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Bluetooth Low Energy (BLE) Based Power Window System

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Abstract. In driving the safety factor, comfort, and convenience become things to note. This study discusses the control of window power using Bluetooth low energy (BLE) and applications on Android. Many of us experience anxiety and discomfort when we forget to close our window or enter our car in the hot air. IOT system can be applied to solve this problem by controlling the window power. This research makes it easy for us either to open or to close car windows from around 10 to 30 meters separated from the vehicle through Android smartphone. With this approach, the user can open or close the car window.

1. Introduction
The development of increasingly sophisticated communication technology. Currently with Bluetooth feature we can communicate between gadgets. By utilizing this feature we can use as a controller tool. No exception in terms of setting the Power Window on the car.

At this time Power Window control is still by pressing the button by the rider. This manual way sometimes creates problems when the car keys lag inside. We have to force open the keyhole or retrieve the backup key.

Much research has been done on controlling the power windows, both national and international. As research by Meydianto from Yogyakarta State University. Then Aditya et al from Narotama University Surabaya and also Binglin Li and Quan Tao from University of Technology, China. From several previous studies many have managed to control this power window. These studies mostly use Arduino as a microcontroller. In this project ESP32 is used as a microcontroller as well as data communication using Bluetooth.

With the current technology is very possible for us to make use of Power Window automation, so it can be remotely controlled by using Android. So if something happens, like a key lags in us there is no need for confusion to solve the problem.

Based on the problems and review of the above research, this research makes an easy and fast power window controller tool used. This tool uses Android / Smartphone, ESP32 as a Bluetooth microcontroller and communication.

2. Methods

2.1. System power window
Power window system is a series of electrical body that serves to open and close the door glass by using a switch, where the power window switch is mounted on the inside of the door. When the power window switch is pressed it will rotate the motor power window and this rotation will be changed by the regulator
into up and down motion to close or open the door glass. How the power window works. The lifting mechanism (regulator power window) is the most important component of the power window system. A small electric motor attached to the regulator by using the gear ratio that provides enough rotary power to lift the car window glass, while keeping the window pane capable of rising / falling smoothly.

2.2. Component
The components used in making this project are as follows:

ESP32 is a single 2.4 GHz Wi-Fi chip and Bluetooth combo chip designed with ultra low-power TSMC 40 nm technology. It is designed and optimized for best power performance, performance, robustness, flexibility, features and RF reliability, for a variety of applications, and different power profiles. ESP32 is designed for mobile applications, wearable electronics, and the Internet of Things (IoT). It has many advanced low-power chip features, including good clock resolution gating, power mode, and dynamic power scaling [1].

![ESP32](image1.png)

**Figure 1.** ESP32.

Motor power window is a motor drive regulator rotates clockwise or reverse direction moves the window regulator to be converted into up and down motion. The type of motor used in the power window system is a DC motor. Electric motors use electrical energy and magnetic energy to produce mechanical energy. Operation of the motor depends on the interaction of two magnetic fields. It is simply said that electric motors work on the principle that two magnetic fields can be made interacting to produce motion. The purpose of the motor is to produce a force that drives (torque) [2].

![Motor Power Window](image2.png)

**Figure 2.** Motor power window.

Power Supply is an electronic component that has a function as a supplier of electric current by first changing the voltage from AC to DC. So the electric current of PLN which is Alternating Current (AC) goes into power supply, then the voltage is converted to Direct Current (DC) and then flows to other components that require.
A relay is an electronic component in the form of a switch or an electrically operated switch. Relays are also commonly referred to as electromechanical components consisting of two main parts namely the coil or the electromagnet and the switch or mechanical. Relay components use the electromagnetic principle as the driving contact of the switch, so by using a small electric current or low power, can deliver a current that has a higher voltage. Here is a picture and also a symbol of the relay component [3].

Smartphones are high-powered mobile phones, with functions that almost resemble a computer. Android is a Linux-based operating system designed for touch screen mobile devices such as smartphones and tablet computers [4].

2.3. Block diagram
Figure 6 shows the block diagram of the power window control. From the figure can be seen section and function below.
- Android / Smartphone serves as a communication tool between users and microcontrollers.
- ESP32 serves as a given data processing microcontroller.
- Relay serves as a voltage control switch.
- DC motor serves as a driver of the power window system.
- Battery serves as a power supply.
2.4. Flowchart

Figure 7 shows the flowchart for the process of reading the data up to the process of moving the power window. The process begins by reading data from the keystrokes that are on the remote control transmitter. If there is a keystrokes, then the data will be sent via transmitter. The data will be received by the receiver, then processed by ESP32. After the process is complete, the dc power window motor will rotate according to the data received from the keystrokes. The dc power window motor will stop when there is a keystroke once again or the switch is touched by the mechanical window [5].

Figure 6. Block diagram of the power window control.

Figure 7. Flowchart.
3. Results and discussion

In testing the DC Power Window motor control circuit, it is done by giving ESP32 program to play DC motor. The ideal results that are omitted are listed in Table 1 [5].

| Relay 1 | Relay 2 | Motor Output |
|--------|--------|--------------|
| 0      | 0      | 0            |
| 0      | 1      | Clockwise    |
| 1      | 0      | Anti-Clockwise |
| 1      | 1      | 0            |

In fact, the results of the work for this study were obtained in Table 2.

| Relay 1 | Relay 2 | Motor Output |
|--------|--------|--------------|
| 0      | 0      | 0            |
| 0      | 1      | Clockwise    |
| 1      | 0      | Anti-Clockwise |
| 1      | 1      | 0            |

Temporary test result is DC motor can be rotated according to given input. When relay 1 is given HIGH motor will rotate clockwise, relay 2 is given HIGH motor will rotate counter clockwise.

4. Conclusions

After going through system design and testing, the result of power window automation system with remote control using ESP32 can be summarized as follows, the whole tool is running well as desired. The motor has also rotated according to the input given. To develop this tool in the future, will be made some improvements to the system, display on the application and others to create maximum results for its users.

References

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