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RFID SMART LOCK WITH BUZZER SECURITY AND BLYNK IOT INTEGRATION

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Abstract – The use of Radio Frequency Identification (RFID) technology has brought notable advancements in the field of electronic security by enabling secure authentication and controlled access. This project introduces an RFID-based Smart Lock System integrated with a buzzer alert mechanism, aimed at providing a secure and convenient access-control solution without the need for conventional lock-and-key systems. In this system, RFID cards or tags function as unique digital credentials, allowing entry only to authorized users. When an invalid or unauthorized RFID tag is detected, the system instantly triggers a buzzer to warn of an access violation, thereby enhancing overall security. By combining contactless RFID authentication with an immediate audible alert, the proposed system ensures both reliability and user awareness. This design is well suited for use in homes, offices, educational institutions, and commercial facilities. The project demonstrates a simple, cost-effective, and scalable approach to modern security by replacing traditional mechanical locks with efficient electronic authentication and alert mechanisms.

Key words – NODE MCU, ESP 8266, RFID

1. INTRODUCTION

In recent times, ensuring security has become a critical requirement across residential, commercial, and industrial sectors. Conventional lock-and-key mechanisms are no longer sufficient, as they are vulnerable to issues such as key loss, duplication, theft, and physical damage. To address these drawbacks, advanced security solutions now rely on electronic identification and access-control technologies. One of the most commonly used and reliable technologies is Radio Frequency Identification (RFID). An RFID-based Smart Door Locking System operates by using RFID tags and a reader to identify and authenticate users automatically. When an authorized RFID tag is placed close to the reader, the system reads the unique identification code stored in the tag and verifies it against predefined data. If the tag is valid, the system activates an electronic locking mechanism, such as a servo motor or solenoid lock, to grant access. Any unregistered or invalid tag is denied entry immediately, ensuring enhanced protection. This system provides several benefits, including contactless access, fast response time, improved reliability, and reduced human intervention. Additionally, it can be easily integrated with IoT platforms for real-time monitoring and remote control. By replacing traditional locking methods with RFID-based solutions, the smart door locking system significantly improves security, increases user convenience, and offers an efficient access-control system suitable for homes, offices, laboratories, and high-security areas.

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2. DESIGN

In this project, the main hardware components used are the NodeMCU ESP8266 and the RFID reader module MFRC522. The NodeMCU ESP8266 is a microcontroller that includes built-in ROM, RAM, and Wi-Fi capability, making it suitable for IoT-based applications. The MFRC522 RFID reader is responsible for reading data from RFID tags and transmitting the unique identification information to the NodeMCU. Once the RFID data is received, the NodeMCU ESP8266 processes the tag ID and checks whether the cardholder is authorized or not. If the scanned RFID tag is valid, the system activates the servo motor to unlock and open the door. If the tag is unauthorized, access is denied; the servo motor remains in its default (idle) position keeping the door closed, and a buzzer is activated to indicate an invalid attempt. To program the NodeMCU, the Arduino IDE must first be downloaded and installed on the computer. Since the NodeMCU ESP8266 is not a standard Arduino board, additional board support packages must be installed in the Arduino IDE. Similarly, the required libraries for the ESP8266 and the MFRC522 RFID reader module need to be added. After completing the setup, the appropriate program code is written and uploaded to establish communication between the NodeMCU and the RFID reader module.

STEP 1: Open the Arduino software, click on File, and then choose Preferences.

