

# Design of a Home Door Security System Based on NodeMCU ESP32 Using a Magnetic Reed Switch Sensor and Telegram Bot Application

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**Abstract:** With very rapid technological advancements, it is not possible now that all activities can be carried out quickly, easily, and instantly. The Internet of Things (IoT) allows us to solve various problems by making some devices communicate with each other across the virtual world network. Using the Telegram Bot application, which is connected to the internet, allows you to control door access remotely and can also be monitored in real time so that you can find out if a crime has occurred and respond more quickly. The design of this tool consists of several stages, namely designing a block diagram of how the circuit works, and designing hardware (Hardware) and software (Software). From the results of system testing, it can be seen that when conducting RFID testing by tapping the card on the reader. The system is successful and the door can be opened according to the NUID card that has been registered with the program and it can fail by using a card that is not registered in the system. Which indicates the test results are working properly. The working capability of the system on the door security device is as expected and the response from the magnetic reed switch sensor as input from the notification is very good. This system using RFID functions to make it easier for users to control the door of the house with a smartphone connected to wifi so that users don't just use conventional keys.

**Keywords:** Magnetic Reed Switch, NodeMCU ESP32, RFID, Smartphone, Telegram.

## INTRODUCTION

With very rapid technological advancements, it is not possible now that all activities can be carried out quickly, easily, and instantly. The Internet of Things (IoT) allows us to solve various problems by making some devices communicate with each other across the virtual world network. So, it can be concluded that security is a very important thing for a house. The security system is a set of elements or elements that are interrelated and have the same goal of being free from risk. A security system is really important for every building. Because in it there are various valuable items that we store in it (Sepudin & Abdullah, 2023). Because One example of the use of IoT-based microcontrollers using social media is Telegram, which is used as a key control medium in terms of locking, closing, and opening doors (Kurniawan, 2020).

By looking at these problems, then from this writing Developed into a home door security system based on the NodeMCU ESP32 with a magnetic reed switch sensor and the Telegram Bot application. The benefits of the devices used in the home door security system First, by using an RFID device as a door access device. So, users who have cards that have been authorized on the system So, the door can

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be opened easily by simply attaching the card to the reader, making it easier for the user because there is no key and providing high security because it is difficult to counterfeit. Second, using a magnetic reed switch sensor to detect when the door is open or closed so that users can take action to secure their home. Finally, using the Telegram Bot Application, which is connected to the internet, functions to control door access remotely and can also be monitored in real time so that you can find out if a crime has occurred and can respond more quickly. The reason I use the Telegram application is because the costs are relatively cheap because this application is free and multiplatform, as it can be used on smartphones, tablets, and computers.

## LITERATURE REVIEW

### NodeMCU ESP32 Type DEVKITV1

The NodeMCU ESP32 is a low-cost System on Chip (SoC) Microcontroller from Espressif Systems, which is also the developer of the famous ESP8266 SoC with NodeMCU. The ESP32 is the successor to the ESP8266 SoC using the Xtensa LX6 32-bit Tensilica Microprocessor with integrated WiFi and Bluetooth. The good thing about the ESP32, like the ESP8266 is the integrated RF parts like Power Amplifier, Low-Noise Receive Amplifier, Antenna Switch, and Filter. This makes designing hardware on the ESP32 easier because it requires very few external parts. This microcontroller already provides WiFi and Bluetooth modules on the chip so they are very supportive of making Internet of Things application methods.



Fig. 1 NodeMCU ESP32 Type DEVKITV1

### Magnetic Reed Switch Sensors

Magnetic reed switch sensors in general are electrical sensors that are operated by utilizing a magnetic field as a condition changer. Or briefly called a magnetic sensor because it will be active when exposed to a magnetic plate. A magnetic reed switch is composed of metal plates connected by a glass tube, so that when a magnetic field is created between the two plates, the plates are attracted so that an electric current can flow. When the magnetic field disappears, the plates return to their original position and the path of motion of the current is again interrupted.



Fig. 2 Magnetic Reed Switch Sensors

### Buzzer

Buzzer is an electronic component that functions to convert electrical vibrations into sound vibrations. Basically the working principle of a buzzer is almost the same as a loudspeaker, so the buzzer also consists of a coil that is attached to the diaphragm and then the coil is energized so that it becomes an electromagnet, the coil will be pulled in or out, depending on the direction of the current and the polarity of the magnet, because the coil is installed on the diaphragm, each movement of the coil will move the diaphragm back and forth, causing the air to vibrate which will produce sound. The buzzer is generally

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used as an indicator that the work procedure has been completed or an error has occurred in a tool (alarm).



