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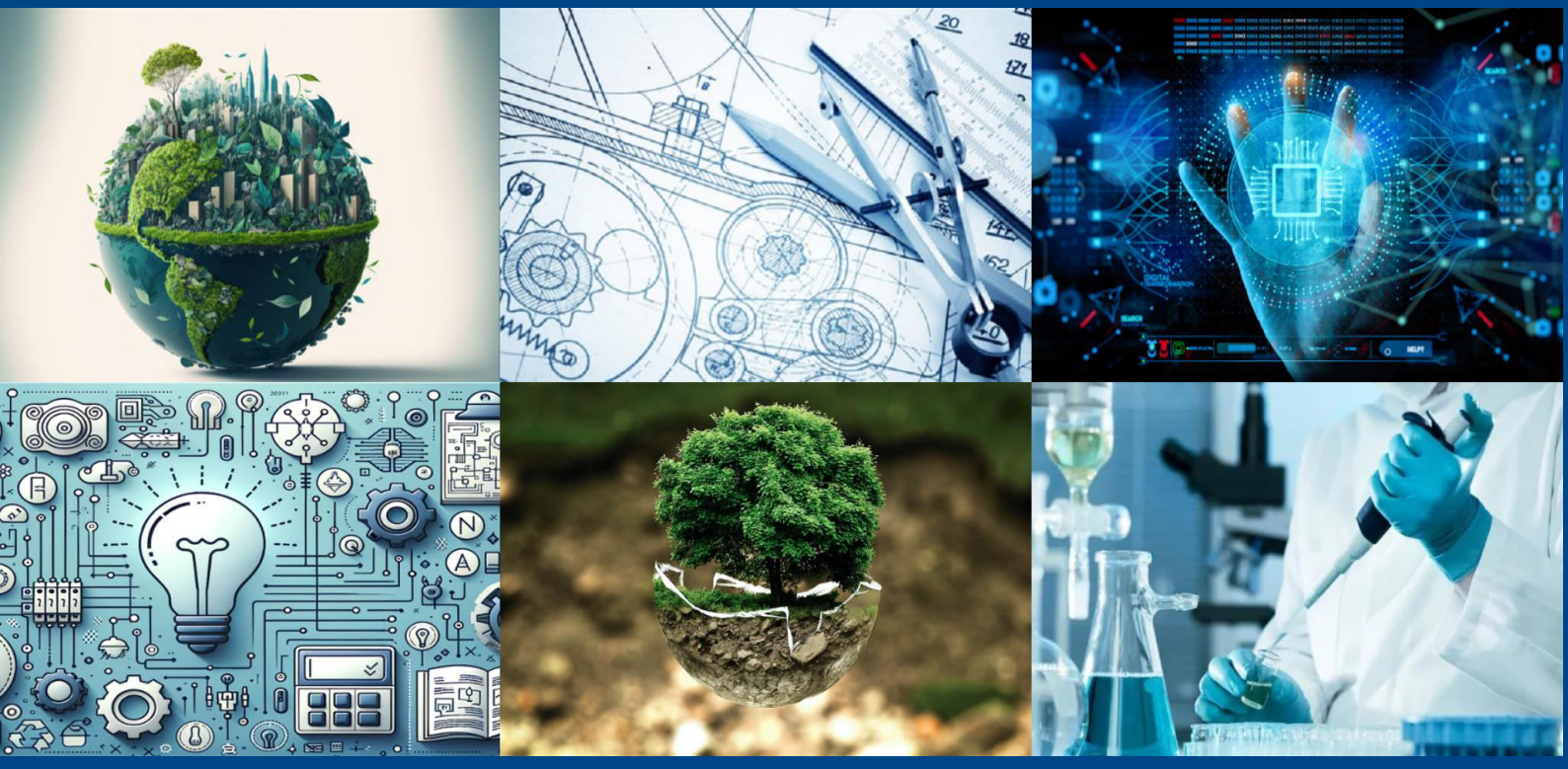

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Arduino-Based Intelligent Home Security System

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ABSTRACT: This paper presents an Arduino-based intelligent home security system that incorporates multiple smart technologies to ensure enhanced safety and automation. The system includes a smart gate mechanism using an RFID card and reader paired with a servo motor for automatic gate opening. A smart lighting system in the parking area uses a PIR motion sensor to detect human or vehicle movement, switching lights on automatically. Additionally, a smart keypad system is installed on the main entrance door for secure access control. The system also features a smart fire detection module using the MQ-3 gas sensor for fire hazard detection. This integrated security solution provides homeowners with a reliable and efficient safety mechanism.

