SMART DOOR LOCK SYSTEM

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ABSTRACT

“IoT technology is integrated into the Smart Door Lock System to improve convenience and security in both home and business environments. Without the need for physical keys, users may remotely monitor and control access through smartphone apps or web interfaces thanks to smart locks, sensors, and a central control unit. Remote access management, adjustable access credentials, and real-time notifications are important features. Protection against illegal access is ensured by sophisticated security features like encryption and multi-factor authentication. Furthermore, by adjusting the system to user behaviors, data analytics and machine learning improve user experience and security. All things considered, it offers enhanced security, ease of use, and adaptability for a variety of uses.The system architecture is intended to be user-friendly and adaptable. Users can quickly enroll their fingerprints by completing a simple registration process, which securely keeps the unique fingerprint templates in the system memory. When accessing the door, users just need to place their registered finger on the sensor to initiate the authentication procedure.”

I. Introduction

The way we engage with our environment has changed dramatically as a result of the Internet of Things (IoT) technology being incorporated into commonplace products in our increasingly linked world. The smart door lock is one of these breakthroughs that sticks out as a ray of convenience and security, fusing cutting-edge technology with essential elements of everyday life. In the future, keys will be obsolete and be replaced with an advanced system that can recognize and adjust to your demands instantly. The smart door lock offers to open the door to a safer, more intelligent, and more effective way of living.

Fundamentally, the smart door lock uses the Internet of Things to convert a commonplace household item into a proactive digital protector. It creates a thorough network of security by connecting to the internet and interacting with other smart devices in the home environment, like motion sensors and security cameras. This connectivity allows for unmatched ease as well

as improved security. Imagine coming home after a long day and not having to worry about misplaced or stolen keycards or scrabbling around for keys in the dark. Access is provided with ease with a single tap on your smartphone or a voice command to your virtual assistant. Furthermore, the goal of the smart door lock is to give people unmatched control over their living areas rather than just locking and opening doors. With a few taps, users can quickly and easily provide temporary or permanent permissions to family members, friends, or service providers through user-friendly mobile applications that allow for remote monitoring and management of access. With this degree of detail, homeowners can customize access privileges to fit their security and lifestyle preferences, giving them a renewed sense of autonomy. The smart door lock is a shining example of innovation in the IoT space, and it bears witness to our continuous pursuit of more intelligent, safer, and networked living spaces.

II. Literature Survey

1.Design and Implementation of an IoT based Smart Door Lock System

This paper summarizes that in today's internet-driven world, security and comfort are paramount. IoT offers solutions that provide both, with smart locks emerging as vital components. Traditional locks are evolving into contactless smart systems, addressing limitations of mechanical locks. This article proposes a Smart Door Unlock System, integrating Face Recognition, Fingerprint, RF card, Password, and IoT for enhanced security. A camera captures faces, matched via an image algorithm, while a fingerprint sensor eliminates key management issues. Designed with accessibility in mind, this system benefits the elderly, offering ease of use and heightened security for all.

2.IoT Based Door Lock Surveillance System Using Cryptographic Algorithms

This paper focuses on IoT as it’s reshaping security, notably through smart door locks. However, transmitting sensitive data over networks poses risks. To tackle this, we introduce a highly secure door lock system, blending password-based access with cryptographic shielding. Our solution includes an Android app, leveraging cryptographic algorithms for secure communication, and programmable hardware with sensors and actuators to thwart unauthorized access. Dubbed cryptoLock, it not only safeguards physical valuables but also shields transmitted data. Offering seamless remote access and comprehensive security, cryptoLock ensures peace of mind in an increasingly connected world.

3.Design and Implementation of an IoT based Smart Door Lock System

The author of this paper summarizes that IoT devices, like smart door locks, revolutionize security by overcoming traditional limitations. This proposed system, employing Arduino, integrates voice, fingerprint, and keypad unlocking methods for convenience and flexibility. Voice control allows hands-free access, fingerprint recognition ensures reliability, and keypad entry offers simplicity. By combining these methods, this offers

security.This article investigates the transformative role of IoT devices, namely smart door locks, in overcoming traditional security constraints. The proposed system, which uses Arduino, combines voice, fingerprint, and keypad unlocking methods to provide a complete solution for ease, versatility, and security.Voice control technology enables hands-free access by allowing users to unlock doors using simple voice commands. Fingerprint recognition ensures accuracy by utilizing biometric data that is unique to each individual. Keypad entry is simple and provides an alternate way to access the door. By integrating these approaches, the system improves security by providing numerous levels of authentication. Users can select the technique that best meets their tastes and needs, providing greater flexibility in access control.