Fig. 3 Buzzer

### RFID (Radio Frequency Identification)

RFID (Radio Frequency Identification) is a wireless or wireless technology for automatic recognition or identification with radio frequency that applies two parts in the form of a tag and a reader which are controlled by a control method (usually in the form of a computer) as a way center and link to apply this technology to hardware or software. device for identification. RFID consists of two parts to work, an RFID (Radio Frequency Identification) tag and a reader. the tag is an object that stores data, while the reader is a device that performs identification of the RFID tag by utilizing radio frequency.



Fig. 4 RFID (Radio Frequency Identification)

### Servo Motors Type SG90

Servo Motor is an electrical device used in advanced industrial machines that functions to support or rotate objects with high-precision control in terms of angular position, acceleration and speed, electric motors designed to use a closed loop feedback method. The closed system on the Servo creates a feedback that affects the input and holds the device. In this case the aim is to control the speed, acceleration and position of the rotation angle of the motor.



Fig. 5 Servo Motors

### LCD (Liquid Crystal Display)

LCD (Liquid Crystal Display) is a data display module that uses liquid crystals as a material for displaying data in the form of articles or images. Uses in everyday life that are easy to find include calculators, game bots, TVs, or even computer screens.

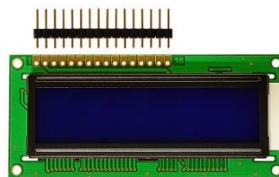
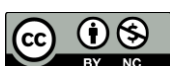


Fig. 6 LCD (Liquid Crystal Display)

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**LED (Light Emitting Diode)**

LED (Light Emitting Diode) is an electronic part that can emit monochromatic light when given a voltage with a forward or forward bias. LED (Light Emitting Diode) can be termed as a diode that emits light, because indeed LED (Light Emitting Diode) is a family of diodes made of semiconductor material.



Fig. 7 LED (Light Emitting Diode)

**Telegram Application**

Telegram is an application developed by the companies Telegram FZ LLC and Telegram Messenger Inc. from Russia. This application was released in 2013. Telegram is a cloud-based, multi-platform instant messaging service application that is free and non-profit. The Telegram client is available for both mobile phone devices and computer devices. Users can send messages and exchange photos, videos, stickers, audio, and a variety of other files.



Fig. 8 Telegram Application

**METHOD**

**RESEARCH STAGES**

This design consists of several stages, namely the design of block diagrams of how the circuit works, the flowchart of the security system with NodeMCU ESP32, and the design of hardware and software.

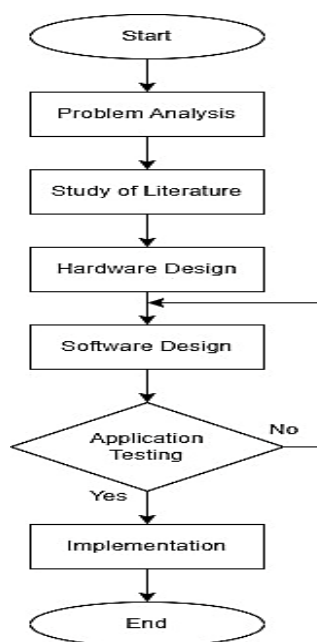


Fig. 9 Research Stages

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*Problem Analysis*

Analyzing the problems that arise due to the lack of security at the door of the house, making it easier for thieves to enter the house, by collecting data as study material, a door security method that is controlled from a mobile phone is needed, which can improve security so that the worries of homeowners are lower.

*Study of Literature*

Conducting research using library data collection methods, reading and taking notes from various journals and books, and then managing the research material.

*Hardware Design*

Perform hardware design using the NodeMCU ESP32 microcontroller module type DEVKIT-V1, RFID Type MFRC522 Module, Magnetic Reed Switch, Servo Motor Type SG90, Buzzer, LCD (Liquid Crystal Display), LED (Light Emitting Diode), and Jumper Cables to support the work of this tool and make a prototype.

*Software Design*

Designing the device to be created in prototype format with the programming language implemented by the Arduino IDE.

*Application Testing*

Conduct testing on applications that have been made to reveal errors in the program by running and selecting the program.

*Implementation*

After testing and being successful So, these applications and tools will be implemented manually.

