

Password Based Smart Door Lock System for Enhanced Security

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Abstract

In this progressively insecure world today, there is indeed no going back into using old-fashioned keys and locks. That is because keys can get lost, stolen, or even duplicated and leave homes or offices vulnerable. This is why this project aims at building a Smart Doorlock System that uses a password instead of a key, simple and added security. In fact, this entire system would be powered by a small yet very sturdy microcontroller known as the ESP8266. It can do the locking process alone, and it is also base to future online access system. For example, in this manner, to unlock the door, the user needs to enter a password into the keypad. If the password is correct, a relay switches on a solenoid lock and the opening of the door takes place; if incorrect, the door is locked always by the system-and we can even add some features like alarms or mobile alerts later. A small LCD display would also be used for messaging purposes, such as "enter password" and "access denied," which would keep the user updated on the occurrence in the system. It is cost-effective and extremely easy to build, making it an irresistible option for anyone who wishes to increase the safety of their residence or experiment with technology toward a smart home. Overall, smart lock project combines security, simplicity and future promises. This is a modern way of keeping things under lock and key, and not having to carry keys around anymore. This can be a home, office, or even a school locker.

Keywords: Esp8266, 4*4 keypad lock, security, solenoid.

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1. Introduction

Security is a huge part of modern life whether at home, in the office, or anywhere else where one needs privacy. In technological advancement days, traditional lock-and-key systems are on their way out and are becoming very unreliable. Too easily can these locks be picked; keys can be lost or duplicated; and they do not offer the flexibility and control that modern users expect.

This project aims to give a solution to that problem by developing a Password-based Smart Doorlock System with affordable and easily accessible components such as the ESP8266 Microcontroller, Keypad, Relay, Solenoid Lock, and an LCD Display. The idea is pretty much straightforward: instead of being opened by a key, the door may be unlocked using a secure password entered by the user. The door automatically unlocks if the entered password is

correct; otherwise, access is denied. What makes this system especially useful is that it can also be upgradable in the future. Since it is working on ESP8266 which is a Wi-Fi-based chip, the lock may be web-enabled in the future to have applications like remote control, real-time notifications, etc. or smartphone application connectivity.

The ultimate goal of this project is to produce a smart locking system suitable for houses, offices, or anywhere where access control is of great importance; one that is cheap, easy, and secure. It achieves higher levels of security to some degree, and it serves as a practical lesson on how smart technology can one day aid us in our daily tasks.

2. Methodology

The Password-Based Smart Door-Lock System was developed in several planned phases to function properly, prove reliable in use, and remain user-friendly. The very first stage of this project consisted of a general choice of components that would allow for base access control as well as improvements. The ESP8266 microcontroller serves as the core of this system, being preferred due to its highly effective I/O operations control and inbuilt Wi-Fi support. For entering the password, a 4x4 matrix keypad was used, the password would then be confirmed by the microcontroller, which, in turn, when entered correctly, would let the Wi-Fi-enabled ESP8266 pull high a relay module that switches on the power to the solenoid lock, thus unlocking the door in an efficient yet safe way.

The other user-feedback device was the gathering of visual messages on a 16x2 LCD display to indicate its state, i.e., messages such as "Enter Password," "Access Granted," and "Access Denied." The components were integrated onto a breadboard for preliminary testing to confirm all the electrical connections and paths; requirements for voltage regulation were also established. The ESP8266 was programmed in the Arduino IDE to process keypad input, password matching, relay activation, and LCD communication.

Different tests were carried out in various conditions, such as correct and wrong password entries, fast input sequences, or power resets. Problems like input delay and occasional flickering during tests were also intended for resolution. Changes and improvements were made towards the progress of the project concerning the reliability and responsiveness of the system.

Basically, the approach taken was modular, cheap, and user-friendly. In addition, with the advantages that the ESP8266 gives, such as potential upgradeable features, the smart lock can include remote access, mobile app control, and real-time alerts. Such a systematic and unrigid approach will allow the system to change according to the product's growth in the field of smart home security while keeping it simple and easy to use.

