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DOOR SECURITY SYSTEM FOR HOME MONITORING BASED ON IOT

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ABSTRACT

The smart door lock system Using IoT is an innovative solution that combines the power of Internet of Things (IoT) technology with traditional door locking mechanisms to enhance security, convenience, and control. This system employs smart devices, sensors, and a cloud-based platform to create an intelligent and responsive door access management system. The core components of the smart door lock system include a smart door lock device, IoT-enabled sensors, and a centralized cloud-based platform. The smart door lock is equipped with electronic locking mechanisms and wireless communication capabilities, allowing it to be controlled remotely. The IoT sensors integrated into the door and surrounding environment, provide real-time data on various parameters such as door status, temperature, and motion. The system utilizes a secure and scalable cloud-based platform to manage and monitor access control. Users can interact with the smart door lock system through a dedicated mobile application, web interface, or voice commands. The cloud platform enables seamless integration with other smart home devices and provides a centralized hub for data storage and analysis. The smart door lock system using IoT addresses the growing need for advanced security solutions while offering users unprecedented control over their door access. Making it a valuable addition to modern households and commercial spaces.

Keywords: Android Application, Access and Control, IoT, Real-time Monitoring, Smart Door Lock, Wireless Communication, Remote

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1. INTRODUCTION

The advent of the Internet of Things (IoT) has revolutionized the way we interact with our surroundings, providing innovative solutions to enhance various aspects of daily life. One such application is the integration of IoT technology with traditional door-locking mechanisms, giving rise to the smart door lock system. This system aims to redefine the concepts of security and access control by leveraging the power of connectivity and intelligent data processing. Traditional door locks, while effective, often lack the flexibility and advanced features required for modern living. The smart door lock system introduces a paradigm shift, transforming a conventional door lock into a dynamic and responsive device. Incorporating IoT-enabled sensors, wireless communication, and cloud-based platforms, this system offers users unprecedented control, convenience, and security [1][27]. Equipped with electronic locking mechanisms, the smart door lock serves as the cornerstone of the system. Features wireless connectivity for remote access and control via IoT protocols. IoT Sensors Various sensors, including door status sensors, temperature sensors, and motion sensors, provide real-time data to the system. Enhances security by monitoring environmental conditions and detecting any unauthorized activities. Cloud-Based Platform The central hub for data storage, processing, and user management. Enables remote access to the smart door lock system through mobile applications, web interfaces, and voice commands

[2]. As we delve into the details of the smart door lock system, it becomes evident that the integration of IoT technology not only enhances security but also transforms the way we manage access to our homes and commercial spaces. This introduction sets the stage for exploring the various components and functionalities that make this system a pioneering solution in modern security and home automation [3].

2. METHODOLOGY

Methodology for implementing a smart door lock system Using IoT involves a series of systematic steps to ensure the successful integration of the various components. Here is a general outline of the methodology [4].

- **System Design:** Define the requirements and functionalities of the smart door lock system. Determine the types of sensors and authentication methods to be used. Design the user interfaces for mobile applications and web platforms.
- **Hardware Setup:** Acquire or develop a smart door lock device with electronic locking mechanisms and IoT capabilities. Integrate IoT sensors, such as door status sensors, temperature sensors, and motion sensors, into the door and surrounding environment. Ensure compatibility and seamless communication between the smart door lock, sensors, and other hardware components [5].
- **IoT Connectivity:** Choose appropriate IoT communication protocols (e.g., MQTT, CoAP) for data exchange between devices and the cloud platform. Implement secure communication channels to protect data during transmission. Configure the smart door lock to connect to the designated cloud-based platform.
- **Cloud-Based Platform Setup:** Select a reliable and scalable cloud platform (e.g., AWS IoT, Azure IoT) for managing and storing data. Set up databases to store user profiles, access logs, and system configurations. Implement security measures, including encryption and access control, to protect stored data [6].
- **User Authentication System:** Develop authentication mechanisms, such as PIN codes, biometrics, or digital keys. Implement multi-factor authentication for enhanced security. Integrate the authentication system with the cloud platform for centralized user management.
- **Mobile Application and Web Interface Development:** Design and develop user-friendly interfaces for mobile applications and web platforms. Implement features for remote door control, monitoring, and user management [7]. Provide ongoing support for users and address any issues that may arise. By following this methodology, developers can systematically implement a smart door lock system using IoT, ensuring a robust, secure, and user-friendly solution for enhanced door access control and security [8].