**BLOCK DIAGRAM**

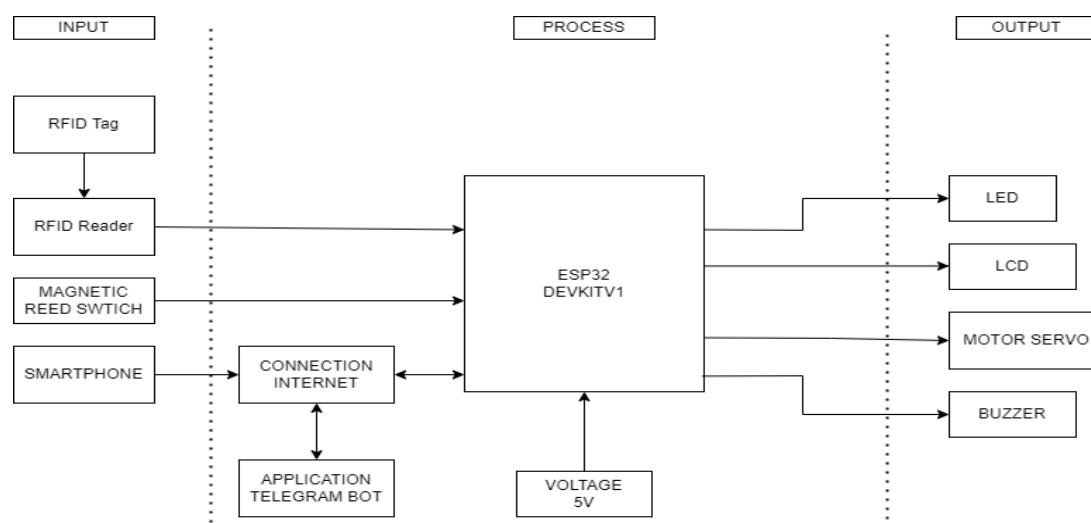


Fig. 10 Block Diagram

The explanation of the system block diagram can be described as follows:

Smartphones as input that will give orders. Commands are carried out from the integrated telegram bot application. The Telegram Bot application was created to control and monitor home door security systems using a Smartphone. Functioning to connect networks, the router will capture signals from wi-fi, which then transmits the signal so that it reaches the Telegram application on the smartphone. The router used is a smartphone hotspot. NodeMCU ESP32 as the central control system. The one used in this system is the ESP32 microcontroller type DEVKITV1. Magnetic reed switch as a security sensor that uses a magnetic field to change its condition. This magnetic reed switch is connected to the microcontroller. RFID tags are used as a substitute for keys, namely a card consisting of a microchip that is used as access to enter the house. RFID Reader is a card reader that consists of an antenna to process card access in the form of data for the microcontroller. LED (light-emitting diode) as an

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indicator that the card has been confirmed as successfully read and the door can be opened. LCD (Liquid Crystal Display) As system monitoring with manual monitoring mode, which can be seen whether the card has been successfully read or rejected. Buzzer As an alarm system when the door is forced to be opened. Then the active buzzer sounds. Servo Motor Serves as a key activator for the security of the door of the house, and the servo motor is also interconnected with the microcontroller.

