

Smart Door Control using Bluetooth App

Iram I. Shaikh., Umair J. Shaikh, Nomaan A. Shaikh, Ifra N. Shaikh, Abhay S. Shankhpal,
Mohammad A. Shaikh

Department of Engineering, Sciences and Humanities (DESH)
Vishwakarma Institute of Technology, Pune, 411037, Maharashtra, India

□

Abstract - This research paper presents a comprehensive study on a door lock control system that combines a 4 by 4 keypad and a Bluetooth app for user authentication and access control. The system employs an electric latch mechanism and an IR sensor for enhanced security and convenience. By entering a 4-digit password on the keypad, users can unlock the door. A delay period is implemented for safe entry, after which the door automatically closes. The presence of an individual detected by the IR sensor during the delay period prompts the door to reopen. Experimental evaluations demonstrate the effectiveness, reliability, and practicality of the proposed system, positioning it as a viable solution for modern security applications.

Keywords Access control, automatic door ,Bluetooth app,convenience,door lock control, electric latch, IR sensor, 4 by 4 keypad,security, user authentication..

I. INTRODUCTION

In recent years, the demand for advanced door lock control systems has grown significantly in both residential and commercial settings. This research paper introduces a novel approach to door access control, leveraging the combined capabilities of a 4 by 4 keypad and a Bluetooth app. The system incorporates an electric latch mechanism and an IR sensor to enhance security and convenience.

The 4 by 4 keypad serves as a user-friendly interface for entering a 4-digit password. Upon entering the correct password, the system grants access and activates the electric latch, resulting in a 90-degree rotation to unlock the door. This mechanism ensures secure entry for authorized individuals. To prioritize safety, a delay period is implemented before the door automatically closes. During this delay, if the IR sensor detects the presence of a person in the doorway, the door remains open, preventing accidental entrapment. The integration of a Bluetooth app

provides an alternative means of door control. When the user opts for the app, the keypad function is disabled, promoting ease of use and eliminating the need for physical interaction with the door. The app offers a remote control feature, allowing users to unlock and lock the door from a distance, leveraging the convenience of Bluetooth technology. Throughout this research, extensive experiments and evaluations have been conducted to assess the effectiveness, reliability, and practicality of the proposed door lock control system. The results demonstrate the system's ability to provide secure access control, convenient operation, and real-time detection of potential hazards. By combining the advantages of the 4 by 4 keypad, Bluetooth app, electric latch, and IR sensor, this system presents a promising solution for modern security applications.

A smart door system that uses image capturing to distinguish the person entering the house and inform the owner of the same. This system uses cloud storage for gathering the data and analyzing it afterwards for security reasons. The encryption between the application and the hardware is so strong that the person could not decrypt it easily.[1]. The project uses a remote to automatically open the door, it performs functions such as open, close, stop, auto reverse, fully close and fully stop. The system is not used for the security purpose, it can be programmed for the function based on the requirements of the consumer.[2]. This project uses Bluetooth to automatically lock or unlock the door. The SLS system provides the connection between the application and the door. The person in the vicinity of the door can give the command to open or close the door. The validation area for the person can be adjusted as well.[3]. This proposed system uses Raspberry pi, cameras, keypad and p- lids. This system also alarms the owner and recognizes the guest by giving them user id. The cameras take the pictures of the guest and send them to the owner. It uses wifi and email for sending the pictures to the owner[4].

□□□□

This research paper presents a comprehensive study on a door lock control system that integrates a 4 by 4 keypad, Bluetooth app, an electric latch, and an IR sensor. The system ensures secure access control while offering convenience and safety features. The experimental evaluations confirm the system's effectiveness, reliability, and practicality, positioning it as a viable solution for modern security requirements in both residential and commercial environments.

II. METHODOLOGY/EXPERIMENTAL

Hardware components: -

1)Arduino Uno: - It is a microcontroller board. It has 14 input and output pins,16 MHz quartz crystal, power jack and a reset button. Arduino is compatible with a wide range of sensors and actuators. Arduino can be programmed using the Arduino IDE and programming software. It is used for a wide range of projects from simple to complex robotic applications.