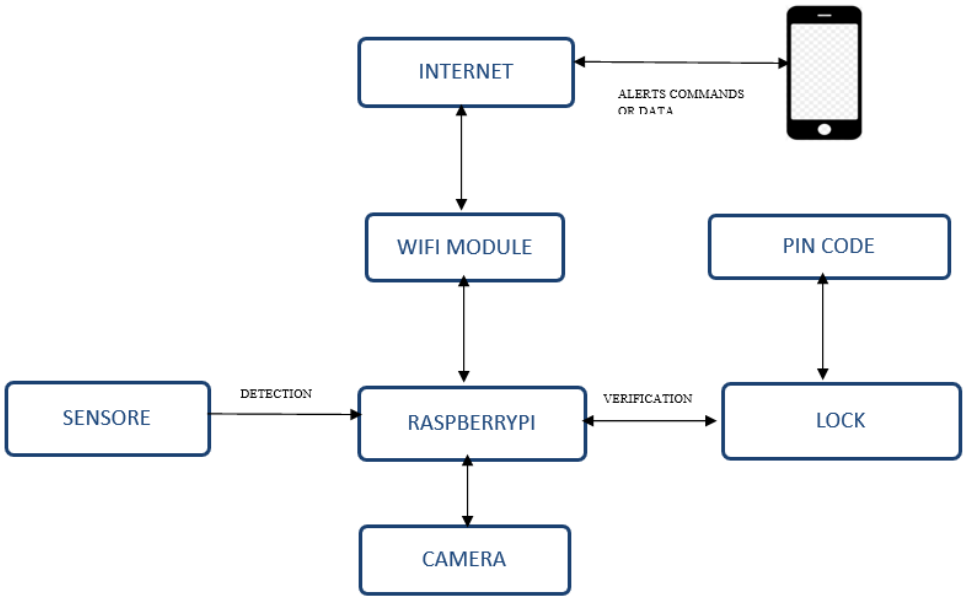

Figure 1: The Block Diagram of Door Proposed System

Hardware and Software Development

Creating a smart door lock system using the IoT (Internet of Things) involves a combination of hardware and software development. Here's a basic guide to help you get started.

A. Raspberry Pi as Processing Element and Server

Using Raspberry Pi as both a processing element and a server for a smart door lock system using IoT is a feasible and cost-effective approach. The Raspberry Pi is a versatile and compact single-board computer that can run lightweight server applications and interface with various sensors and actuators. Here's a methodology for implementing this system [9].

- **Hardware Setup:** Raspberry Pi Configuration: Set up the Raspberry Pi with the necessary peripherals (keyboard, mouse, monitor) and install the operating system (e.g., Raspbian). Enable SSH for remote access to the Raspberry Pi.
- **Sensor Integration:** Connect IoT sensors (door status sensors, temperature sensors, and motion sensors) to the GPIO pins of the Raspberry Pi. Install any required libraries or drivers to interface with the sensors.
- **Connectivity**: Establish a secure connection to the cloud platform using IoT communication protocols (e.g., MQTT or CoAP). Ensure that the Raspberry Pi can communicate with the cloud server for data exchange [10].

Software Implementation

- **Server Software Setup:** Choose a server application for the Raspberry Pi (e.g., Flask for a web server). Develop server-side scripts to handle incoming requests from the cloud platform and mobile applications.
- **Cloud Integration:** Set up an account on a cloud platform (e.g., AWS IoT, Azure IoT). Configure the Raspberry Pi to connect to the cloud platform using the appropriate credentials [11]. Implement a secure and encrypted communication channel between the Raspberry Pi and the cloud. Address any hardware issues promptly, and update configurations as needed. By adopting this methodology, you can leverage the capabilities of the Raspberry Pi as a processing element and server for your smart door lock system using IoT, providing an affordable and efficient solution for enhanced door access control and security [12].