4.Blockchain-based Secure Data Storage for Door Lock System

From this paper we can understand that smart homes, leveraging IoT, offer convenience but face data security challenges, especially regarding door lock access. Ensuring the integrity of this data is crucial for homeowner safety. Blockchain emerges as a solution due to its immutable and non repudiable properties. This study employs Ethereum blockchain and smart contracts to securely store and manage door lock access data. Testing reveals a high security level, with an average avalanche effect index of 96%, indicating the proposed system's efficacy in safeguarding sensitive information and enhancing home security.The suggested method makes use of the Ethereum blockchain's immutable and non-repudiable features to ensure the integrity and security of access data. Smart contracts are used to govern access permissions, guaranteeing that only authorized users interact with the door lock system.During testing, the system displayed a high level of security, with an average avalanche effect index of 96%. This demonstrates the effectiveness of the suggested approach in protecting sensitive information and improving home security.The use of blockchain-based door lock access management has numerous benefits, including increased security, transparency, and accountability. By decentralizing access data storage and utilizing blockchain's cryptographic characteristics, the system reduces the dangers associated with centralized databases, such as data breaches and unlawful access.Overall, this study demonstrates the promise of blockchain technology.

5. Automatic Door Locking System in Households Using IoT

The study addresses the critical problem of waste management in highly populated metropolitan areas by developing an IoT-enabled garbage segregator system. Traditional garbage disposal practices, such as dumping into landfills or burning, contribute to environmental degradation by emitting greenhouse gases. To address this, the suggested system uses sensors such as IR, moisture, and metal sensors to sort municipal waste into biodegradable and non-biodegradable categories. Three DC motors help garbage travel smoothly along a conveyor belt, allowing for efficient sorting. The system's successful implementation indicates its effectiveness in sorting deposited garbage. Furthermore, by connecting to the cloud, the device allows for the preservation of sensed data for future analysis and processing, indicating its potential

for further improvements in waste management techniques.

III. Limitations in Existing System

Smart door lock solutions rely on power sources like batteries or electricity. In the event of a power outage or battery failure, the system may become unreachable, posing inconvenience or security risks.Smart door lock systems, particularly those connected to the internet, are vulnerable to hacking attacks. Malicious actors can exploit weaknesses in encryption methods or software flaws to gain unwanted system access.Existing smart door lock systems may not be compatible with all devices or platforms. This may hinder interoperability with other smart home devices or IoT platforms, reducing the system's overall functionality and convenience.
While biometric systems such as fingerprint recognition are highly reliable, they are susceptible to false positives and false negatives. Environmental conditions such as dampness and grime can impair the accuracy of fingerprint sensors, resulting in authentication mistakes.Smart door lock system installation and configuration can be time-consuming and complicated. Users may encounter difficulties configuring the system appropriately, resulting in potential security risks or operational concerns.

IV. Proposed System

The Smart Door Lock IoT project utilizes Arduino microcontroller technology and biometric scanning capabilities to revolutionize traditional door security. At its core, the system employs biometric sensors, such as fingerprint scanners or facial recognition modules, interfaced with Arduino boards to authenticate users securely.The Arduino microcontroller initiates actuators that regulate the door's locking and unlocking mechanisms when the user verifies the information. The system also incorporates Internet of Things concepts to allow for remote access and control through a web interface or mobile application. Users can remotely monitor door status, authenticate themselves using biometric scans, and grant access to authorized individuals from anywhere with an internet connection. Robust security measures, including encryption of communication channels and secure storage of biometric data, safeguard the system against unauthorized access or tampering. Through thorough testing and validation, the system ensures reliability, performance, and adherence to stringent security standards, ultimately providing users with a seamless, secure, and convenient door access solution for residential and commercial applications.Each unlocking mechanism is thoroughly tested and optimized to assure its reliability, accuracy, and security, with a focus on performance, power efficiency, and responsiveness. Security upgrades, such as encryption techniques and procedures to prevent unwanted access, are implemented to protect the system's integrity. The project also includes extensive documentation, such as system architecture, design decisions, implementation details, and a user manual for installation, use, and troubleshooting. The proposed work is to build a durable, dependable, and user-friendly Multi-Method Smart Door Lock System, which will contribute to the growth of smart home security technology.Furthermore, much effort is put into user interface development to maintain a consistent user experience. Fingerprint registration, voice command setup, and access

code management all use a user-friendly interface. Feedback systems have been implemented to give users with real-time status updates and error notifications. Testing and optimization are critical to the project's success. Each unlocking method is rigorously tested to ensure its reliability, accuracy, and security. Optimisation efforts are aimed at enhancing system performance, power efficiency, and responsiveness.