Automation in buildings began long before recorded time, with the help of microprocessors. The use of dedicated software for safety and control applications began with the technological advancement. The controlling unit in building management system automation is a PLC. In the comfort way of human life styles in the building there are many system has automated, with increase the almost all the facility to throughout all the machine with less economics introduces. Car parking facility, light control, fire system,gate open close,door control proposed here. Almost everywhere the parking problem is a big issue in the urban state. In this the parking facility has introduced, by automated. Light control also the big issue, Less Consumption of the energy in the overall building as external light by automated has introduces. Keeping in the mind internal facility has also automated, controlling light in buildings should be necessary. Keeping all the things in the mind all the system are introduces automated here.

KEYWORDS: Arduino-based automation**,** RFID gate control**,** motion sensor lighting**,** fire detection with MQ3 sensor**,** GSM alert system**,** keypad-based security**, and** energy-efficient smart building security**.**

I. INTRODUCTION

Security is a primary concern in residential and commercial spaces. Traditional security systems often lack automation and intelligence, making them inefficient in some scenarios. This paper introduces a cost-effective and intelligent home security system using Arduino, providing real-time monitoring and automated responses to various security threats.

The system further elevates security with fire detection through the use of an MQ3 sensor, which sends immediate alerts via a GSM module to notify residents in case of smoke or gas detection. This real-time notification allows for prompt action in emergency situations, minimizing potential damage. Moreover, the home door lock and locker system is equipped with a keypad-based security feature, where residents can set personalized passwords for secure access. This comprehensive system effectively combines automation, security, and efficiency, making it a modern and reliable solution for enhancing building and home safety.

The Arduino-based smart building or home security system leverages a range of technologies to deliver enhanced security and automation. It uses RFID (Radio Frequency Identification) technology to control access to the building, allowing only authorized individuals to enter by scanning their unique RFID tags. Motion sensors, such as Passive Infrared (PIR) sensors or ultrasonic sensors, are employed in the parking area to detect the presence of humans or vehicles, triggering the lighting system to turn on automatically, thereby improving energy efficiency. For fire detection, the system integrates an MQ3 gas sensor, which is capable of identifying smoke or gas leaks, signaling potential fire hazards. When a fire is detected, the GSM (Global System for Mobile Communications) module plays a crucial role in sending immediate alerts

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to the residents or building managers, enabling quick responses to emergencies. Additionally, the system uses a keypad-based interface for secure home or locker access, where users can set and enter a personalized password. The core control of the entire system is powered by an Arduino microcontroller, which acts as the central unit to manage the 2

various components and execute programmed instructions. The combination of RFID technology, motion sensors, the MQ3 gas sensor, the GSM module, and Arduino-based automation highlights the system's capability to integrate modern security measures with convenience and real-time responsiveness for smart building applications.

II. SYSTEM MODEL AND ASSUMPTIONS

The **intelligent home security system** is designed to provide a comprehensive and automated solution for residential or commercial security. The system integrates various hardware components, each serving a unique function to ensure that the system is responsive, reliable, and secure. Below is a detailed description of the key components used in this system:

The **Arduino microcontroller** acts as the central hub of the intelligent home security system. It is responsible for managing input and output operations, processing signals from sensors, and controlling actuators to take appropriate actions in response to various security events. The Arduino board handles communication between the components, making decisions based on data received from sensors (such as motion detection, RFID card scans, or gas leakage). It executes predefined logic to trigger corresponding actions, such as opening the gate, activating the lights, or sounding an alarm. Arduino's versatility and ease of programming make it the ideal choice for building such a customizable and intelligent system.

The **RFID card and reader** are used to provide secure and automated access control to the gate of the property. RFID (Radio Frequency Identification) technology allows for keyless entry. The RFID card contains a unique identifier, and when it is scanned by the **RFID reader**, the Arduino processes the signal. If the card is authorized, the system triggers the **servo motor** to open the gate automatically. This feature offers both convenience and security, as it eliminates the need for traditional keys, which can be lost or duplicated.

The **PIR (Passive Infrared) motion sensor** is used to detect motion in the parking area or entrance. The PIR sensor detects infrared radiation emitted by moving objects, such as humans or vehicles. When movement is detected, the sensor sends a signal to the Arduino, which then triggers the lighting system to turn on automatically. Once no movement is detected for a specified time, the lights are turned off. This feature improves safety by ensuring the parking area or driveway is lit when necessary, and it also enhances energy efficiency by avoiding unnecessary lighting.

The **keypad** is integrated into the system to provide an additional layer of security for the home's main entrance. To access the property, individuals must enter a pre-programmed **PIN code**. The Arduino processes the entered code, and if it matches the stored PIN, it triggers the door lock mechanism to unlock the door. If the incorrect code is entered, the system can activate an alert (such as a buzzer or LED), indicating an unauthorized access attempt.

