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ijircce@gmail.com



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Smart Doorbell and Door Lock Security System

Ms.Srushti Jadhav¹, Ms.Gauri Kandarkar², Ms.Riya Sawant³, Ms.Siddhi Hewalekar⁴,
Mr.S.M.Mayekar⁵

Students, Department of Computer Engineering, YBIT, Sawantwadi, Maharashtra, India¹²³⁴

Faculty, Department of Computer Engineering, YBIT, Sawantwadi, Maharashtra, India⁵

ABSTRACT: This research paper explores the design and implementation of an advanced home security system by integrating a smart doorbell and door lock using Raspberry Pi and Arduino technologies. With the increasing prevalence of smart homes, there is a growing need for robust and intelligent security solutions. The proposed system leverages the capabilities of Raspberry Pi for video processing and communication, while Arduino manages the control and automation of the door lock. The integration of these two platforms allows for seamless communication and coordination, providing homeowners with a comprehensive and user-friendly security solution.

KEYWORDS: Doorbell, Door Lock, Raspberry Pi, Arduino, Camera Module, Bluetooth Module, Servo Motor

I. INTRODUCTION

In recent years, the rapid advancement of technology has revolutionized the way we approach home security. One notable innovation in this realm is the integration of smart doorbells and door locks, leveraging the power of devices like Raspberry Pi and Arduino. These systems go beyond traditional security measures by offering intelligent, connected solutions that enhance the overall safety and convenience of homeowners. This research paper explores the design, implementation, and evaluation of a smart doorbell and door lock security system, employing the versatility of Raspberry Pi and Arduino to create a robust, interconnected network for safeguarding residential spaces. The foundation of our research lies in the utilization of Raspberry Pi as a central processing unit for the smart security system. Raspberry Pi's compact size, low cost, and compatibility with various sensors and modules make it an ideal choice for creating an intelligent and customizable security hub. Additionally, integrating Arduino microcontrollers further enhances the system's capabilities by providing real-time monitoring, automation, and control. This paper delves into the technical aspects of the implementation, discussing the selection and integration of sensors, cameras, and actuators to create a seamless and responsive smart security ecosystem.

II. PROBLEM STATEMENT

1. While smart doorbell and door lock systems have become increasingly popular in modern households, there is a pressing need for research and development in ensuring their security and reliability.
2. Existing solutions often fall short in providing comprehensive protection against emerging threats, leaving smart homes susceptible to unauthorized access and potential security breaches.
3. The challenge lies in developing a system that not only incorporates cutting-edge technologies such as Raspberry Pi and Arduino but also addresses the vulnerabilities inherent in current smart security systems.

III. SCOPE

The project to develop a smart doorbell and door lock security system using Raspberry Pi and Arduino presents a promising scope in enhancing home security and automation. Leveraging the Raspberry Pi for its computational capabilities and connectivity, the system can offer advanced features such as real-time video streaming, facial recognition, and remote monitoring through a mobile application. The integration of Arduino can enable smart locking mechanisms and sensor-based functionalities, ensuring a comprehensive security solution. With the rising demand for

smart home technologies, this project has the potential to provide users with a seamless and customizable solution for monitoring and controlling access to their homes, fostering a safer and more efficient living environment.

1. **Video Streaming:** Integrate a camera with the Raspberry Pi for live video streaming.
2. **Motion Detection:** Use PIR sensors or computer vision algorithms to detect motion at the doorstep.
3. **Face Recognition:** Integrate facial recognition for identifying known faces.
4. **Mobile App Integration:** Allow users to receive notifications and view the doorbell camera feed on their mobile devices.
5. **Electronic Lock Control:** Use a servo motor or solenoid to control the door lock mechanism.
6. **Mobile App Unlocking:** Enable users to unlock the door remotely using a mobile app.

IV. OBJECTIVES OF THE PROJECT

1. **Implement Secure Access Control:** Develop a secure access control system that allows authorized users to remotely lock and unlock their door using a smartphone or other authorized devices.
2. **Integrate Raspberry Pi and Arduino Technologies:** Integrate the capabilities of Raspberry Pi for user-friendly interface design and monitoring, and Arduino for efficient control of the Bluetooth door lock, ensuring seamless communication between the two.
3. **Enhance Security Features:** Implement advanced security features such as facial recognition technology to enhance the overall security of the system, providing an additional layer of authentication.
4. **Enable Remote Monitoring:** Enable users to remotely monitor their premises by incorporating live video streaming capabilities through the Smart Doorbell System, enhancing situational awareness.
5. **Address System Scalability:** Design the system to be scalable, allowing for potential expansion or integration with other smart home devices, ensuring compatibility with evolving technologies and user needs.
6. **Provide System Logging and Notifications:** Implement a logging system to record access events and send notifications to authorized users in real-time, enhancing security monitoring and user awareness.

