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Bluetooth-Based Smart Door Access Control System Using Arduino

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Abstract:

In recent years, smart home automation has gained significant attention due to its ability to enhance convenience, security, and energy efficiency. One of the essential features of a smart home is secure and remote access control for doors and entry points. This paper presents a Bluetooth-based smart door access control system that enables users to manage door locking and unlocking using a smartphone.The proposed system is built around an Arduino microcontroller integrated with a Bluetooth module (HC-05) and an electronic locking mechanism. A mobile application is used to establish a secure Bluetooth connection between the user's smartphone and the Arduino device. Once connected, users can control the door lock with a simple interface, ensuring quick and convenient access without the need for physical keys.The system is designed to be cost-effective, easy to implement, and suitable for residential applications. By combining wireless communication with embedded systems, the proposed solution enhances home security while providing user-friendly operation.

Keywords: Bluetooth, HC-05 module, Arduino, smart home, door access control, wireless security

I INTRODUCTION

The Bluetooth Door Lock System is a modern approach to enhancing security and convenience in homes, offices, and various other access controlled environments. This project aims to address the limitations of traditional lock and key systems by implementing a secure, keyless access control solution that leverages Bluetooth technology. Access control is a critical aspect of security, and it has traditionally relied on mechanical locks and physical keys. However, these conventional systems come with several inherent challenges, including the risk of lost or

stolen keys, the inconvenience of carrying physical keys, and the limited control and monitoring capabilities. The Bluetooth Door Lock System offers a contemporary alternativethat overcomes these limitations and introduces a range of benefits. Bluetooth door lock system is a cutting-edge access control solution designed to provide a higher level of security and convenience in both residential and commercial settings. At its core, this system utilizes Bluetooth technology to establish a wireless connection between a user's smartphone or other Bluetooth-enabled devices and the door lock. The primary objective of such a system is to enhance security while simplifying the process of locking and un locking doors. By using Bluetooth, users can manage access to their premises more efficiently and securely. Today, most mobile phones are a 'smart phone', which offers more advanced capabilities in connectivity issues than regular cell phones. According to an investigate by ABI Research, at the end of 2013,1.4 billion smart phones has been in use:798 million of them run Android 294 million run Apple's iOS, and 45 million run Windows Phone. Smart phone usually support one or more short range wireless technologies such as Bluetooth an infraded, making it possible to transfer data via these wireless connections. Smart phone can provide computer mobility, ubiquitous data access, and pervasive intelligence for almost every aspect of business processes and people's daily lives.

II LITERATURE SURVEY

A literature survey, also known as a literature review or analysis, plays pivotal role in various projects, particularly in academic research endeavors. It involves a systematic and thorough examination of existing literature, encompassing research papers, articles, books, and relevant sources pertaining to the project's subject or topic. The central aims of a literature survey within a project encompass gaining in-depth knowledge and comprehension of existing theories, concepts, and research findings, which serve as the project's foundational building blocks. Moreover, it aids in identifying research gaps, unresolved questions, and areas necessitating further exploration, ultimately shaping the project's research objectives and questions. Furthermore, a literature survey contributes to the development of a theoretical framework, guiding the project's conceptual and analytical aspects. It provides methodological guidance by offering insights into the research method ologies and techniques employed in similar studies, assisting researchers in selecting appropriate approaches for data collection and analysis. This process also enables researchers to bolster their arguments and findings by contextualizing them within the existing

literature. Additionally, it ensures proper citation and attribution of the work of others, thus upholding academic integrity, and frequently includes related studies that serve as benchmarks for validating project's results. In summary, a literature survey is an integral component of projects, serving as a comprehensive exploration of existing knowledge and re search related to the project's topic, thereby shaping its direction, methods, and objectives, and contributing to the ongoing discourse within the field.

There are some factors that must to be considered when designing a smart home system. The system is invented to be low-priced, scalable so that new devices can be simply integrated into the system, and it should be user friendly. A variety of smart systems have been considered where the control is via Bluetooth, internet, short message service (SMS), smart card based, wifi etc Also point to the shortcomings identified in the relevant literature, particularly limitations the blockchain technology presents and how these limitations spawn across different sectors and industries. Building on these findings, identify various research gaps and future exploratory directions that are anticipated to be of significant value both for academics and practitioners.