The **MQ-3 gas sensor** is designed to detect harmful gases like carbon monoxide (CO), methane (CH4), and smoke, which are typically present in the event of a fire or gas leak. This sensor continuously monitors the air quality in the environment and sends the data to the Arduino microcontroller. If dangerous levels of gases are detected, the Arduino triggers an alarm or a notification, warning the occupants of the potential fire hazard. This feature ensures early detection of fire or gas leaks, significantly improving safety within the home or commercial space.

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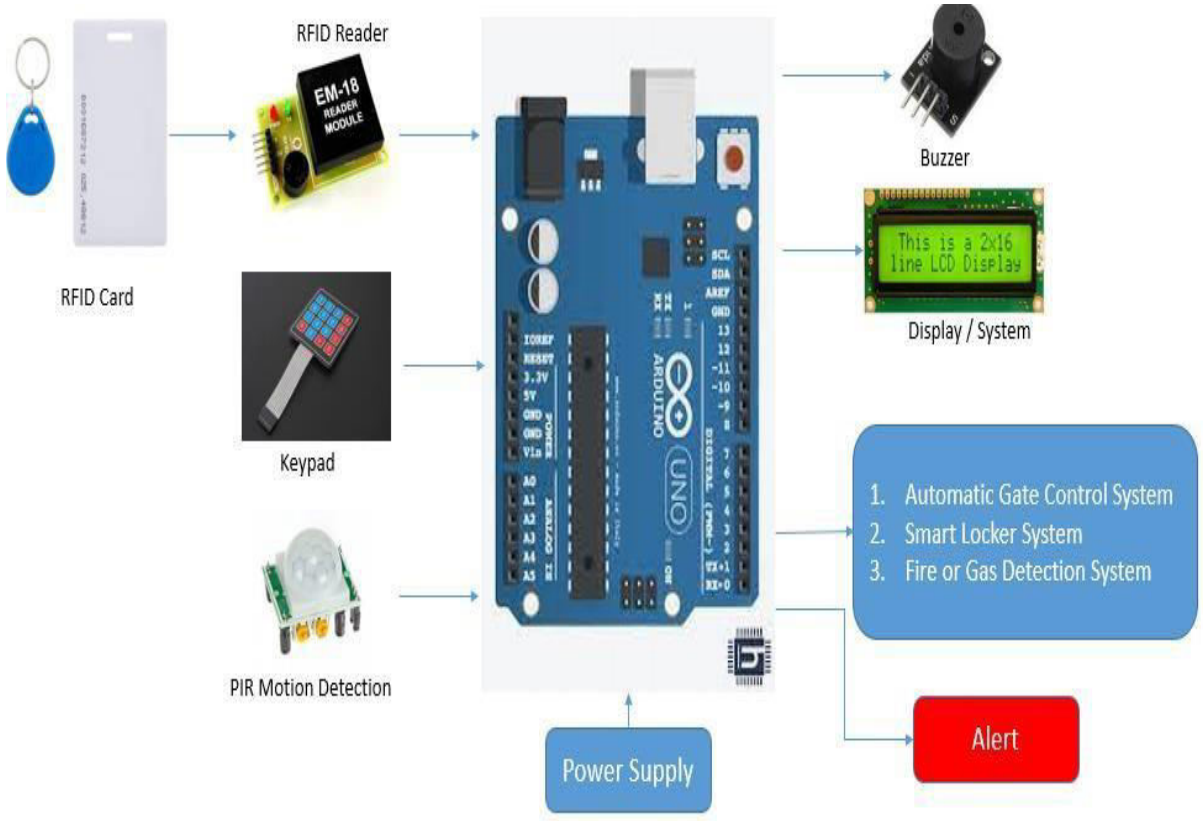

Architecture of Proposed Work Flow

III. OPERATION AND WORKFLOW

The **intelligent home security system** is designed to automate various security features and provide real-time responses to ensure maximum safety and convenience. Below is a detailed overview of the **operation** and **workflow** for each component of the system:

1.Smart Gate System

Operation:

1. **Card Scanning**: When an RFID card is placed near the **RFID reader**, the reader scans the card's unique identifier.
2. **Card Verification**: The Arduino microcontroller verifies the data received from the RFID card against the list of authorized cards stored in its memory.
    - If the card is **valid**, the system proceeds to the next step.
    - If the card is **invalid**, the gate remains closed, and no action is taken.
3. **Gate Opening**: If the card is verified as valid, the Arduino sends a signal to the **servo motor**, which rotates to open the gate.
4. **Automatic Gate Closure**: After a predefined duration (e.g., 10 seconds), the Arduino sends a signal to the servo motor to rotate the gate back to its closed position automatically.