Table 1. Hardware Module

No	Name	Description
1	Adaptor	Supply electricity to the Adaptor (12V) to the system from the stop contact
2	Step Down	Step down to reduce the voltage from 12V to 5V
3	PCB Board	To connect all devices
4	ESP 32	Using the Wemos LOLIN D32, 2.4 GHz Wi-Fi, and Bluetooth combo chip. TSMC low-power 40nm technology.
5	Reset Button	Button to reset the ESP 32
6	PIR Sensor	PIR sensor for movement detection
7	LED	Used is an LED as a power indicator, Bluetooth indicator, and Wi-Fi indicator
8	Magnetic Sensor	A magnetic sensor is used to tell the status of the smart door
9	Internal Touch Sensor	A smart door is used to detect whether the door is open or closed from inside
10	MOSFET	MOSFET for automatic switches
11	Alarm Buzzer	The alarm sounds when the smart door is forcefully opened
12	Electric Strike	Electric strike to open or close the smart door

B. Camera and Doorbell Interfacing

Integrating a camera and a doorbell into a smart door lock system using IoT adds an extra layer of security and functionality. This allows users to not only remotely control door access but also visually confirm and interact with visitors. Here's a methodology for incorporating a camera and a doorbell into the system [12].

Hardware Setup

- **Camera Integration:** Choose a compatible camera module (e.g., Raspberry Pi Camera Module) and connect it to the processing element (e.g., Raspberry Pi). Install the necessary drivers and software to capture images or video streams.

- **Doorbell Integration:** Select a smart doorbell with IoT capabilities or retrofit a traditional doorbell with an IoT-enabled microcontroller (e.g., Arduino or Raspberry Pi). Connect the doorbell to the processing element [13].

Software Implementation

- **Camera Software Setup:** Develop software to capture images or stream video from the camera. Implement motion detection algorithms if needed. Configure the software to store or transmit images or videos securely.
- **Doorbell Software Setup:** Develop software to detect doorbell presses and trigger notifications. Implement two-way communication features, allowing users to talk to visitors through the doorbell[14].

C. ANDROID APPLICATION AS CLIENT

Integrating an Android application as a client for your smart door lock system using IoT adds a user-friendly interface and enhances the accessibility of the system. Here's a methodology for developing the Android application.

Android application development

- **Define Functionalities:** Identify the key functionalities to be implemented in the Android application, such as remote door lock/unlock, real-time monitoring, user authentication, and integration with the camera and doorbell features.
- **User Interface Design:** Create an intuitive and user-friendly interface for the Android application. Design layouts for accessing door controls, viewing camera feeds, and interacting with the doorbell [15].

3. DISCUSSION

A smart door lock system using IoT represents a significant advancement in the field of home security and automation. This system leverages the capabilities of the Internet of Things to enhance traditional door access control mechanisms, providing users with greater convenience, security, and control over their living spaces. The following discussion outlines the key aspects and benefits of a smart door lock system using IoT.

- **Enhanced Security:** Authentication Methods Integrating multiple authentication methods, such as PIN codes, biometrics, and digital keys, enhances security by ensuring that only authorized individuals can access the premises.
- **Real-time Monitoring:** The inclusion of IoT sensors allows for continuous monitoring of door status, temperature, and motion, providing real-time alerts and insights into potential security breaches.
- **Convenience and Remote Access:** Mobile Control The system allows users to remotely lock or unlock their doors using dedicated mobile applications, providing unparalleled convenience and flexibility [16].
- **User Management:** Users can grant temporary or permanent access to others remotely, making it ideal for managing access for guests, service providers, or family members.
- **Integration with Smart Home Ecosystems:** Interoperability The Smart Door Lock System seamlessly integrates with other smart home devices, creating a holistic smart home ecosystem. For example, integration with security cameras, lights, and alarms enhances overall home automation and security.
- **Automation Scenarios:** Users can create custom automation scenarios based on door activity, such as triggering lights or cameras when the door is opened [17].
- **Cloud-based Analytics and Reporting:** Data Insights The centralized cloud platform enables the analysis of historical data, providing users with insights into user behavior, door usage patterns, and security events. Customization Users can customize their security settings based on historical data, improving the overall effectiveness of the system.

