Smart Home Security System with Password Protection and Motion Detection

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***Abstract*— The Smart Home Security System with Password Protection and Motion Detection is an Arduino-based solution designed to enhance home safety by integrating a keypad, PIR motion sensor, servo motor, buzzer, LED, and LCD. Users can securely access their home by entering a predefined 4-digit password on the keypad, which, if correct, opens the door via a servo motor and provides real-time feedback on the LCD. Unauthorized attempts trigger a buzzer alarm, while the PIR sensor monitors motion, alerting users to suspicious activity. This cost-effective system offers reliable entry and exit management, making it a practical solution for modern home security needs.**

# INTRODUCTION

Home security has become an essential aspect of modern living, driven by the increasing need to protect property and ensure the safety of individuals. The **Smart Home Security System with Password Protection and Motion Detection** is an innovative project that addresses these concerns by providing an efficient and user-friendly solution for managing access and detecting potential threats.

This system leverages an Arduino microcontroller to integrate multiple components, including a keypad for password entry, a PIR motion sensor for detecting unauthorized movement, a servo motor for automated door control, a buzzer for audible alerts, an LED for visual feedback, and an LCD to display system status in real-time.

By requiring a 4-digit password for entry, the system ensures secure access while denying unauthorized attempts and activating alerts. The PIR sensor enhances security by detecting motion and triggering alarms in case of suspicious activity. Designed for reliability and ease of use, this project demonstrates the potential of microcontroller-based systems to provide affordable and effective home security solutions, with opportunities for future expansion into advanced features like dynamic password management and remote monitoring.

# METHODOLOGY

**Smart Home Security System with Password Protection and Motion Detection** employs a systematic approach to integrate and coordinate various components for secure and efficient operation. The methodology is outlined as follows:

1. **Component Integration**:
   1. **Keypad**: A 4x4 matrix keypad is used for password input, allowing users to securely authenticate access by entering a predefined 4-digit code.
   2. **PIR Motion Sensor**: Monitors the environment for motion. When unauthorized activity is detected, it triggers alerts to notify the user.
   3. **Servo Motor**: Controls the door mechanism, opening or closing it based on successful password authentication.
   4. **Buzzer and LED**: Provide auditory and visual feedback for security alerts or status indications.
   5. **LCD (16x2 with I2C)**: Displays real-time system messages, including prompts, access status, and alerts.
2. **System Initialization**:
   1. During setup, the Arduino initializes all connected components, including configuring the pins, calibrating the PIR sensor, and setting the servo motor to the closed-door position.
   2. The LCD displays a "System Ready" message to indicate that the system is operational.
3. **Password Authentication**:
   1. The system waits for password input via the keypad. The entered digits are masked on the LCD for security and stored temporarily.
   2. Once four digits are entered, the system compares the input to the predefined password.
      1. If correct, the servo motor opens the door for a specified duration, and an "Access Granted" message is displayed.
      2. If incorrect, the system denies access, displays an "Access Denied" message, and resets the input.
4. **Motion Detection**:
   1. The PIR sensor continuously monitors the surroundings. If motion is detected, the system checks whether access has been granted.
      1. If unauthorized motion is detected, the buzzer is activated, and the LED turns on to alert the user.
      2. If motion corresponds to authorized access, the system logs entry or exit and manages the door status accordingly.
5. **State Management**:
   1. The system transitions between different states, such as waiting for a password, granting access, handling motion detection, and resetting to the initial state.
   2. Unauthorized motion or failed password attempts reset the system, ensuring robust security.
6. **Automation and Feedback**:
   1. The servo motor automatically closes the door after a set duration to maintain security.
   2. The LCD provides continuous feedback on the system's status, enhancing user interaction and clarity.

This structured methodology ensures the system's reliability and effectiveness, providing a robust solution for home security while allowing for future scalability and enhancements.

# RESULTS

# CONCLUSION

The **Smart Home Security System with Password Protection and Motion Detection** provides a reliable, cost-effective, and user-friendly solution for enhancing home security. By integrating a keypad for secure password authentication, a PIR motion sensor for real-time intrusion detection, and a servo motor for automated door control, the system successfully addresses the essential requirements of modern home security.

The inclusion of a buzzer and LED for alerts and an LCD for real-time feedback ensures clear communication and immediate response to security events. The system's state-based functionality allows seamless transitions between password authentication, access management, and motion handling, demonstrating robustness and efficiency.

This project showcases the potential of microcontroller-based systems for solving real-world problems, with ample scope for future improvements such as dynamic password management, multi-factor authentication, and IoT integration. It lays the foundation for building advanced, scalable, and automated security solutions for smart homes.

# ACKNOWLEDGMENT

The authors sincerely thank Mr. Rajesh M for his invaluable guidance and support during the preparation of this IEEE report. His expertise and encouragement played a pivotal role in shaping our understanding of the complex topics discussed herein. His feedback and suggestions greatly enriched the content and quality of this report.

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