

## RFID DESIGN ON MOTORCYCLE KEYS WITH ARDUINO NANO ATMEGA USING THE BLACKBOX TESTING METHOD

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### Abstract

*This research develops a motorcycle security system utilizing Radio Frequency Identification (RFID) technology integrated with an Arduino Nano microcontroller to replace traditional analog ignition keys. The study addresses the high prevalence of motorcycle theft by providing a dual-layer electronic security solution. The methodology encompasses system architecture design, hardware integration, and software development, followed by comprehensive validation using the Blackbox Testing method. The system utilizes a MIFARE card as an identification tag; the Arduino Nano verifies the stored data specifically the user's name and license type to trigger a relay that activates the ignition. Results demonstrate that the system effectively distinguishes between registered and unauthorized access, significantly enhancing vehicle security. This design offers a cost-effective, low-power, and reliable alternative for modern vehicle protection.*

**Keywords :** RFID; Arduino Nano; Motorcycle Security; Blackbox Testing.

### Introduction

The rapid advancement of technology has significantly transformed human life, offering convenience across various sectors. However, this progress is often accompanied by new challenges, particularly in terms of security. One prominent issue is the vulnerability of conventional motorcycle security systems. Traditional mechanical keys are susceptible to wear, physical damage, and theft through the use of "T-keys" or lock-picking techniques. Furthermore, the reliance on physical keys often leads to practical issues, such as keys being misplaced or forgotten. Mechanical security systems often fail to provide adequate protection against modern theft methods, necessitating a shift toward electronic authentication [1]. In Indonesia, motorcycle regulations are strictly governed, including the mandatory possession of a Driver's License (SIM) as stipulated in Law No. 22 of 2009. Integrating this legal requirement with vehicle security technology presents an innovative opportunity. By utilizing Radio Frequency Identification (RFID) technology, a motorcycle's ignition system can be digitized and linked to a specific identification tag, such as a modified driver's license card. This approach aligns with previous studies demonstrating that utilizing official identification cards as RFID tags can streamline the authentication process while enhancing security [9]. RFID technology offers a contactless, efficient, and secure method of authentication. When integrated with the Arduino Nano a compact, low-cost, and power-efficient microcontroller it is possible to create a robust security system that replaces the traditional ignition switch. The Arduino Nano's versatility and low power consumption make it an ideal choice for embedded systems in automotive applications [10]. This research focuses on the design and

implementation of an RFID-based motorcycle key system using the Arduino Nano ATmega328P. To ensure system reliability, the functionality of the hardware and software components is validated through the Blackbox Testing method, ensuring that the system meets the predefined functional requirements [11]. This study aims to provide an effective and affordable solution to enhance vehicle security while providing peace of mind for motorcycle owners through a seamless integration of legal identification and digital access control. The purpose of this study is to address the problems in society faced by motorcyclists, such as theft, when they park or leave their motorcycles in remote places. RFID motor locks play an additional role as a security by using cards. When following this journal, the author was inspired by a number of previous research references that were related to this report.

### Literature Review

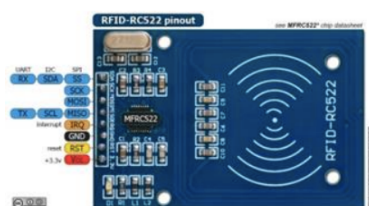
Based on the previous research entitled 'Arduino Nano-Based Motorcycle Ignition Activation Safety System', this study discusses the manufacture of an Arduino microcontroller-based motorcycle security system with LED indicators. The researchers felt that the findings from the study were inadequate. [10]. Based on the latest research entitled 'Development of Radio Frequency Identification (RFID)-Based Motor Vehicle Safety System,' the security system was created using Arduino Nano and RFID, and the buzzer was used as an indicator [11].

