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Smart Bell

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ABSTRACT

This paper presents the design and implementation of a smart doorbell system that integrates Radio Frequency (RF) technology with video surveillance and remote door lock control. The idea of informing the hosts about a visitor at the door started much before the invention of the electrical doorbell. In these modern times bells are based on smart technologies that made easy human life. Many intruder alert systems with motion detection and other complex systems have been developed and they are working perfectly well. This smart doorbell system circuit integrates knowledge of these other previous models and uses more readily available components. The introduction of video for real-time monitoring and motion sensors has increased the sensitivity of the whole system. The door lock was introduced to help mostly people with disabilities to easily give access to visitors. Major components used in the project are the motion sensors, the RF module transmitter and the receiver, the camera, the Android module, etc. The motion sensor connected to the RF transmitter picks up movement and activates the camera to start videoing, then sends a signal to the receiver which triggers the speaker. The output from the camera will then allow the homeowner to decide whether to open or not the door lock. The system was tested and found to offer enhanced sensitivity, increased security, and greater affordability compared to existing alternatives. The system's modular design ensures ease of maintenance and reduces the risk of cybersecurity vulnerabilities

Keywords: Radio Frequency (RF), Smart Systems, Microcontroller, Home Security, Video Surveillance

INTRODUCTION

As technology continues to advance, the integration of smart devices into residential settings has become increasingly common, with homeowners seeking to enhance convenience, security, and energy efficiency. The development of a smart doorbell system with video surveillance and Radio Frequency (RF) door lock technology represents a significant advancement in this domain. One of the biggest problems with traditional security systems is not having real-time access to events happening around them. The advent of video doorbells has begun to address some of these limitations, offering homeowners the ability to see and communicate with visitors through a camera and speaker system. However, many of these systems are standalone devices that do not integrate with other security features, such as door locks. RF door locks offer a convenient way to control access to a home without the need for physical keys. These systems can be operated remotely, allowing homeowners to lock or unlock their doors from a distance. However, like video doorbells, RF door locks are often implemented as separate systems, if this is not done it can create complexity and reduce overall security when multiple devices are used dependably. Creating a separate standalone system also makes it not susceptible to hacking. The ability to control smart home devices through an Android application offers unparalleled convenience and accessibility (Shrivastava, A. K. et al. 2020). The study focuses on the development of a smart doorbell system that combines these technologies to provide a comprehensive security solution.

LITRATURE REVIEW

Smart bell systems are IoT-based enhancements of traditional doorbells that provide real-time visitor detection, notification, and interaction. The literature shows that most smart bells integrate microcontrollers (ESP32/Raspberry Pi), sensors, cameras, and Wi-Fi connectivity to send alerts and images/videos to users' smartphones when the bell is pressed or motion is detected. Research primarily focuses on home security and automation, enabling features such as remote monitoring, two-way audio/video communication, motion detection, and facial recognition. Several studies highlight the use of cloud or edge computing for faster processing and improved response times. Low-cost implementations using embedded systems are also widely explored to improve affordability.

However, the literature identifies challenges related to data privacy, cybersecurity risks, internet dependency, and system reliability. Overall, smart bell research demonstrates significant potential in enhancing smart home security, while emphasizing the need for stronger privacy protection and secure system design.

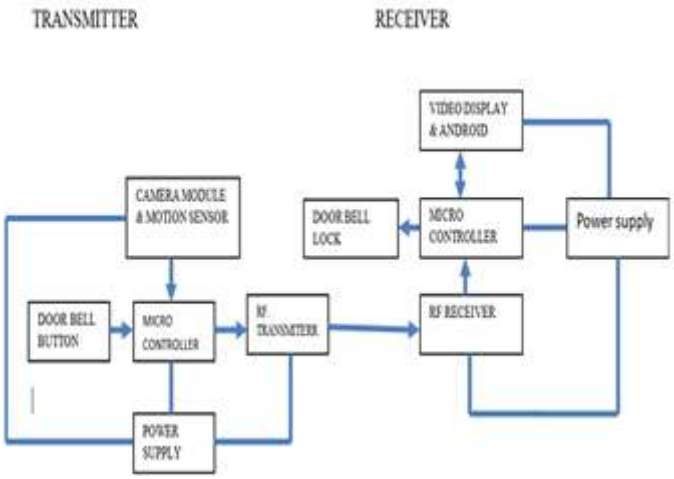

Fig 1.Block diagram Smart bell System

METHODOLOGY

The smart bell system is developed using an IoT-based approach to improve the functionality of a traditional doorbell. A push button or motion sensor is installed at the entrance to detect the presence of a visitor. When the bell is pressed or motion is detected, a microcontroller such as an ESP32 or Raspberry Pi activates a camera module to capture the visitor's image or video.