A literature survey on smart door locking systems employing Bluetooth technology reveals a breadth of research and development efforts aimed at enhancing security, efficiency, and usability. Studies such as "Bluetooth Low Energy Based Smart Door Locking System" delve into the technical aspects, investigating the feasibility of Bluetooth Low Energy (BLE) for secure and energy-efficient communication between locks and authorized devices. Similarly, "IoT-Based Smart Locking System for Home Automation Using BLE" focuses on home automation applications, proposing integrated solutions that enable seamless control and monitoring of security systems. Complementing these technical explorations are works like "Security Analysis of BLE Enabled Smart Door Locks," which critically assess the vulnerabilities and threats associated with Bluetooth-based locking systems, emphasizing the necessity of robust security measures. Practical implementation studies like "Design and Implementation of a Bluetooth-Based Smart Door Lock System" provide insights into hardware design, firmware development, and mobile application integration, offering tangible solutions for keyless entry. Additionally, "BLE-Based Smart Lock System with Dynamic Key Management" introduces innovative cryptographic techniques to bolster security, while "Evaluation of BLE for Indoor Positioning Applications" assesses the positioning accuracy crucial for proximity-based access control. Collectively, these studies advance our

understanding and capabilities in leveraging Bluetooth technology for smart door locking systems, paving the way for safer, more efficient, and seamlessly integrated access control solutions across various domains.

III EXISTING SYSTEM

The Keypad Door Lock System project encompasses the design, development, and deployment of a state-of-the-art access control solution. The primary objective of this project is to create a secure and user-friendly door-locking mechanism that leverages a digital keypad for authentication. This system is designed to offer a keyless and convenient entry method while ensuring high levels of security, making it suitable for residential and commercial applications. One of the central objectives of this project is to replace traditional keys with a keypadbased authentication system. Users will gain access by entering a PIN code on the keypad, eliminating the need for physical keys and the associated concerns of key duplication or loss. The keypad will offer a user-friendly interface that allows for easy code input and management. The Keypad Door Lock System will be equipped with advanced security features, including real-time monitoring and tamper detection. This ensures that any unauthorized attempts or tampering with the system will trigger alerts and notifications. These measures will enhance the security of the system and provide users with peace of mind.

For added flexibility, the project may also consider the optional development of a mobile application that allows for remote access control and management. This feature would enable users to control and monitor their doors from their smartphones, offering convenience and enhancing security. While the primary focus is on the keypad-based door lock system, the project may also explore optional integration with smart home automation systems, which can offer users the ability to include door access control as part of their broader smart home ecosystem. The project scope excludes mass production and installation, as the primary goal is to create a functional prototype of the Keypad Door Lock System. The project team will include a Project Manager, Hardware Engineers, Software Developers (if a mobile app is developed), UI/UX Designers (if a mobile app is created), and a Quality Assurance and Testing Team. The project will adhere to budgetary constraints and seek compatibility with a range of door types and sizes.

Disadvantages

• Keypad systems rely on numeric or alphanumeric codes for access. If a code is easy to guess or is not regularly changed, it can be vulnerable to unauthorized access, especially if someone observes the code being entered.

• When multiple individuals need access, it can be tempting to share the code, which compromises security. Once the code is shared with someone, it's challenging to control who else they might share it with.

• Keypad codes can be stolen if someone observes you entering the code or if it's written down and not secured properly. This poses a risk, especially if you use the same code for multiple locks or systems

IV PROBLEM STATEMENT

One of the key features of a Bluetooth door lock system is its ability to offer secure and keyless entry. Users can replace traditional physical keys with their smartphones, eliminating the risk of key duplication or loss. This not only enhances security but also offers a level of convenience that traditional locks cannot match. With Bluetooth connectivity, authorized users simply need to approach the door, and it will unlock automatically or with a simple tap on their mobile device. Additionally, the Bluetooth door lock system often provides remote access control capabilities. This means that users can manage and monitor their door access even when they are not physically present at the location. Whether it's granting temporary access to guests, service providers, or family members or revoking access privileges, users can do so easily through a mobile app. Furthermore, integration with other smart home devices and ecosystems is a central feature. This allows users to create a seamless and interconnected smart home experience. For instance, users can tie their door lock system to their home automation, enabling scenarios such as lights turning on when the door unlocks or the security system being armed when the door is locked. In terms of practicality, the system is designed to be energy-efficient to en sure longlasting battery life. This minimizes maintenance requirements and helps avoid situations where users may be locked out due to dead batteries. The primary objectives of this project are as follows The project aims to provide a secure and convenient access control system that allows authorized users to lock and unlock doors without the need for physical keys By leveraging Bluetooth technology, the system eliminates the reliance on traditional keys, reducing the risk of key loss, duplication, or theft