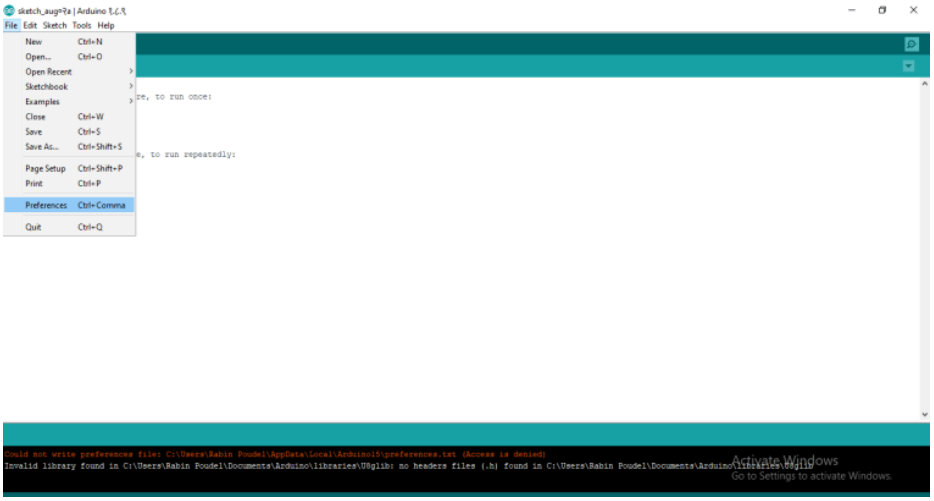

Fig. 1. Arduino IDE page

STEP 2: Copy the URL below into the section **Additional board Manager** and click OK to close the Preferences tab.

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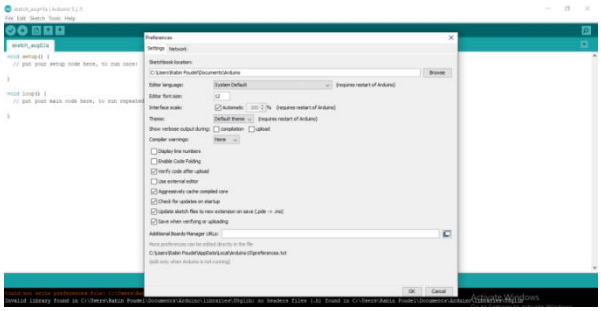

Fig. 2. Arduino ide URL

STEP 3: Then Goto Tools – Board … – Board Manager

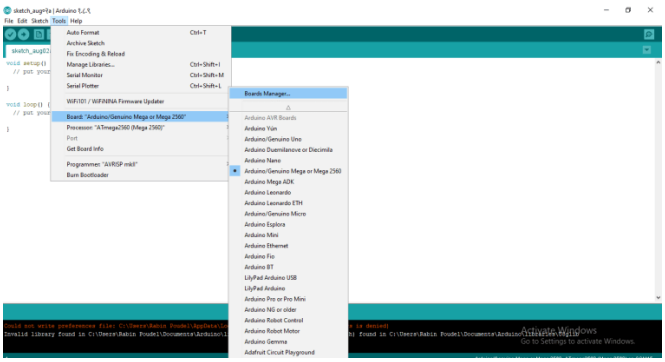

Fig. 3. Arduino IDE board manager

STEP 4: In the search box, type ESP8266, install the package, and after installation we will observe the NodeMCU board added in the Arduino IDE.

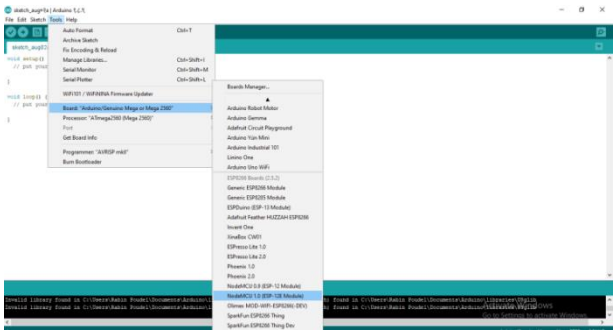

Fig. 4. Arduino ide installation of ESP8266 file

STEP 5: All the steps are now finished, program can be now written and forwarded to the board.

Hardware connection*:*

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Take the Node MCU and connect it with USB data cable. Connect the RC522 RFID module to the ESP8266 by jumper wiring VCC to 3.3V, GND to GND, SDA(SS) to D2, RST to D1, SCK to D5, MOSI to D7, and MISO to D6. Connect the servo motor by wiring its signal pin to D3, its VCC to an external 5V supply, and its GND to the ESP8266 GND (common ground is required). Connect the buzzer by connecting its positive pin to D8 and its negative pin to GND. Power the ESP8266 through USB or 5V, power the RC522 only from 3.3V, and power the servo from an external 5V source to avoid current overload.

