Close	10 Second	Successfully closed
9	Open	14:17:28 Close 14:17:38 Open	10 Second	Opened successfully
10	Close	14:17:40 Open 14:15:50 Close	10 Second	Successfully closed

Testing the servo open and close experiment was carried out to avoid problems when opening and closing the garage door, in the experiment above there was a time difference when the servo opened or closed due to lag constraints on the Blynk sarver.

At the testing stage of the system, the results of testing the entire system were carried out in real time using toy cars that were included in the prototype of the house and the garage. The car was put into the garage. The experiments were carried out sequentially based on the time of data collection

Testing on the whole system in opening and closing the garage door. The first experiment was carried out from the closed gate condition, the car was there until the gate was closed, the car was empty. The experimental results of the entire system automatically can be seen in Table 6.

Table 6. Overall system results

No	Servo time	Servo Condition	Garage description	
			Distance	Car condition
1	10	Closed Condition	3 cm	There are Vehicles
2	10	Open Condition	3 cm	There are Vehicles
3	10	Closed Condition	4 cm	Empty Vehicle
4	10	Open Condition	4 cm	Empty Vehicle

4. Conclusion

Based on the research and the results of monitoring and controlling access to the garage of the house using an IoT-based smartphone, it can be concluded that this research has been successfully designed and works according to the research objectives, namely being able to control the opening and closing of the garage door through the control system on ESP8266 and can control it using the Blynk application.

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