The captured data is then processed by the controller and sent to the user through a Wi-Fi connection. A real-time notification is delivered to the user's mobile phone, allowing them to see who is at the door even when they are not physically present. Depending on the system design, features like two-way communication or visitor identification can also be included.

The smart bell system is built to work like a normal doorbell but with extra features. When someone presses the bell or comes near the door, a sensor detects it. A microcontroller such as ESP32 or Raspberry Pi then turns on the camera to capture the visitor's image or video.

The system sends this information to the user's mobile phone through a Wi-Fi connection. The user gets an instant notification and can see who is at the door from anywhere. If needed, features like voice communication or visitor recognition can also be added.

The system is tested to check how fast it responds and how reliably it sends notifications

RESULT AND DISCUSSION

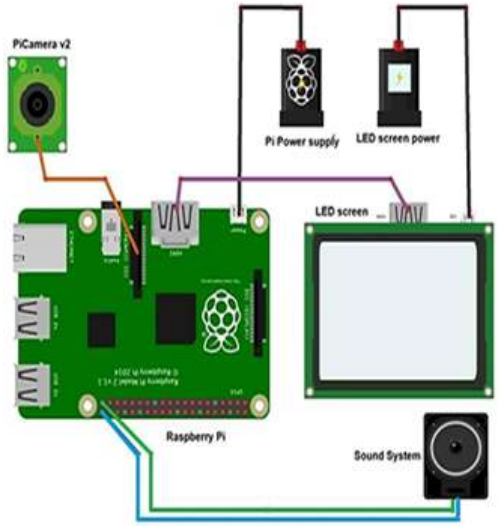

Fig 2.Circuit diagram of the proposed system

The Smart Bell project was successfully designed and tested to automate bell ringing based on predefined schedules. The system accurately triggered the bell at the programmed times without requiring manual intervention. During testing, the bell rang consistently according to the timetable entered into the system, including regular class periods, breaks, and special schedules.

The microcontroller responded correctly to time inputs from the real-time clock module, and the relay mechanism effectively controlled the bell circuit. No noticeable delay was observed between the scheduled time and the bell activation. The system continued to operate reliably during extended testing periods, indicating stable performance.
Additionally, the Smart Bell demonstrated ease of use, as schedules could be updated quickly without modifying hardware components. Power consumption was minimal, making the system suitable for continuous operation in schools and institutions.

However, the system depends on continuous power supply, which could be a limitation during power failures. This issue can be addressed in future improvements by adding a backup battery or solar power support. Additional features such as wireless control, mobile app integration, or voice announcements could further enhance the system.

Overall, the Smart Bell project demonstrates how simple automation can significantly improve daily operations in schools and institutions. The successful results confirm that the system is practical, cost-effective, and suitable for real-world implementation.

CONCLUSION

The Smart Bell project was successfully designed and implemented to automate the bell ringing system using time-based control. The system operated accurately according to the predefined schedule, eliminating the need for manual bell operation. Testing results confirmed reliable performance, timely activation, and stable operation over extended periods. The project demonstrates that automation can improve efficiency, reduce human effort, and ensure punctuality in educational institutions.

The use of a microcontroller and real-time clock proved effective for precise scheduling, while the relay mechanism provided safe and efficient control of the bell. Overall, the Smart Bell system is cost-effective, easy to use, and suitable for practical deployment in schools, colleges, and other institutions.

Although the Smart Bell system performs its intended function effectively, several enhancements can be considered for future development. A backup power supply such as a battery or solar system can be added to ensure uninterrupted operation during power failures. Wireless connectivity can be integrated to allow remote schedule updates through a mobile application or web interface.

Further improvements may include voice announcements, LCD display for real-time status, and integration with attendance or school management systems. The system can also be expanded to support multiple bells across different buildings. These enhancements would make the Smart Bell more intelligent, flexible, and suitable for large-scale institutional use.

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