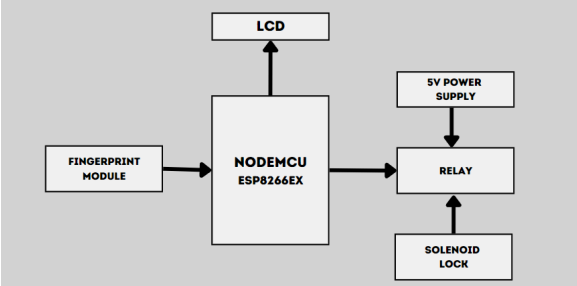

Figure 1: System Architecture

Each unlocking method is rigorously tested to ensure its reliability, accuracy, and security. Optimisation efforts are aimed at enhancing system performance, power efficiency, and responsiveness.Security is critical in the planned work. Advanced encryption techniques are used to safeguard communication between components, and precautions are taken to prevent unauthorized access and protect critical data. The project also contains extensive documentation outlining the system architecture, design decisions, implementation specifications, and a user manual to ensure easy setup, use, and troubleshooting.By the end of the project, a strong, dependable, and user-friendly Multi-Method Smart Door Lock System will exist. This system will provide extensive security features while being flexible and easy to use. Finally, the project seeks to contribute to the advancement of smart home security technology by offering homeowners a complex yet user-friendly option for securing their properties.

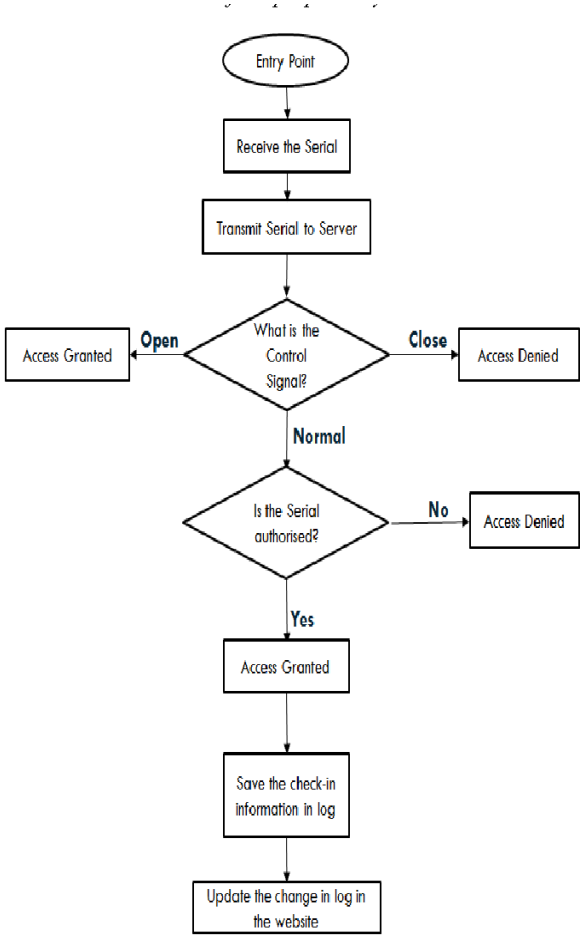

Figure 2: Data Flow Diagram

V. Work Process

1. Solenoid Door Lock

A solenoid lock is an electromechanical device that manipulates magnetic fields and electric currents to secure access points. The fundamental idea of electromagnetism—that a magnetic field is produced by an electric current

flowing through a coil of wire—underpins how it works. The mechanism is then locked or unlocked by means of a mechanical part that is usually a bolt or plunger, activated by this magnetic field. The solenoid moves the plunger or bolt into a position that locks the door or access point when it gets an electric current because it becomes magnetized. Unauthorized entrance is prevented by this locked position. On the other hand, the door may be opened easily when the electric current stops, the magnetic field weakens, and the plunger or bolt retracts.