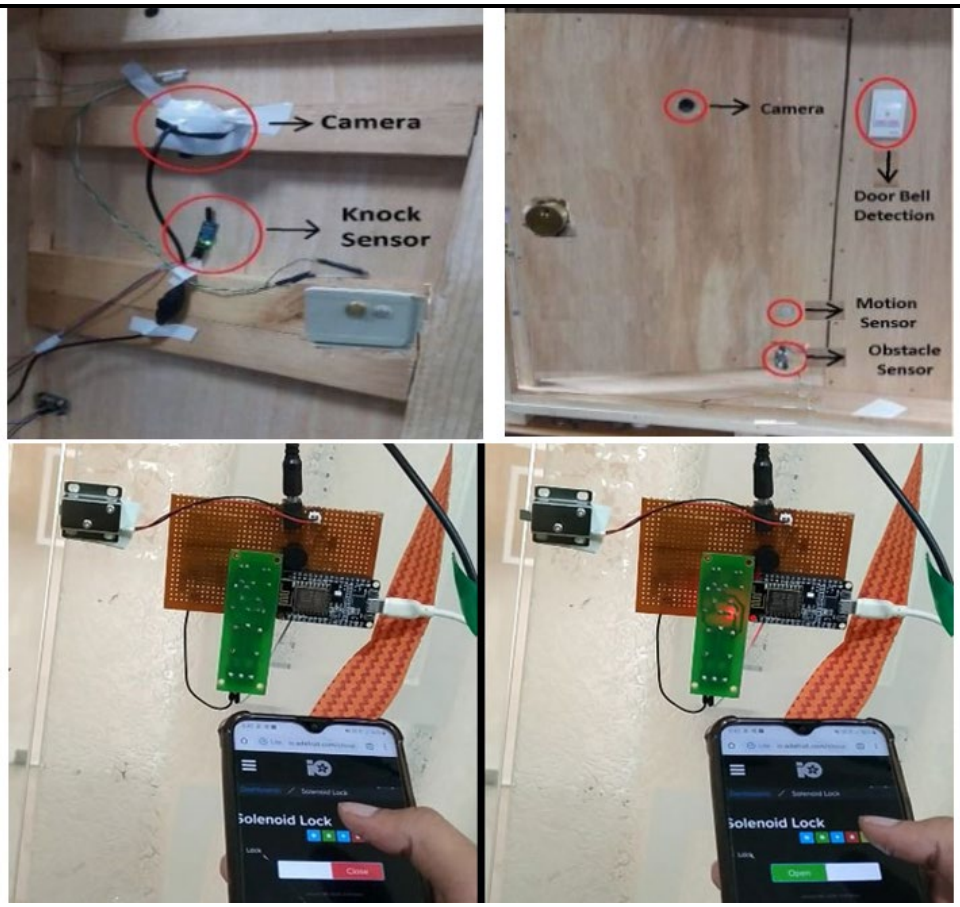

Figure 2: Device interfaced with home door lock (Prototype system developed)

- **User-friendly Interfaces:** Mobile Applications The dedicated mobile application and web interface provide users with intuitive platforms to control and monitor their smart door locks effortlessly. Two-way Communication Integration with cameras and doorbells allows for two-way communication, enhancing user interaction and security.
- **Scalability and Flexibility:** Expandable Features The modular nature of the smart door lock System using IoT allows for the addition of new features and devices over time, ensuring scalability. In conclusion, a smart door lock system using IoT represents a transformative approach to traditional door access control. It combines security, convenience, and automation to create a comprehensive solution that aligns with the evolving needs of modern living. As technology continues to advance, these systems are likely to become more sophisticated, offering even greater levels of security and integration with the broader smart home ecosystem [17].