2.1 Hardware Design

The hardware and design of the Password based Smart Doorlock system is based on integrating many components in an efficient layout with a small size. The core of the layout is the ESP8266 microcontroller, which serves as a brain for input and output operations inside the system. A Password entry is done through 4x4 matrix keypad connected to the ESP8266 digital input pins. For user feedback and output, a 16x2 LCD is connected through an I2C module; it is simple to wire and requires fewer pins. The relay module is the one controlling the locking mechanism - a simple switch will power solenoid lock only when access is permitted. The solenoid operates on higher voltage (generally 12V), so it is isolated from high current microcontroller. All these components are fed with a

regulated power supply at different voltages, that is, 3.3V for ESP8266 and 12V for solenoid. The circuit was made breadboard proof and initially mounted on a PCB in an easily removable setup for permanent installations. The design is very simple and compact, quite safe as well as modular, thus allowing upgrades and additive features for future versions of the system.

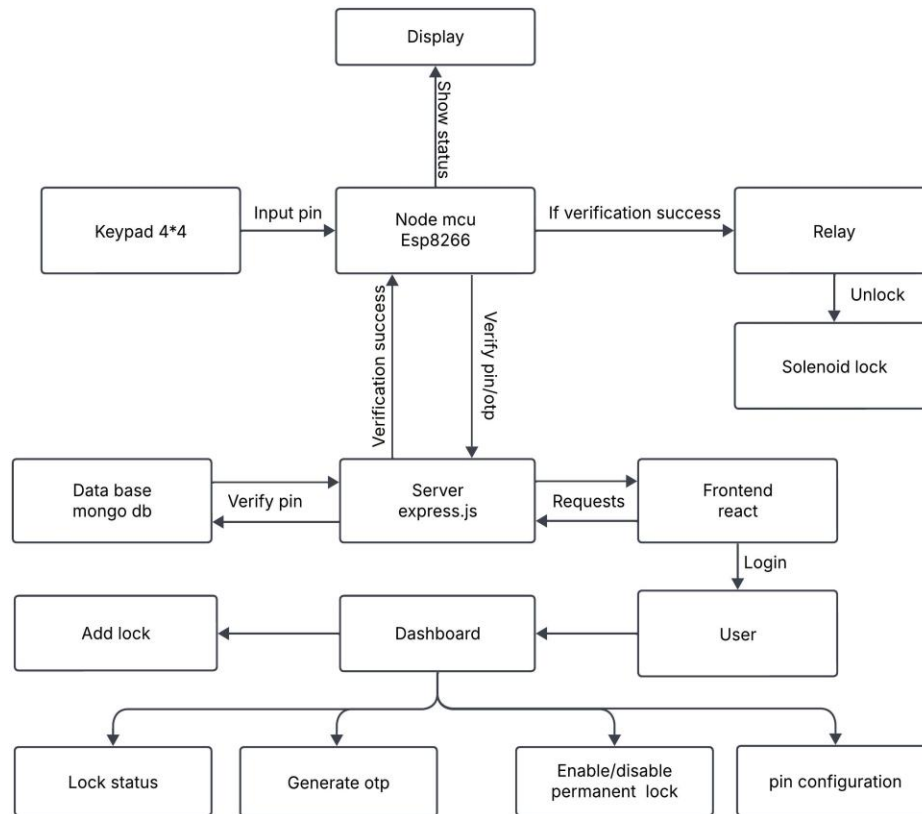


Figure 1: System Design

2.2 Software design

Password-Based Smart Doorlock System software design is mainly dedicated to user input handling, controlling the hardware components, and providing real-time feedback to users. The entire coding is carried out in Arduino IDE and later uploaded on the ESP8266 microcontroller. This whole program is preceded by initializing all peripherals including keypad, LCD display, and relay. The system is prompted to ask for the password to be typed through the keypad from entry. Each keypress is read, and temporarily, it gets stored in operation until all are collected. A comparison is made between this password entered into the program and a predefined password that has been stored within the memory of that program. A relay gets activated if the password matches; a solenoid lock gets unlocked; otherwise, a success message is displayed on an LCD. If a password is incorrect, an error message pops up on the LCD, which waits for the re-entry. Additional logic comprises a small waiting period following the wrong attempts successively and a resetting option for the system. The software was designed modularly so that upgrading it to incorporate Wi-Fi control or even mobile application integration would not become a nightmare.