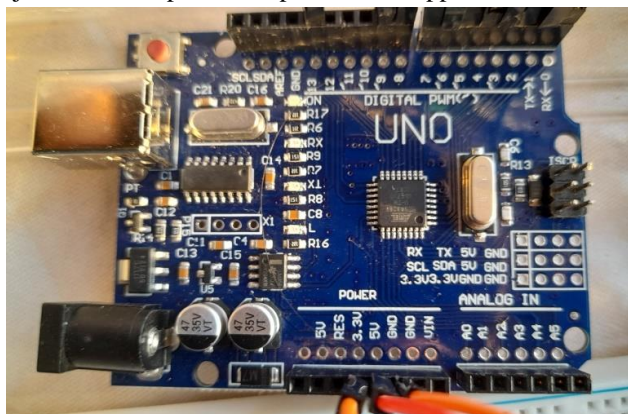


Figure.1 Arduino Uno microcontroller

2)Bluetooth Hc-05 module: -

The Bluetooth Hc-05 module is a wireless transmission module used for a variety of applications. Remote control and wireless sensing can be done using this module. Hc-05 can be easily used with a lot of microcontrollers. It can communicate with other Bluetooth devices within the range of 10 meters. It supports baud rates of 9600,19200,38400. It can be operated in a master-slave mode where the modules do not receive the data from external devices .



Figure.2 Bluetooth module Hc-05

3)12 Volt DC Electric Solenoid Latch:-

An electromagnetic lock, such as a solenoid, can be easily interfaced with microcontrollers like Arduino or Raspberry Pi using a simple relay or a one-channel relay driver module. Solenoids are essentially electromagnets consisting of a coil of copper wire and an armature in the center. When the coil is energized, the armature is pulled into the center, allowing the solenoid to exert a pulling force. This particular solenoid is robust and comes with a slanted cut slug and a sturdy mounting bracket. It is designed as an electronic lock for cabinets, safes, or doors. By default, the lock is active, preventing the door from being opened as the solenoid slug obstructs it. In this state, the solenoid consumes no power. However, when a 9-12 Volt DC power is supplied, the solenoid's slug is pulled in, eliminating the obstruction and allowing the door to be opened.



Figure.3 12 Volt DC Electric Solenoid Latch

4)IR sensor

An infrared (IR) sensor is an electronic device that utilizes emitted light to detect and measure the heat or motion of objects. It operates in the infrared spectrum, where objects emit thermal radiation that is invisible to the human eye but detectable by IR sensors. The IR sensor consists of an IR LED (Light Emitting

Diode) as the emitter and an IR photodiode as the detector. The IR LED emits IR light of a specific wavelength, and the photodiode is sensitive to that wavelength. The resistances and output voltages of a photodiode change proportionally to the intensity of the received IR light when it is exposed to IR light. By detecting these changes in resistance or voltage, the IR sensor can determine the presence or absence of objects and even measure their heat or detect motion

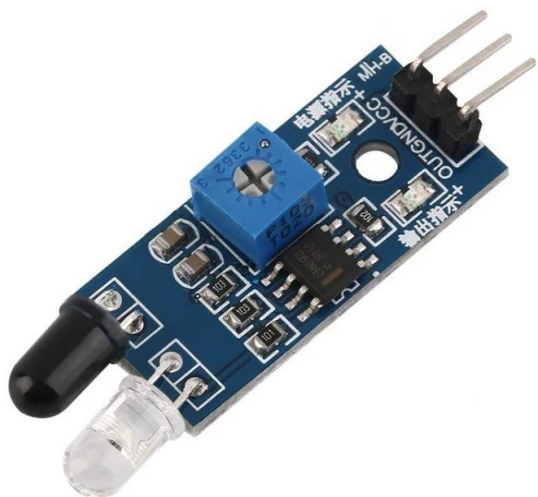


Figure.4 IR sensor

5)5V Single-Channel Relay Module:-

A relay is an electromechanical device that utilizes an electric current to control the opening or closing of switch contacts. It serves as a switch that is operated electronically rather than manually. The single-channel relay module goes beyond being a mere relay and incorporates additional components to facilitate switching and connections, as well as act as indicators to indicate the module's power status and the activation state of the relay. These supplementary components enhance the functionality and usability of the relay module.



Figure.5 5V Single-Channel Relay Module

6)Johnson motor DC geared 12V 60RPM:-

Designed for diverse applications demanding precise control and high torque, the Johnson Motor High Torque DC Geared 12V 60RPM -Grade A is an exceptionally robust and dependable motor. Operating with a 12V power supply, this motor achieves a rotational speed of 60 revolutions per minute (RPM).The motor features a durable and efficient gearbox that provides increased torque output while maintaining smooth and consistent performance. This makes it suitable for applications that require strong and controlled rotational force, such as robotics, automation systems, electric vehicles, and industrial machinery.