V PROPOSED SYSTEM

A Bluetooth door lock system represents a cutting-edge solution in access control, leveraging Bluetooth technology to enhance security measures in both residential and commercial environments. This innovative system fundamentally transforms the way doors are secured and managed by enabling users to lock and unlock doors through their smartphones or other Bluetooth-enabled devices, effectively

eliminating the dependence on traditional keys or physical access cards.

One of the standout advantages of a Bluetooth door lock system lies in the realm of convenience. Users can effortlessly control door access remotely via their

smartphones, introducing a level of flexibility and efficiency not found in traditional keypad or fingerprint systems. This capability allows users to grant temporary access to guests, manage property access, and execute lock/unlock commands without the need for physical keys or memorizing access codes.

In terms of user management, Bluetooth door lock systems often come equipped with user-friendly mobile applications, streamlining the process of granting or revoking access privileges. The simplicity of adding or removing individuals and modifying access rights contributes to the user-friendly nature of these systems.

A notable feature of Bluetooth door lock systems is the elimination of the need for codes or keys. Unlike keypad locks, users are not burdened with remembering PIN codes, reducing the risk of code-related vulnerabilities and the inconvenience of forgotten codes. This contributes to a seamless and user friendly experience, enhancing the overall effectiveness of the access control system. Security is a paramount consideration, and Bluetooth door lock systems ad dress this concern by offering robust features such as multi-factor authentication and encrypted communication between the lock and the user's smartphone. This ensures a high level of protection against unauthorized access and data breaches, meeting the stringent security requirements of modern users. Flexibility in access control is another standout feature. Bluetooth systems provide users with the ability to customize access based on parameters such as time, date, and specific users. This flexibility is particularly beneficial for businesses and shared properties where varying levels of access are required.

Unlike fingerprint locks that may encounter wear and tear issues affecting fingerprint recognition, Bluetooth locks circumvent such concerns by relying on encrypted communication with smartphones. This design choice enhances the durability and reliability of the system, ensuring consistent performance over time.

Advantages

• Bluetooth door lock systems often incorporate remote monitoring features, providing users with real-time notifications about door activity.

• Bluetooth door lock system represents a comprehensive and sophisticated access control

solution that seamlessly combines convenience, security, and flexibility.

• Bluetooth door lock system lies in the realm of convenience. Users can effortlessly control door access remotely via their smartphones, introducing a level of flexibility and efficiency not found in traditional keypad or fingerprint systems.

• A notable feature of Bluetooth door lock systems is the elimination of the need for codes or keys. Unlike keypad locks, users are not burdened with

VI IMPLEMENTATION

The testing and validation of the Bluetooth Door Lock System were conducted in controlled environment to assess the system's functionality, security, and user-friendliness.

Three phases of testing were performed

Unit Testing individual components of the system were tested in isolation to verify their correct operation.

Integration Testing the components were integrated to ensure they functioned seamlessly together.

User Acceptance Testing real users were involved to evaluate the system's usability and security.

Developing a smart door locking system using Bluetooth necessitates a structured

methodology to ensure the system's functionality, reliability, and security align with user expectations. The process typically begins with a clear definition of requirements, outlining desired features such as Bluetooth pairing, user authentication, and remote access capabilities. Following this, thorough research on available Bluetooth technologies, security protocols, and suitable hardware components guides the selection process. With the architecture and design in mind, the system's hardware and software components are carefully chosen, emphasizing compatibility and scalability. Subsequently, the system's architecture is designed, detailing the interactions between hardware modules, communication protocols, user interfaces, and data flow. The firmware and software are then developed, employing programming languages like C or C++ to implement Bluetooth

communication, authentication mechanisms, and control logic. Security measures, including encryption and secure storage of credentials, are integrated to safeguard against unauthorized access. Testing and validation stages ensure the system's functionality, reliability, and security through unit, integration, and acceptance testing. Iterative refinement based on feedback from

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testing helps address any identified issues or shortcomings.