Figure 3: Solenoid Door Lock

2. 5V Relay

Performing at a low voltage of 5 volts, a 5V relay is a versatile electromechanical switch. By manually switching on and off electrical circuits, it functions by making use of an electromagnet. The relay coil creates a magnetic field that moves the switch contacts when just a tiny bit of electrical current is sent through it. 5V relays are appropriate for a wide range of applications, such as industrial control systems, robotics, and home automation, thanks to this feature. Functioning as a crucial interface between numerous electrical components, they can be made use of for managing circuits that require higher voltages or devices with lower voltage signals.

Figure 4: 5V Relay

3.NODE-MCU

The NodeMCU is a flexible open-source firmware and development kit built on the ESP8266 Wi-Fi module. It combines a microcontroller unit (MCU) with Wi-Fi capabilities to allow for smooth prototype and development of Internet of Things (IoT) projects. Its design includes GPIO ports, analog-to-digital converters (ADCs), and Lua programming language support, providing an intuitive environment for connecting sensors, actuators, and other devices to the internet. With its low cost, small form factor, and extensive community support, the NodeMCU has grown in popularity among hobbyists, makers, and professionals for efficiently building Wi-Fi-enabled applications and IoT solutions, establishing it as a go-to choice in the realm of connected devices.

Figure 6:NODE-MCU

VI.Future Enhancements

Several additional functions may significantly enhance the smart door lock system's performance, security, and user experience. For instance, bringing together remote access and notifications would allow customers to manage their doors from anywhere, receive real-time alerts, and provide remote access via their cell phones. A focused mobile application might streamline these aspects by providing an easy-to-use interface for enrollment, authentication, and access control, as well as user management and access logs.

Additionally, adding speech recognition software would provide hands-free access, increasing convenience and accessibility. Multi-factor authentication, which incorporates fingerprint recognition with PIN codes or recognition of facial features may improve security.Time-based access control might enable users to define specified time slots for access, hence enhancing adaptability. Combining the system with existing smart home platforms, such as Amazon Alexa or Google Home, would enable uniform connection with other smart devices.

A battery backup system enables currently underway functioning during power outages, while tamper detection features alert users of unlawful attempts. Enhanced data encryption and privacy safeguards would protect sensitive information, while personalized user profiles with various access permissions would provide flexibility. Finally, linking the system with CCTV cameras would allow for visual authentication of access attempts, improving safety and accountability. These future upgrades promise to make the smart door lock system more versatile, user-friendly, and secure, meeting the changing needs of users.Adding features such as intrusion detection sensors or video surveillance integration would improve security. Intrusion sensors could alert to tampering efforts, and video surveillance would provide visual proof of access events.Using machine learning techniques to examine access patterns and user behavior may improve security.

The system might modify its security rules based on previously learnt patterns, detecting abnormalities and altering access rights accordingly.Improving energy efficiency and adding power backup systems would alleviate concerns about power dependency. Implementing low-power modes and energy harvesting techniques could help to improve battery life, while backup power sources such as solar panels or secondary batteries would ensure continuous operation during outages.Empowering customers to modify and customize their experiences would increase user happiness. This could include features like configurable access schedules, personalized voice commands, and user profiles that can be adjusted. As previously mentioned, implementing blockchain technology could add

an extra layer of security by assuring the indestructibility and integrity of access logs and permissions.

VIII. Conclusion

In its entirety, the smart door lock system with a fingerprint module, compact LCD, and NodeMCU represents an important advancement in access control technology. This project provides a strong and convenient approach for managing access to various spaces through the use of biometric authorization and sophisticated technology. The fingerprint module ensures secure and reliable authentication, eliminating the need for conventional keys or passwords. Meanwhile, the small LCD serves as an easy-to-use interface for system status and suggestions, ensuring users are aware of the authentication process. With the NodeMCU as the central control unit, the system is quickly connected to the internet, which enables remote access and monitoring. While the system does not provide significant feedback, its core function of authenticating and unlocking the door effectively accomplishes its objective. Looking ahead, the project allows for future modifications, such as remote access, multi-factor authentication, and communication with smart home ecosystems, to improve functionality and security. Overall, this smart door lock system represents an immense leap in access management, providing a secure, simple, and customizable solution geared to modern needs.

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