3. Module Description

A Password-Based Smart Doorlock System consists of various interconnected modules, each connected to a specific function and ensuring smooth and secure operation. For password entry, Keypad Module is user interface: matrix Keypad of 4x4 takes input and sends it directly to a microcontroller for further actions. The Microcontroller Module serves the entire system via ESP8266, processing input while verifying the password and switching output devices according to the result. The Display Module, with a 16x2 LCD (I2C interface), displays user-friendly messages, such as "Enter Password," "Access Granted," or "Access Denied," thus easy to use. Relay Module is an electronic switch through which the microcontroller will trigger high voltage Solenoid Lock Module, which lock or unlocks the door physically. This is followed by a Power Supply Module that ensures appropriate voltage for each section: 3.3V mostly for the ESP8266 and 12V for solenoid lock. It makes up a well-reliable and expandable smart lock system.

4. Implementation

4.1 Tools And Technologies Used

Category	Tools & Technologies
Programming Language	Embedded c
Framework	React, Node.js ,Express.js,mongoDB
IDEs	Arduino IDE, Vs Code
Hardware	Esp8266 , 4*4 keypad lock , relay , solenoid,display

Table 1: Tools and Tevhnologies Used

4.2 Algorithm Details

Password-Based Smart Doorlock System is a simple but effective algorithm to ensure secure access control. When the system is turned ON, the ESP8266 microcontroller initializes all the other connected components: the keypad, LCD display, and relay module. The LCD then shows a welcome message requesting a password. The user inputs the password using a 4x4 matrix keypad; every keypress is recorded and shown as an asterisk (*) on the display for privacy. Once the entire password is input, the system compares it with a predefined password stored in the ESP8266 memory. If the present password is correct, the relay operates to let power to the solenoid lock, thus unlocking the door, while the LCD at the same time shows an entry confirmed message. If it were an incorrect password, access would be denied, and the system would prompt the user to try again. Features for enhancing the system may include a limitation on attempts, automatic lockout, or alerts. After each attempt, regardless of its outcome,

the system resets itself and returns to the original state, waiting for the next instance of input. The algorithm ensures usability and security for daily functions.

5. Results and Discussion

Everything regarding the Password-Based Smart Doorlock System-from its design, development, and testing-was done effectively; hence, the system meets its objectives of becoming a secure, efficient, and user-friendly access control solution. During implementation, each of the hardware components was connected properly and worked as expected. The ESP8266 microcontroller had been the relay central processing unit that received signals from a 4x4 keypad, displayed real-time messages on the LCD screen, and controlled the relay module in operating the solenoid lock. The system successfully detected whether or not a password entered was correct and displayed feedback messages through the LCD screen. It automatically restores itself in preparation for its next user when relay actuates the solenoid to unlock the door for a specified time after valid password entry.