Workflow:

- **Input**: RFID card scan.
- **Process**: Card verification, servo motor control.
- **Output**: Gate opens and closes automatically based on card validity and preset timing.

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2. Smart Lighting System

Operation:

1. **Motion Detection**: The **PIR motion sensor** continuously monitors the parking area or entrance for any movement.
    - When **movement is detected**, the Arduino processes the signal from the sensor.
2. **Lighting Activation**: Upon detecting motion, the Arduino sends a signal to turn on the **lights** in the designated area.
3. **No Motion Detected**: If no further movement is detected for a specified period (e.g., 5 minutes), the **lights automatically turn off** to save energy.

Workflow:

- **Input**: Motion detection by the PIR sensor.
- **Process**: Arduino processes the sensor's data and triggers lighting.
- **Output**: Lights turn on when motion is detected and turn off after no motion is detected for a set period.

3. Smart Keypad System

Operation:

1. **Passcode Entry**: The user enters a **unique passcode** using the **keypad**.
2. **Passcode Verification**: The Arduino compares the entered passcode with the pre-programmed code stored in the system's memory.
    - If the **correct passcode** is entered, the Arduino sends a signal to **unlock the door**.
    - If the **incorrect passcode** is entered, the system triggers an alarm.
3. **Alarm and LED Indicator**: The system activates the **buzzer** and **LED indicator** to alert the homeowner or security personnel of an unauthorized access attempt.

Workflow:

- **Input**: Passcode entered via keypad.
- **Process**: Code verification by the Arduino.
- **Output**: Door unlocks for correct code or triggers alarm and LED for incorrect code.

4. Smart Fire Detection System

Operation:

1. **Gas and Smoke Monitoring**: The **MQ-3 gas sensor** continuously monitors the air for the presence of hazardous gases such as carbon monoxide (CO) or smoke.
2. **Threshold Detection**: The Arduino continuously compares the sensor's readings with predefined threshold values.
    - If the **gas concentration exceeds the threshold**, indicating a possible fire or gas leak, the system triggers an alert.
3. **Alert Activation**: Upon detecting dangerous gas levels, the Arduino sends signals to activate the **buzzer** and an **LED indicator** to warn the occupants.
    - The **buzzer** emits a loud sound to draw attention.
    - The **LED indicator** changes color to visually indicate the alert (e.g., red for danger).

Workflow:

- **Input**: Gas concentration data from the MQ-3 sensor.
- **Process**: Data comparison with threshold values, alert triggering by the Arduino.
- **Output**: Buzzer and LED alert to notify users of potential fire or gas leak.

System Performance And Analysis

The performance of the intelligent home security system was evaluated through various tests to assess the response times of its individual modules: the **Smart Gate System**, **Smart Lighting System**, **Smart Keypad System**, and **Smart Fire Detection System**. The **Smart Gate System** demonstrated a reliable performance, completing the entire gate operation, including opening and closing, within approximately 5-7 seconds after scanning a valid RFID card. The **Smart Lighting System**, controlled by the PIR motion sensor, showed exceptional efficiency by turning the lights on in less than 1 second after detecting movement and then turning them off 3-5 seconds after no further movement was detected. The **Smart Keypad System** responded promptly, with a response time of 1-2 seconds for both correct and incorrect passcodes. When

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a correct passcode was entered, the system unlocked the door immediately, while an incorrect passcode triggered an alarm within the same time frame. Finally, the **Smart Fire Detection System** exhibited a response time of 2-4 seconds, detecting hazardous gas levels and triggering the buzzer and LED alerts in a timely manner, ensuring prompt action in the event of a fire or gas leak. Overall, the system performed efficiently across all modules, with response times falling well within the acceptable range, making the system a reliable and effective solution for smart home security.

IV. CONCLUSION

In conclusion, the Arduino-based smart building or home security system offers a robust and multifaceted approach to enhancing safety and convenience for residents. By integrating features such as RFID-based gate control, motion-activated lighting, fire detection using an MQ3 sensor, and a keypad-locked system, the solution addresses various aspects of modern security needs. The RFID system ensures that only authorized users can enter the premises, thereby reducing unauthorized access, while the motion sensors in the parking area provide illumination that enhances safety without wasting energy. The fire detection capability serves as a critical safety feature, enabling immediate alerts through the GSM module, which can significantly reduce response time in emergencies. Furthermore, the keypad- based locker system adds an additional layer of security for personal belongings, allowing users to maintain privacy and control over their valuables. Overall, this proposed system not only prioritizes user safety and convenience but also reflects the increasing trend towards smart technology in residential spaces, making it an essential project for addressing contemporary security challenges.

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