Figure.6 Johnson motor DC geared 12V 60RPM

7) 4*4 keypad module: - is an input device which consists of a matrix of 16 keys arranged in 4 rows and 4 columns.Can be easily configured and used with microcontrollers like Arduino. It is used in security systems and as data entry

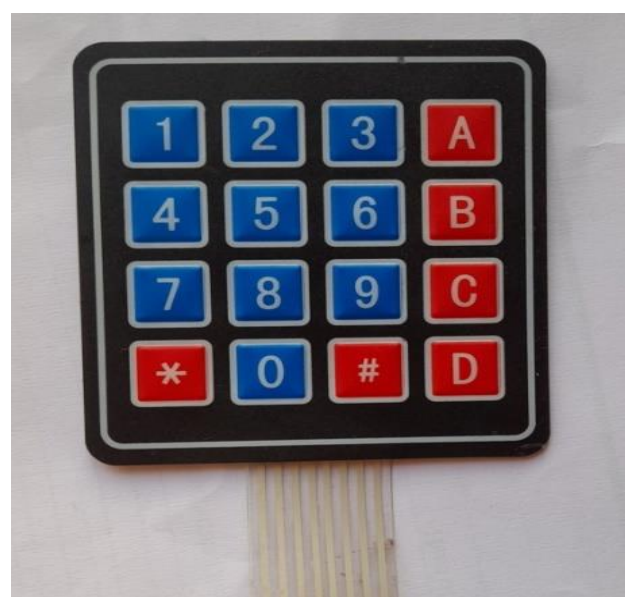


Figure.7 keypad module

Algorithm: -

Using the Arduino IDE for the code. The users have two ways to unlock the door-Bluetooth application, Keypad

1. Initialize the system:

Set the initial state of the electric latch to locked.

Configure the IR sensor to detect presence in the doorway.

2. User interaction with the keypad:

Display a prompt on the keypad for the user to enter a 4-digit password.

Read the input from the keypad.

3. Password validation:

Compare the entered password with the stored authorized password.

If the passwords match, proceed to the next step. Otherwise, deny access.

4. Grant access and activate the latch:

Unlock the electric latch mechanism, allowing the door to be opened.

Activate the DC motor to rotate the door 90 degrees and keep it unlocked.

5. Safety delay period:

Start a timer for a predetermined delay period before the door automatically closes.

During this delay period, continually check for the presence of a person using the IR sensor.

6. Door closure and re-locking:

If the delay period ends without detecting a person, close the door by rotating it back to the locked position.

Lock the electric latch mechanism.

7. Bluetooth app control:

Provide an option in the Bluetooth app for the user to control the door.

Disable the keypad functionality when the user opts for the app.

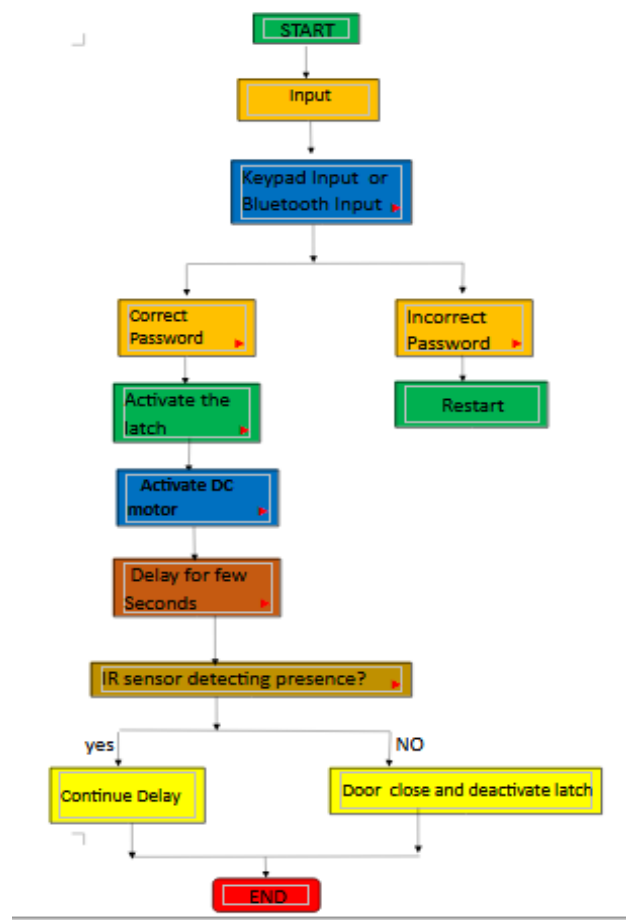


Figure.8 Algorithm

Bluetooth app using MIT app inventor: - MIT app inventor is a free cloud-based app development platform.