In a journal entitled "Design and Build a Motorcycle Safety System for Islamic Universities Using Fingerprint and GPS Tracker Based on JoT, create a motorcycle security system using finger technology. as a biometric method to identify the owner. The system is also equipped with a GPS tracker that allows monitoring the position of the motorcycle

through a smartphone, a buzzer as a warning, and a bypass button (secret key) to allow access by parties authorized by the owner. With this device, it is hoped that it will make it easier to supervise the company's assets, especially motorcycles [12].

In the journal entitled "Microcontroller Based Motorcycle Safety System Using Arduino and Fingerprint Sensors, Security refers to the condition of no risk. This concept applies to various aspects, including crime, harassment, and accidents. This research was carried out by the author to create a safety system for motor vehicles, especially motorcycles. [13]. In the use of this device, any individual who wishes to operate a motorcycle must first register or insert his/her fingerprint into the fingerprint sensor. This aims to avoid access by unauthorized parties, thereby increasing the level of system security [14]. In a journal entitled "Internet of Things Based Motorcycle Security System", motorcycles have an important role in the mobility of the Indonesian people because of their affordable prices, especially for those with a middle to lower economic level of motorcycles. But it is also a favorite option for individuals who want to avoid frequent highway congestion. Affordable price and fuel efficiency are the main reasons for using motorcycles. As the times evolve, the need for means of transportation, including motorcycles, is increasing. However, this development also has an impact on the increase in criminal acts, such as motorcycle theft cases. This theft problem still often occurs due to the lack of security systems on motorcycles [15].

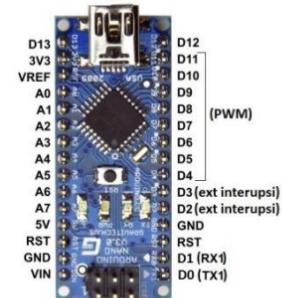
Based on previous findings, further studies and innovations are needed to make the process of starting a motorcycle easier for users. The goal of this project is to develop a motorcycle ignition system using RFID networks and microcontrollers." From previous research, it still uses MIFARE RC522 as an RFID sensor and uses an indicator, which helps the public in understanding information. Because the data on the card is private, this study uses a fake driver's license. The difference lies in the use of a fake SIM as a motorcycle ignition key, where the fake SIM contains data about the owner of the SIM. In this edition which was taken with the title of rfid design on motorcycle keys with arduino mega 2560 using the blackbox testing method. To be able to apply it several tools are needed as design materials consisting of:



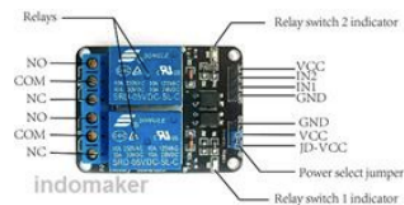
picture 1 RFID Module



picture 2 Arduino Jumper Cable



picture 3 arduino nano atmega168ch340g



picture4 relay 2 ch(channel)



picture 5 Step down



picture6 USB Cable for Arduino



picture 7 OTG-JETE-USB-to-Type-C



picture 8Card RFID

Research Method

Security System Architecture Design for each component

Part	Component	Deskripsi
Input	RFID Tag	RFID tags are held by the user and used to access the system.
Proses	Modul RFID	Read the data from the RFID Tag and transmit this information to the Arduino.
Process	Step Down	Reduce the voltage from the battery to supply the appropriate power to the Arduino and RFID Module

Process	Battery	Providing portable resources for sistem, ensure all components get the necessary power.
Output	Relay	Controlled by Arduino to enable or disable the motorcycle lock.
Output	LED dan Buzzer	Provide visual and audio feedback to the user about the authentication status (successful or failed).