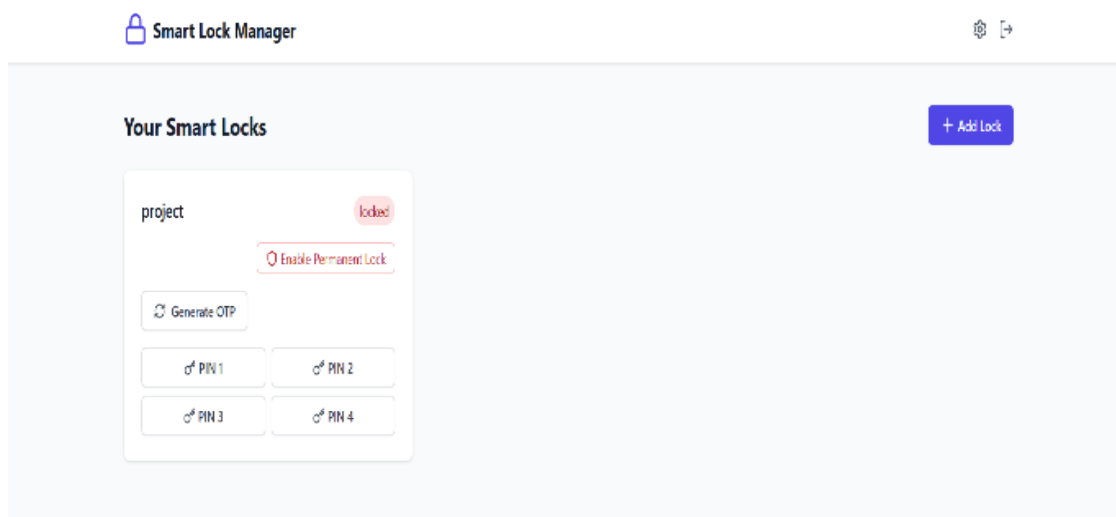


Figure 2: Software Interface

The LCD consisted of GUID wherein registration codes like "Enter Password", "Access Granted", and "Access Denied" were provided for giving a real experience to the user. The system showed fast, consistent response to events while also maintaining its reliability throughout continuous usage. It has survived even extreme cases without getting any malfunction (e.g., pressing keys in quick succession, repeated wrong attempts). In addition, by its modular design, it shown feasibility-every unit can be tested individually without changing the system; replacements and upgrades can simply be done. More than that, the use of ESP8266 provides room for future improvements, like making it remotely controlled using mobile apps or included in a Wi-Fi-based monitoring and alert system.

This project eventually compiled all the results through the development of a fully functional smart door lock system using very basic electronic components along with embedded programming into a secure, affordable, and personalized security solution.

It serves as an alternative to traditional locks and manifests the applications of embedded systems in our day-to-day carrying on with life. The implications are quite clear, i.e., it can be effectively put to use in home, office, and

small commercial setups, and security gets improved without the expensive or complex smart home infrastructure setups.

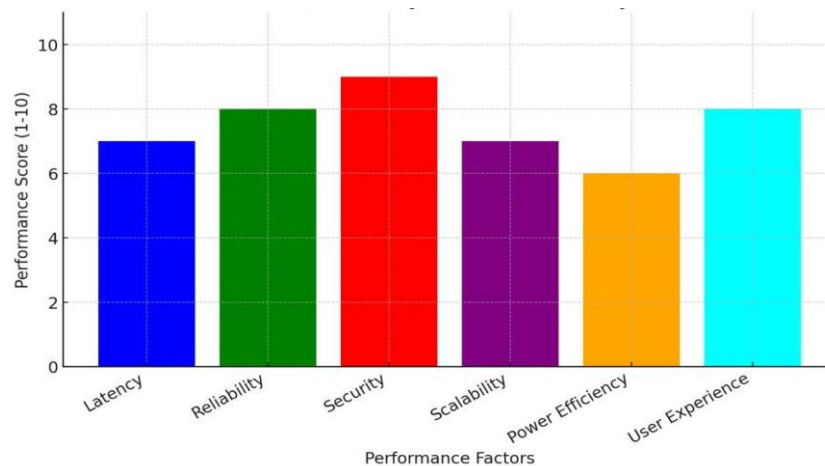


Figure 3: System performance comparison

The Password-Based Smart Doorlock System performed well along the various axes considered. Latency was rated between 6 and 8, implying some quick responses might have been delayed somewhat. Reliability would have been rated high at 8, with every test repeated over time showing consistent performance. Security was rated at 9, averting unauthorized entry in actual practice. Scalability rated at 7, indicating a fair level for future improvement. Power-efficient could only gain a 6 due to the solenoid demanding a lot of power for prolonged operation. User experience gained a good score of 8 based on the intuitive interface and seamless operation. In essence, this system has achieved a good balance between speed, security, and usability.