**FLOWCHART**

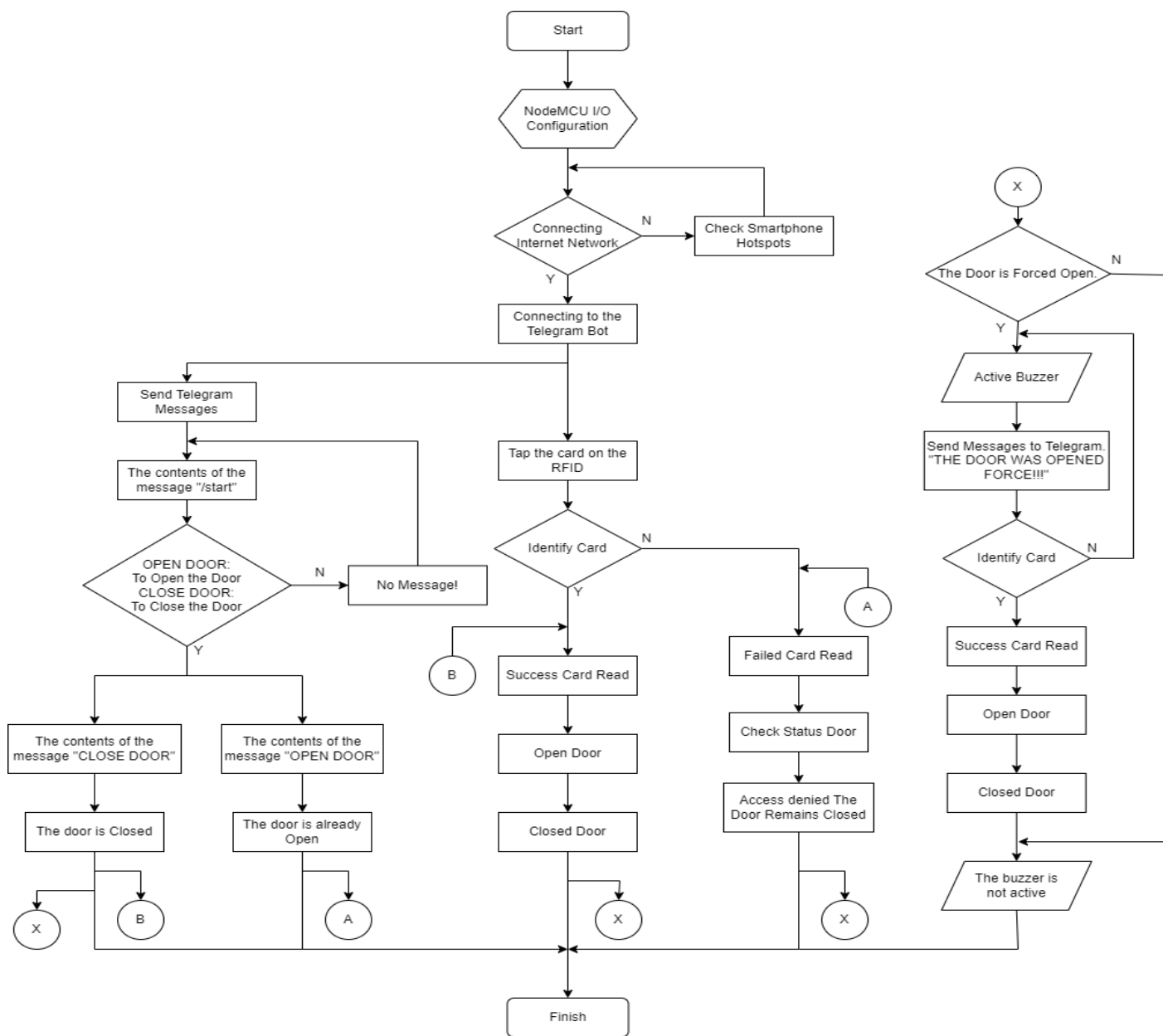


Fig. 11 Flowchart

The system flowchart in Figure 10 Above is a schematic that describes a system's process when it works. There are 4 conditions when monitoring, namely connecting to the internet, choosing a message between “BUKA PINTU” and “TUTUP PINTU” with no message, identifying the card read successfully and failing to read, and identifying the card read successfully to deactivate the alarm.

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### RESULT

After carrying out the analysis and design carried out in the previous chapter, a design for a security system for a house door has been made. The first step is to test the range of the smartphone's wifi connectivity to the microcontroller.

To be able to find out the connectivity of the circuit with a smartphone, testing is necessary. Where to connect the entire door security system that has been pre-assembled. So that it can be controlled via a smartphone. The Telegram Bot application must be connected to the internet. The internet that is connected to the Telegram Bot application must be registered with the home security system program that has been created on the Arduino IDE. Table 1 The results show the connection is working properly.

Table 1. Testing the maximum distance from the wifi connection

Wifi Connection	Distance	Status
Connected	5 meters	Succeed
Connected	10 meters	Succeed
Connected	15 meters	Succeed
Connected	20 meters	Succeed
Connected	25 meters	Succeed
Not Connected	30 meters	Not Successful

Next, system testing. This process is done by testing the entire system. In order to get the required data, the data being tested is connectivity with the Telegram bot application and tools that are already connected to each other to find out whether the monitoring data is working properly or not. Table 2 shows the test results when the door is unlocked.

Table 2. System test results when the door is unlocked

Condition	Action	Results	Conclusion
The door is unlocked.	Type the message on the Telegram bot, "CLOSE DOOR"	Door Locked	Succeed
	Telegram Status Messages	"The Door is closed"	Succeed
	LCD Display	"The Door was closed again"	Succeed
	RFID Detection Card Tags	Door Locked	Succeed
	Telegram Status Messages	"Access is denied, and the door stays closed!"	Succeed
	LCD Display	"Access Denied"	Succeed

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From the test results above, it can be said that controlling the door in an unlocked state works well. Next, do the reverse test. Test when the door is locked. Can be seen in Table 3. Test results when the door is locked.