Result and Discussion

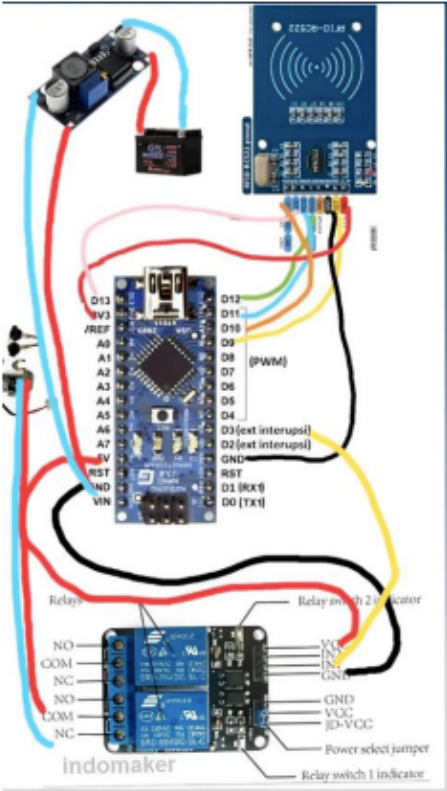
The following is a representation in the form of a table for the connection between the Arduino Nano, the RFID Module, and the Relay:

Connection Table.

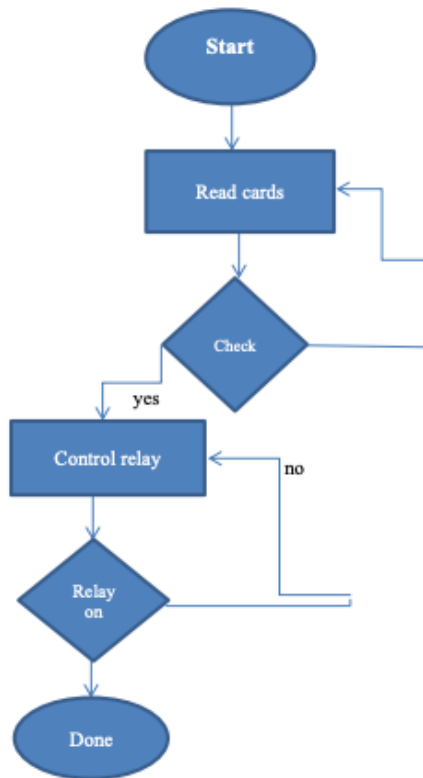
Device	Arduino Nano Battery	External Pins	External Devices
Modul RFID	3V3	VCC	Modul RFID
	D9	RST	Modul RFID
	GND	GND	Modul RFID
	D1	MISO	Modul RFID
	D11	MOSI	Modul RFID
	D13	SCK	Modul RFID
	D10	SDA	Modul RFID
Relay	GND	GND	Relay
	D3	IN1	Relay
	5V	VCC	Relay

Table 1 connection table

The following is a flowchart proposed to represent the steps of connecting the Arduino Nano with the RFID Module and the Relay



picture 9 Arduino schematic



picture 10 Arduino flowchart

Start: Start the program. Initialization:

- Initialization of Arduino Nano, RFID Module, and Relay.
- Ensure that the RFID Module is ready to read the card.

The process of reading data from an RFID card. Readable Card? (Decision): If Yes: Proceed to the Relay control. Otherwise: Return to the process of reading the RFID card. Relay Control: Enables or disables the Relay based on the RFID card reading results. Active Relay? (Decision): If Yes: Turns on the indicator or performs further actions (e.g. unlocking). Otherwise: Return to the Relay control process or repeat the RFID card reading. Complete: Ends the program or returns to the beginning for subsequent RFID card readings.

### Conclusions and Recommendations

Based on the findings of the research, discussion, and testing of the system, several conclusions can be drawn. First, the high incidence of theft causes significant anxiety among vehicle owners. Traditional security measures such as ignition locks, padlocks, or vehicle keys alone may not be enough to secure our motorcycles. In addition, the original motorcycle key is no longer used to start the engine but is used to activate the Arduino system and battery, as well

as serve as a handlebar lock. RFID cards now serve as the main key to turn motorcycles on and off. In conclusion, the program works effectively according to the design. The application of RFID with a fake driver's license for motorcycle keys increases people's confidence when parking or abandoning their vehicles

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