V. EXISTING SYSTEM

1. **Ring Doorbell with Smart Locks:**
Products like the Ring Doorbell offer video doorbell capabilities with remote monitoring and communication features. While these typically do not directly integrate with Arduino, they showcase similar functionalities such as remote access and video streaming.
2. **August Smart Lock:**
The August Smart Lock is another example that focuses on enhancing door access control. It may not incorporate a Raspberry Pi, but it utilizes Bluetooth technology for secure wireless communication and offers smartphone-based control.
3. **Nest Hello Doorbell:**
Nest Hello Doorbell, developed by Google's Nest, provides video doorbell features and may integrate with smart lock systems. While it doesn't use Raspberry Pi or Arduino, it shares the goal of enhancing home security through smart technologies.

V. LIMITATIONS OF EXISTING SYSTEMS

1. **Power Source Dependency:** The system relies on electrical power, and in case of power outages or system failures, there may be vulnerabilities in security. Backup power solutions or contingency plans may be needed.
2. **Internet Dependency:** The system relies on an internet connection for remote access and cloud storage. A loss of internet connectivity could disrupt the system's functionality.

3. Maintenance and Updates: Like any technology, the system will require maintenance and updates to ensure it continues to function correctly and remains secure. Neglecting these tasks could lead to system vulnerabilities.
4. Weather and Environmental Factors: Outdoor smart doorbells must withstand various weather conditions, including rain, snow, and extreme temperatures. Not all models may be equally durable or suitable for all climates.

VII. PROPOSED SYSTEM

The proposed Smart Doorbell System represents a comprehensive solution that leverages the capabilities of Raspberry Pi and Arduino, addressing the limitations of conventional doorbell and lock systems. The system is designed to enhance home security and user convenience through advanced features and seamless integration.

1. Bluetooth-enabled Door Lock:

The core of the system involves an Arduino-based Bluetooth door lock. This component ensures secure and wireless communication, allowing users to remotely lock and unlock their doors using authorized devices such as smartphones or key fobs.

2. Raspberry Pi Interface:

The system utilizes Raspberry Pi as the central hub for user interaction and monitoring. The Raspberry Pi provides a user-friendly interface that allows for easy configuration, real-time monitoring of the doorbell camera, and control of the Bluetooth door lock. The integration of Raspberry Pi enhances the system's adaptability and versatility.

3. Facial Recognition Technology:

To bolster security, the proposed system incorporates facial recognition technology. The doorbell camera, connected to Raspberry Pi, captures and analyzes facial features for user authentication, providing an additional layer of protection against unauthorized access.

4. Remote Monitoring and Notification:

Users can remotely monitor their premises through the system's live video streaming feature. Additionally, the system logs access events and sends real-time notifications to authorized users, ensuring heightened security awareness and prompt responses to access attempts.

5. Scalability and Integration:

The proposed system is designed with scalability in mind, allowing for potential integration with other smart home devices. This ensures compatibility with evolving technologies and provides users with the flexibility to expand their smart home ecosystem.

6. Power Optimization:

Efforts have been made to optimize power consumption in both the Raspberry Pi and Arduino components. This optimization ensures efficient and sustainable operation, considering the system's continuous monitoring and occasional locking/unlocking requirements.

7. Usability and Accessibility:

The user interface on the Raspberry Pi is designed to be intuitive, catering to users with varying technical expertise. Accessibility features are incorporated to ensure inclusivity, allowing a wide range of users to interact with and benefit from the Smart Doorbell System.

VIII. CONCLUSION

In conclusion, the development and implementation of the Smart Doorbell System using Raspberry Pi and Arduino have resulted in a technologically advanced and user-friendly solution for modernizing home access control. By addressing the limitations of traditional doorbell and lock systems, the proposed system enhances both security and convenience. The integration of Bluetooth technology facilitates secure wireless communication, allowing users to

monitor and control access to their premises remotely. The incorporation of advanced features, such as facial recognition, adds an extra layer of authentication, contributing to the overall robustness of the system.

The Smart Doorbell System not only meets its core objectives of providing secure access control and remote monitoring but also offers scalability for potential integration with other smart home devices. As technology continues to evolve, this system represents a stepping stone toward creating smarter and more adaptable solutions for enhancing the security and accessibility of residential spaces. Overall, the project contributes to the ongoing advancements in smart home technologies, offering a promising avenue for future research and development in the field of home automation and security.

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