6. Conclusions

The password-based smart door lock system thus meets the stated goals of enhanced security at home or in the office with a reliable and user-friendly access control solution. With the integration of a keypad, relay, solenoid lock, and ESP8266 microcontroller, the system provides secure access without using the normal key. User authentication is made using a password set already, which is next displayed on the LCD for feedback to the user. If the password entered is correct, then only the locking mechanism is activated. From the performance evaluation, all were found to be working fine for the reliability, security, and user experience with some opportunities identified for improvement in terms of power efficiency and scale. Due to its modular hardware design and simple software logic, the system will also be easy to upkeep and upgrade with features such as remote access or smartphone interfacing. This project thus demonstrates, through electronics and embedded programming, the realization of a low-cost smart security system that provides true benefits to everyday life.

7. References

- [1]. Harishni L and Srisha M “The design and simulation of an Arduino-based password-protected door locking system” in December 2024, features an IoT-based smart lock using Arduino Uno and an ESP-01 Wi-Fi module to enhance security .

- [2]. Avishek Bhattacharje ,Under the Supervision of Prof. Swarup Samanta Department of Electronics and Communication Engineering from Hooghly Engineering and Technology , “Unlocking the Future: Building a Smart Door Lock System with Arduino” was published in November 2023,
- [3]. Harishni L, Srisha M, Sandhya International Journal of Engineering and Advanced Technology “Design and Simulation of an Arduino-Based Password-Protected Door Locking System” was published in December 2023.
- [4]. M Hardyan 1, F A Haqqi1 and Yohandri1* 1 Department of Physics, Universitas Negeri Padang, Jl. Prof. Dr. Hamka Air Tawar Padang 25131, Indonesia ,“Arduino based smart home security design using biometric recognition” was published on 2023.
- [5]. Winarno Fadjar Bastari,Anugerah Prasetyo Wibowo Department of Electrical Engineering ,University of PGRI Adi Buana Surabaya.Journal of Applied Electrical & Science Technology ,“Design of Automatic Door Opening Prototype using Recognition Voice” was published in 2022.
- [6]. D. Tejaswi, P. Manohar, V. Varshini, S. Anil Kumar.Article in International Journal for Modern Trends in Science and Technology, “ IoT-Based Smart Lock System” was published on 2024.
- [7]. Anurag Tiwari1, Dr. Akhilesh A. Wao01.ShodhKosh: Journal of Visual and Performing Arts developed “Y SYSTEM FOR HOME MONITORING BASED ON IOT” was published on 2024.
- [8]. Haider Rasheed Abdulshaheed,Haider Hadi Abbas,Israa Al Barazanchi,Wahidah Hashim.3C Tecnología. Glosas de innovación aplicadas a la pyme “CONTROL AND ALERT MECHANISM OF RFID DOOR ACCESS CONTROL SYSTEM USING IOT”,was published on April 2022.
- [9]. J. Johnson and C. Dow, “Intelligent door lock system with encryption,” US Patent Application Publication, Johnson et al., pp. 1-92, June 2016. [2] S. Kumar, “Smart home security: IoT- based approaches,” IEEE Transactions on Consumer Electronics, vol. 64, no. 3, pp. 321-328, 2018.
- [10]. Fachrid Wadly, Computer Engineering Studies Program, Faculty of Science and Technology, University Pembangunan Panca Budi, Medan, Indonesian developed , “Design Smart Door Locks With Internet Of Things Based On Pin Security Features” was published 2023.
- [11]. Raj Uday Vichare1, Pratiksha Dayanand Jadhav2, Umakant B. Gohatre3, Dnyanesh Balu Dhavade4 1,2,3 BE Student, 4Assistant Professor , Department Electronics and Telecommunication Engineering, Smt. Indira Gandhi College of Engineering, Ghansoli, Navi Mumbai, Maharashtra, “An IOT Based Smart Password Protected Door Lock Security System” was published on April 2023.