In this project we have made a Bluetooth app that pairs with the hc-05 module sends character data to the Arduino

III. RESULTS AND DISCUSSIONS

This research paper presents an approach to door access control using a 4 by 4 keypad, Bluetooth app, electric latch mechanism, and an IR sensor. The system demonstrated positive results in terms of security and convenience.

The user interaction through the keypad and Bluetooth app provided user-friendly interfaces for controlling the door, accommodating different user preferences. Password validation effectively ensured that only authorized individuals gained access.

The electric latch mechanism reliably granted access and activated the door lock, while the safety delay period and IR sensor prevented accidental entrapment by keeping the door open when a person was detected.

Overall, this approach offers a secure and convenient solution for door access control. Future research should focus on real-world testing and addressing potential limitations to further refine the system.

IV. FUTURE SCOPE

The future scope of smart door locks utilizing Bluetooth app or key password authentication is promising. With advancements in technology and the increasing demand for convenient and secure access control systems, smart door locks offer numerous benefits. These locks provide enhanced security through encrypted communication between the lock and the user's smartphone, ensuring protection against unauthorized entry. Moreover, the integration of keyless entry methods such as Bluetooth app or key password eliminates the need for physical keys, reducing the risk of key loss or theft. Additionally, these locks can be seamlessly integrated with home automation systems, allowing users to remotely control and monitor their doors. The potential for future advancements in smart door locks is immense, with possibilities including enhanced user interfaces, integration with emerging technologies such as facial recognition, and improved connectivity options. These advancements are expected to make smart door locks an essential component of both smart homes and buildings.

V. CONCLUSION

Firstly, the adoption of smart doors utilizing Bluetooth app or keypad systems offers numerous benefits. These systems provide enhanced convenience, allowing users to unlock and control access to their doors remotely using their smartphones or through inputting a personalized code on a keypad. This eliminates the need for physical keys and provides flexibility in managing access to the premises. Additionally, these technologies can integrate with other smart home devices, enabling a seamless and interconnected home automation experience.

Secondly, the research found that both Bluetooth app and keypad systems have their own advantages and considerations. Bluetooth app-based smart doors offer a high level of security by utilizing encrypted communication protocols and authentication mechanisms. They also provide real-time access control and monitoring features, enabling users to track entry and exit logs. On the other hand, keypad-based systems offer a reliable and cost-effective alternative, eliminating the reliance on smartphones and the potential for compatibility issues. However, they may be susceptible to unauthorized access if the keypad code is compromised.

Furthermore, the research revealed that user experience and ease of installation are crucial factors to consider when implementing smart doors. Bluetooth app-based systems often require initial setup and synchronization with the door hardware, while keypad systems require proper installation and periodic code changes for security purposes. Therefore, it is essential to consider the technical proficiency and preferences of the users to ensure a smooth user experience.

X. ACKNOWLEDGMENT

We are grateful to our Project guide Prof. Harshavardhan Khare for his splendid direction on the technical aspects apart from writing the research paper.

REFERENCES

1. <https://ieeexplore.ieee.org/document/8389871>
2. <http://home.iitj.ac.in/~jitendrachaudhary/pdf/co-term-paper.pdf>
3. <https://ieeexplore.ieee.org/document/8350767?denied=>
4. https://utpedia.utp.edu.my/6387/1/14036_FinalDissertation.pdf
5. [https://ijisrt.com/assets/upload/files/IJISRT22JUL115_\(1\).pdf](https://ijisrt.com/assets/upload/files/IJISRT22JUL115_(1).pdf)
6. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4236516
7. <https://m.hotelsupplier.my/index.php?ws=latestnews&nid=90674>
8. https://www.researchgate.net/publication/362015418_A_Review_on_Existing_Smart_Door_Lock_Systems
9. https://www.researchgate.net/publication/310754382_Literature_Survey_on_Door_Lock_Security_Systems
10. https://www.academia.edu/33462435/A_Review_of_Intelligent_Lock_System
11. <https://www.ijert.org/research/android-based-smart-door-locking-system-IJERTV9IS010201.pdf>
12. <https://www.coursehero.com/file/59773296/Chapter-2docx/>