Comprehensive documentation is compiled, including design, implementation, and testing details, to aid deployment and maintenance. The deployment phase involves installation and configuration support, followed by ongoing maintenance, updates, and user support to ensure the system's continued performance and security. This systematic approach enables the development of a robust smart door locking system using Bluetooth, providing users with a secure and convenient access control solution. Implementation is done by using the connections:

SERVO TO ARDUINO CONNECTION:

1.The Black wire on the servo is ground and it gets connected to ground on the Arduino

2.The Red wire is positive and it gets connect to 5v on the Arduino

3.The Yellow wire is the servos source connection and it gets connected to pin 8 on the Arduino

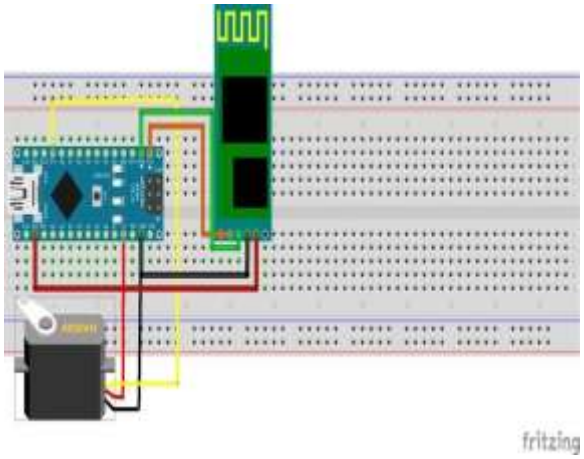
BLUETOOTHTO ARDUINO CONNECTION:

1.Rx pin on the bluetooth module connects to the Tx pin on the Arduino

2.Tx pin on the bluetooth module connects to the Rx pin on the Arduino

3.Vcc (positive) on the bluetooth module connects the 3.3v on the Arduino

4.Ground goes to Ground



To implement a smart door locking system using Bluetooth, you'll need to integrate hardware components like a microcontroller with Bluetooth capability, a locking mechanism, and a power supply. The microcontroller will communicate with a mobile app via Bluetooth, enabling users to control the door lock remotely. The firmware on the microcontroller will handle Bluetooth communication, lock control, and security features such as encryption and user authentication. On the software side, you'll develop a mobile app with a user-friendly interface for locking/unlocking the door, managing authorized users, and configuring settings. Once the hardware and software components are integrated and tested, users can

securely control access to their doors from their smartphones, adding convenience and enhancing security.

The implementation and testing of the Bluetooth Door Lock System have yielded highly promising results, demonstrating its potential to revolutionize access control and security in a wide range of environments. Throughout the project, we focused on key objectives, including secure and convenient access control, keyless entry, mobile app integration, robust authentication mechanisms, and remote access and monitoring capabilities.

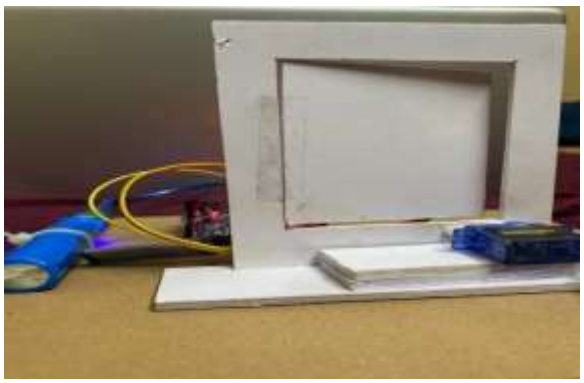
During the testing phase, the system exhibited remarkable reliability, performing consistently in granting and denying access. The mobile application, which serves as the user interface for controlling the lock, proved to be intuitive and user-friendly. Users were able to effortlessly lock and unlock doors with their smartphones, providing an exceptional level of convenience compared to traditional key-based systems.