4. RESULT

The results of implementing a smart door lock system using IoT would be measured based on the successful integration of the system components, its functionality, and the overall improvement it brings to door access control and security. Here are key aspects to consider when evaluating the results.

- **Integration Success:** Verify that the smart door lock device, IoT sensors, and the cloud-based platform are successfully integrated [18]. Ensure seamless communication between the components, including the processing element (e.g., Raspberry Pi) and the server.
- **Functionality Assessment:** Confirm that the system delivers the promised functionalities, such as remote door lock/unlock, real-time monitoring, user authentication, and integration with cameras and doorbells. Test the responsiveness and accuracy of door controls, authentication mechanisms, and communication with other smart home devices.
- **User Experience:** Evaluate the user interfaces (mobile applications, web interfaces) for their intuitiveness and user-friendliness. Gather feedback from users on their experience with the system, considering factors like ease of use, clarity of notifications, and overall satisfaction.

- **Security Validation:** Conduct thorough security testing to identify and address vulnerabilities. Ensure that user authentication is robust and that data transmission between the smart door lock system components is secure [19].
- **Reliability and Performance:** Assess the system's reliability by testing its performance under various conditions, including network interruptions and heavy usage. Measure the response time for door controls, sensor data updates, and communication with the cloud-based platform.
- **Real-time Monitoring:** Verify the real-time monitoring capabilities, including the accuracy of sensor data and the immediacy of notifications for door status changes, doorbell presses, or motion detection.
- **Integration with Camera and Doorbell:** Confirm the successful integration of the camera and doorbell features into the system. Test the two-way communication functionality, ensuring users can view live camera feeds and interact with visitors through the doorbell.
- **Cloud-Based Analytics:** Explore the analytics and reporting features provided by the cloud-based platform. Review insights derived from historical data to assess user behavior, door usage patterns, and security events [20].
- **Scalability:** Evaluate the system's scalability by adding new devices or users to the network.
- Confirm that the system remains stable and responsive as the number of connected devices or users increases.
- **User Feedback and Satisfaction:** Collect feedback from users regarding their overall satisfaction with the smart door lock system. Use user input to identify areas for improvement and potential new features. By thoroughly assessing these aspects, you can determine the success of the smart door lock system using IoT and identify any areas that may require adjustments or enhancements. Continuous monitoring and updates based on user feedback will contribute to the ongoing improvement and optimization of the system [21].

5. CONCLUSION

In conclusion, the implementation of a smart door lock system using IoT represents a significant advancement in the realm of home security and automation. This system seamlessly integrates traditional door-locking mechanisms with cutting-edge Internet of Things (IoT) technology, offering users a myriad of benefits in terms of security, convenience, and control. The key components, functionalities, and considerations involved in the development and deployment of such a system contribute to a holistic conclusion about its impact [22]. The integration of multiple authentication methods and real-time monitoring through IoT sensors significantly enhances the security of door access control. The ability to remotely lock or unlock doors, manage access permissions, and receive real-time notifications through mobile applications provides users with unprecedented convenience and accessibility. The system's interoperability with other smart home devices allows for the creation of comprehensive automation scenarios, contributing to a cohesive and interconnected smart home ecosystem [23]. Leveraging cloud-based platforms for analytics and reporting provides users with valuable insights into user behavior, door usage patterns, and security events. The smart door lock system using IoT is not just a current solution but sets the stage for future developments in the field of smart home technology. As technology evolves, we can anticipate even more sophisticated features, improved security measures, and greater integration with emerging IoT devices [24]. As the technology continues to mature, the smart home landscape will undoubtedly benefit from these innovations, offering users safer, smarter, and more connected living spaces [25].

CONFLICT OF INTERESTS

None

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