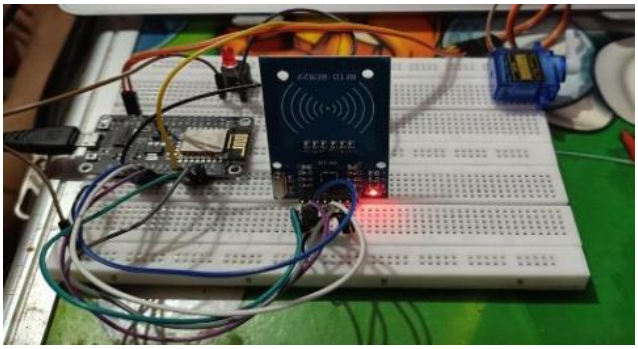

Fig. 5. Hardware connection of the ESP8266

3. SPECIFICATION OF COMPONENT

1. Node MCU (ESP8266): The NodeMCU (Node Micro Controller Unit) is an open-source hardware and software development platform built around a low-cost System-on-a-Chip (SoC) known as the ESP8266. The ESP8266, developed by Espressif Systems, integrates essential computing components such as a processor, memory (RAM), Wi-Fi connectivity, and support for a modern software development kit (SDK). Due to these features, it has become a popular and effective solution for a wide range of Internet of Things (IoT) applications. Although the ESP8266 is powerful, working directly with the bare chip can be challenging. Basic operations such as supplying power or sending input signals require precise soldering and proper voltage handling. Additionally, programming the chip at a low level demands detailed knowledge of machine-level instructions. While these requirements are acceptable for industrial and mass-produced embedded systems, they create difficulties for students, hobbyists, and developers who wish to prototype or experiment with IoT projects.

SL. NO	COMPONENTS	QUANTITY
01.	D FLIOP-FLOP	01
02.	IC7404	01
03.	IC7408	01
04.	LED	01
05.	FUNTION GENARATOR	10

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NodeMCU boards are available in multiple physical designs, all centered around the ESP8266 core and typically following a standard 30-pin configuration. Some versions use a narrow 0.9-inch pin spacing, while others feature a wider 1.1-inch footprint, which is an important factor during hardware design. Among the widely used NodeMCU variants are the Amica version, which follows the narrow pin layout, and the LoL in version, which has a wider pin spacing and a larger board size. Since the ESP8266 platform is open-source, manufacturers continue to develop and release new NodeMCU variants, offering flexibility and options for different application requirements. The board provides 17 GPIO pins that can be programmed for functions like I2C, I2S, UART, PWM, IR control, LEDs, and switches, with pull-up, pull-down, high-impedance, and interrupt options. It also features a 10-bit ADC for measuring supply or external analog voltage, though both cannot be measured at the same time. Additionally, there are four PWM channels (100 Hz to 1 kHz) for controlling motors and LED brightness. Control pins such as EN, RST, and WAKE are used to enable the chip, reset it, and wake it from deep-sleep mode.

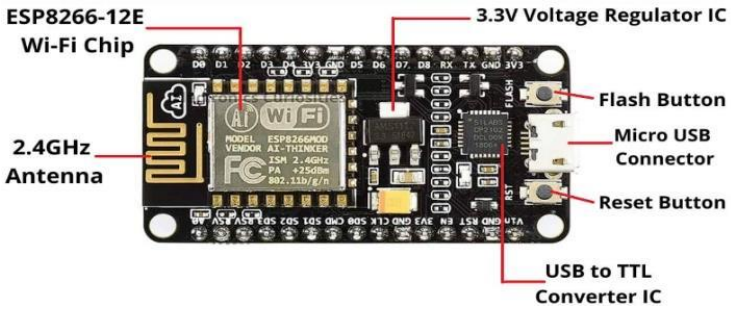

Fig. 6. Component of Node MCU ESP8266

Node MCU Technical Specifications	
Microcontroller	ESP-8266 (32-bit)
Node MCU Model	Clone LoLin
Carrier Board Size	58mm x 32mm
Pin Spacing	n/a
Clock Speed	1.1" (27.94mm)
USB to Serial	80 MHz
USB Connector	CH340G
Operating Voltage	Micro USB
Input Voltage	3.3V
Flash Memory/SRAM	4 MB / 64 KB
Digital I/O Pins	11
Analog In Pins	1
ADC Range	0-3.3V
UART/SPI/I2C	1 / 1 / 1
WiFi Built-In	802.11 b/g/n
Product	Node MCU