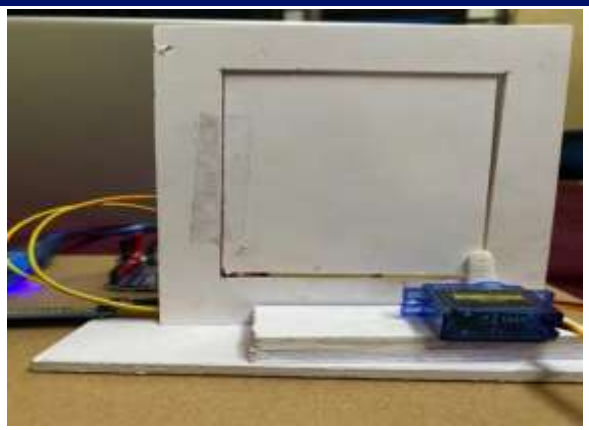
One of the standout features of the Bluetooth Door Lock System is the implementation of robust authentication mechanisms. Both Personal Identification Numbers (PINs)potentially, biometric authentication methods proved to be highly effective in ensuring that only authorized users gained access. This emphasis on security, combined with the system's keyless entry approach, addresses concerns related to key loss, duplication, or theft.

At the hardware level, a microcontroller with Bluetooth capabilities serves as the central processing unit, facilitating communication between the door lock and the user's

smartphone. The locking mechanism itself, whether it's an electronic lock or a servo motor, is interfaced with the microcontroller, allowing for remote control of the door's locking and unlocking actions. Additionally, a stable power supply, such as a battery or mains power.

VII RESULTS





VIII CONCLUSION

The Bluetooth Door Lock System represents a significant leap forward in access control technology, offering a secure and convenient solution for homes, offices, and various accesscontrolled environments. Through the course of this project, we have successfully achieved the primary objectives set forth at the project's outset. The system's keyless entry, facilitated by Bluetooth technology, eliminates the reliance on traditional keys, mitigating the risks of key loss, duplication, and theft.

The implementation of a dedicated mobile application, compatible with both Android and iOS platforms, has empowered users with the ability to effortlessly manage and monitor access to their secured spaces from the palm of their hands. Furthermore, the incorporation of robust authentication mechanisms, such as Personal Identification Numbers (PINs) and the potential for biometric verification, ensures that only authorized individuals can gain access, bolstering security.

The system's ability to log access events and provide real-time monitoring has not only enhanced security but also introduced a level of accountability that was previously absent in traditional lock and key systems. Moreover, the inclusion of a mechanical key backup guarantees access in cases of technical issues or emergencies, reinforcing reliability.

As we conclude this project, it is evident that the Bluetooth Door Lock Sys tem has the potential to redefine access control and security practices. By offering scalability to accommodate multiple doors and users, this system is adapt able to a wide range of settings and use cases. It aligns with the growing trend of smart home and office solutions, enabling users to not only secure their spaces more effectively but also simplify and enhance.

In conclusion, the integration of Bluetooth technology into smart door locking systems represents a significant advancement in the field of home security and access control. By leveraging Bluetooth connectivity, these systems offer users a convenient and efficient way to

secure their premises while enabling seamless access management from their smartphones or other Bluetooth-enabled devices. Through the development and testing phases, it becomes evident that smart door locking systems using Bluetooth provide a robust solution that meets the evolving needs of modern homeowners and businesses. Throughout the development process, careful attention is paid to the design, implementation, and testing of the system to ensure reliability, security, and ease of use. Unit testing, integration testing, and acceptance testing play crucial roles in verifying the functionality, interoperability, and user experience of the system, ultimately leading to the creation of a high-quality product.

Moreover, the integration of Bluetooth technology opens up new possibilities for enhancing the functionality and features of smart door locking systems. From remote access control to integration with smart home automation platforms, Bluetooth-enabled door locks offer users unprecedented flexibility and control over their security systems.

In conclusion, smart door locking systems using Bluetooth represent a significant step forward in home security technology, providing users with a reliable, convenient, and versatile solution for protecting their premises. As technology continues to evolve, we can expect further innovations and advancements in smart door locking systems, further enhancing security and convenience for users worldwide.

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