Table 3. System test results when the door is locked

Condition	Action	Results	Conclusion
Door Locked	Type a message on the Telegram bot, "OPEN THE DOOR"	Open Door	Succeed
	Telegram Status Messages	"The Door is already Open"	Succeed
	LCD Display	"Access Accepted Door Open"	Succeed
	RFID Detection Card Tags	Open Door	Succeed
	Telegram Status Messages	"Open Door"	Succeed
	LCD Display	"Access Accepted Door Open"	Succeed

From the test results above, it can be concluded that controlling the door in a locked state works well, then carry out the process of testing the door forcibly opened or simulating the time of theft. As seen in Table 4. Test results when the door is locked but opened by force.

Table 4. Test results when the door is forcibly opened

Door Forced Open	Door Forced Open	Buzzer ON	Succeed
	Telegram Status Messages	"The Door is Forced Open!!!"	Succeed
	RFID Detection Card Tags	Open Door	Succeed
	LCD Display	"Access Accepted Door Open"	Succeed
	Telegram Status Messages	"The Door is closed"	Succeed
	The Door Is closed	Buzzer OFF	Succeed

From the test results above, it shows the process when the door is forcibly opened, which is illustrated as if an act of theft has occurred. From the time the door opens and the buzzer acts as an active alarm until the door closes and the buzzer turns off. This process is said to be running well. The next test is to test the accuracy of the magnetic reed switch sensor circuit. Table 5 shows the results of the distance test for the accuracy of the magnetic reed switch sensor.

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Table 5. The results of testing the accuracy of the magnetic reed switch sensor circuit

Magnetic Reed Switch Sensor Table			
Testing	Distance	Buzzer response	Condition value
Ke-1	0,1 cm	No Sound	0
Ke-2	0,3 cm	No Sound	0
Ke-3	0,5 cm	No Sound	0
Ke-4	0,8 cm	No Sound	0
Ke-5	1 cm	No Sound	0
Ke-6	1,1 cm	Beeps	1
Ke-7	1,3 cm	Beeps	1

From the test results, it shows that the accuracy of the distance sensor has been checked using a measuring tool; starting from a distance of 0.1cm, 0.3cm, 0.5cm, 0.8 cm, and 1 cm, this tool does not respond. However, at further distances of 1.1cm, 1.3 cm, and so on, this tool was successful in actively responding, and the active buzzer sounded. The test results show that the circuit is functioning properly.

## DISCUSSIONS

From the results of system testing, it can be seen that when conducting RFID testing by tapping the card on the reader, The system is successful, and the door can be opened according to the NUID card that has been registered with the program, or it can fail by using a card that is not registered in the system. Which indicates the test results are working properly. When the system monitors using the LCD, it also works well. The system displays the values read by the card and uses the Telegram bot application. It can be seen that the system, namely opening and closing doors with the Telegram Bot application, works well. Responses are also assessed quickly. Only sometimes are there some time lags or delays when the system responds when it is being controlled. This is due to the instability of the internet network or connection. The magnetic reed switch sensor system has succeeded in changing its condition value, which starts with a value of 0 (Door closed) until it changes to a value of 1 (Door opens), if the door has a value of 1 with a minimum distance of 1.1cm or more.

However, there are some obstacles to overcome. The system, including when the card is successful and the door can be opened, has a delay of 8 seconds, which is intended to illustrate the state of the user after a successful card tap immediately enters the house. If not, then the lock closes immediately and the magnetic sensors are not connected to each other. So, the monitoring sensor reads that the door is forced open. To overcome this, there must be additional components, such as push buttons as fast access buttons to open and close doors. Another solution is that if by adding components to the NodeMCU ESP32 you experience power instability or a lack of power, it's best to add a microcontroller module such as the Arduino UNO, which can then be transferred to the NodeMCU.

## CONCLUSION

Creating a security system with the NODEMCU ESP32 so that the system can transmit monitoring data from RFID (Radio Frequency Identification) is done by testing the door using four tags or cards. a card consisting of two successful cards that the door can open while the two failed cards fail to open the door. Which indicates the test results are good and monitored by the Telegram Bot.

Retrieval and processing of data on the magnetic reed switch sensor are carried out by testing the accuracy of the sensor distance. It has been carried out using a measuring instrument that tries to start from a distance of 0.1cm, 0.3cm, 0.5cm, 0.8 cm, and 1cm. This tool does not respond. However, at further distances of 1.1cm, 1.3 cm, and so on, So, this tool was successful in responding actively, and the active buzzer sounded.

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Controlling the home door security system using the Telegram Bot Application involves connecting the entire home door security system that has been pre-arranged. So that it can be controlled via a smartphone. The Telegram Bot application must be connected to the internet. The internet that is connected to the Telegram Bot application must be registered with the home security system program that has been created on the Arduino IDE.

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