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2. MFRC522 RFID Reader Module: The MFRC522 RFID Reader Module is an economical and widely used device designed to read 13.56 MHz RFID cards by identifying their unique identification number (UID). It communicates with microcontrollers such as Arduino and NodeMCU using the Serial Peripheral Interface (SPI) protocol. Due to its compact size, fast response, and reliable performance, the MFRC522 module is commonly applied in smart door locking systems and access-control applications. The MFRC522 module consists of eight essential pins. The VCC pin is used to supply 3.3 V power, while the GND pin provides the ground connection. The RST pin is used to reset the module during operation. For data communication, the module includes SPI pins such as SCK, MISO, MOSI, and SDA/SS. These pins allow simple and efficient interfacing with microcontroller boards like NodeMCU or Arduino.

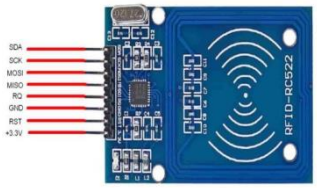

Fig. 8. RFID-RC522

3. RFID Tags: RFID tags are compact electronic cards or key fobs that store a distinct identification number within them. When an RFID tag is placed close to an RFID reader, it is energized wirelessly and transmits its stored ID to the reader. Since each tag carries a unique code, the system can accurately identify and verify the user. These tags are widely used in applications such as access-control systems, smart door locks, attendance management, and contactless identification. Their simple operation—requiring only a tap or close proximity to the reader—makes them convenient, reliable, and user-friendly.

4. Buzzer: An active buzzer is a compact electronic component that generates sound as soon as power is applied to it. Unlike a passive buzzer, it contains an internal oscillating circuit, so it does not require an external signal to produce sound. It can be easily controlled by a microcontroller such as NodeMCU or Arduino by simply switching it ON or OFF. In simple terms, it functions like a small sound indicator used for alerts and notifications. In this project, the active buzzer is used to provide audio feedback during RFID card scanning. A short beep indicates a valid or authorized card, while a longer beep signals an invalid or unauthorized card.

Fig. 9. Buzzer

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4. RESULT ANALYSIS

When a valid RFID card is scanned, the servo motor rotates and the door opens. If an invalid card is scanned, the door remains closed and the buzzer produces an alert sound. The system functions properly in both situations. the proposed RFID-based Smart Lock System with an integrated buzzer alert mechanism offers an effective and modern solution for secure access control. The use of RFID technology enables quick, contactless authentication, ensuring that only authorized users can gain entry to the protected area. By incorporating a buzzer alert for unauthorized access attempts, the system provides an additional layer of security and immediate awareness of potential intrusions. The design eliminates the limitations of traditional lock-and-key mechanisms and reduces the risk of key duplication or loss. Moreover, the system is simple to implement, cost-effective, and requires minimal maintenance. Its modular design allows easy scalability and integration with other smart security features in the future. The project highlights the practical application of embedded systems in improving electronic security infrastructure. Therefore, the proposed system can serve as a reliable and efficient access control solution for residential, institutional, and commercial environments.

5. CONCLUSION

In this project, when a valid RFID tag is scanned by the reader, the automation system grants access to the user. The NodeMCU ESP8266 processes the received data and rotates the connected servo motor to 90°, which opens the door and allows entry into the room. If an invalid or unauthorized RFID tag is scanned, the system denies access. In this condition, the servo motor remains in its default position to keep the door closed, and the buzzer is activated to alert about the unauthorized attempt.

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