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Internet of Things-Domain Analyst

Project:

Home Automation system using Bluetooth module

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Abstract:

This paper introduces a smart home automation system designed with an Arduino Uno board, motion sensors, and gas sensors. The system aims to boost residential safety by detecting intrusions and potential gas leaks. Motion sensors are strategically positioned to detect unauthorized movements, triggering immediate alerts. Gas sensors identify harmful gases like carbon monoxide for a timely response. The Arduino Uno serves as the central processor, collecting sensor data, analysing it, and generating appropriate responses. This affordable solution integrates motion and gas sensors effectively for threat detection, enabling prompt action to mitigate risks.

Introduction:

The field of Smart home has witnessed significant advancements in recent years, driven by the increasing need for enhanced security, improved safety, and greater convenience in residential environments. Smart home applications have emerged as a promising solution, integrating technology to automate various aspects of daily life. In this research paper, we present a comprehensive study on the design and implementation of a Smart Home Application using Arduino Uno, with a specific focus on ensuring safety through gas monitoring and providing automation and convenience to homeowners.

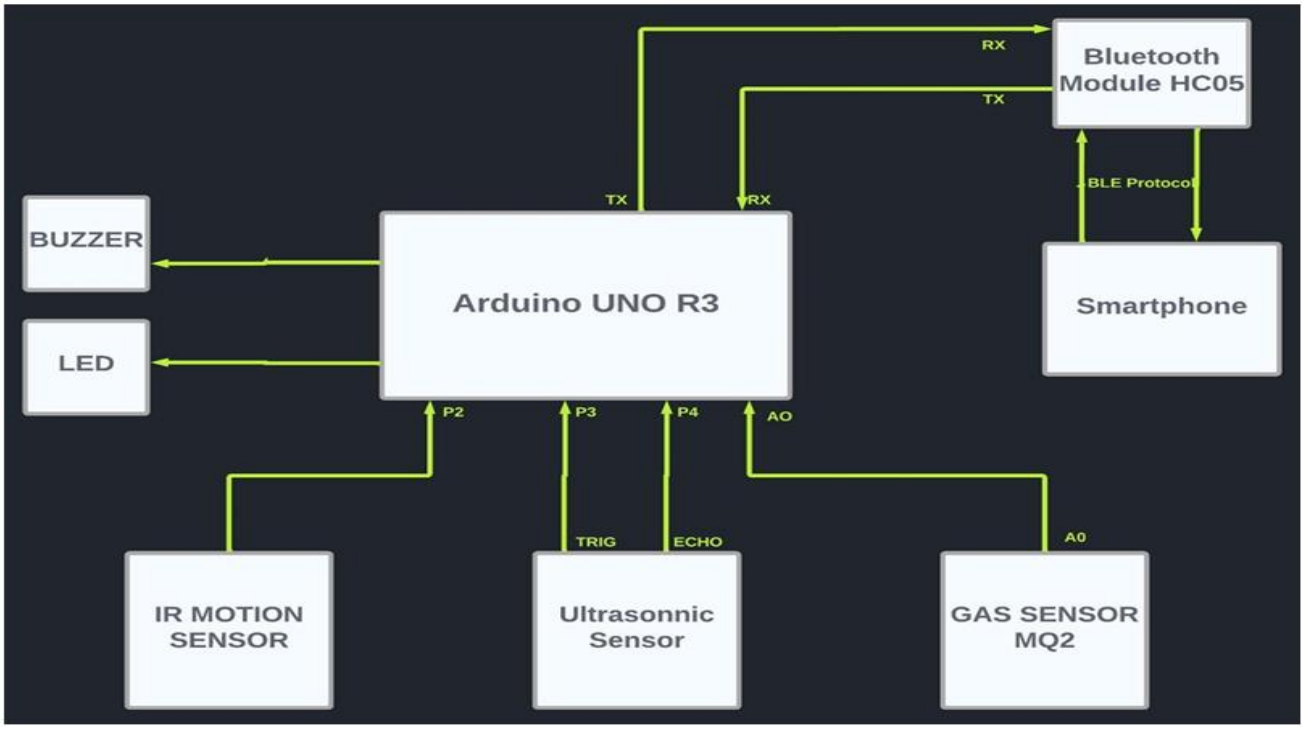
Literature Review :

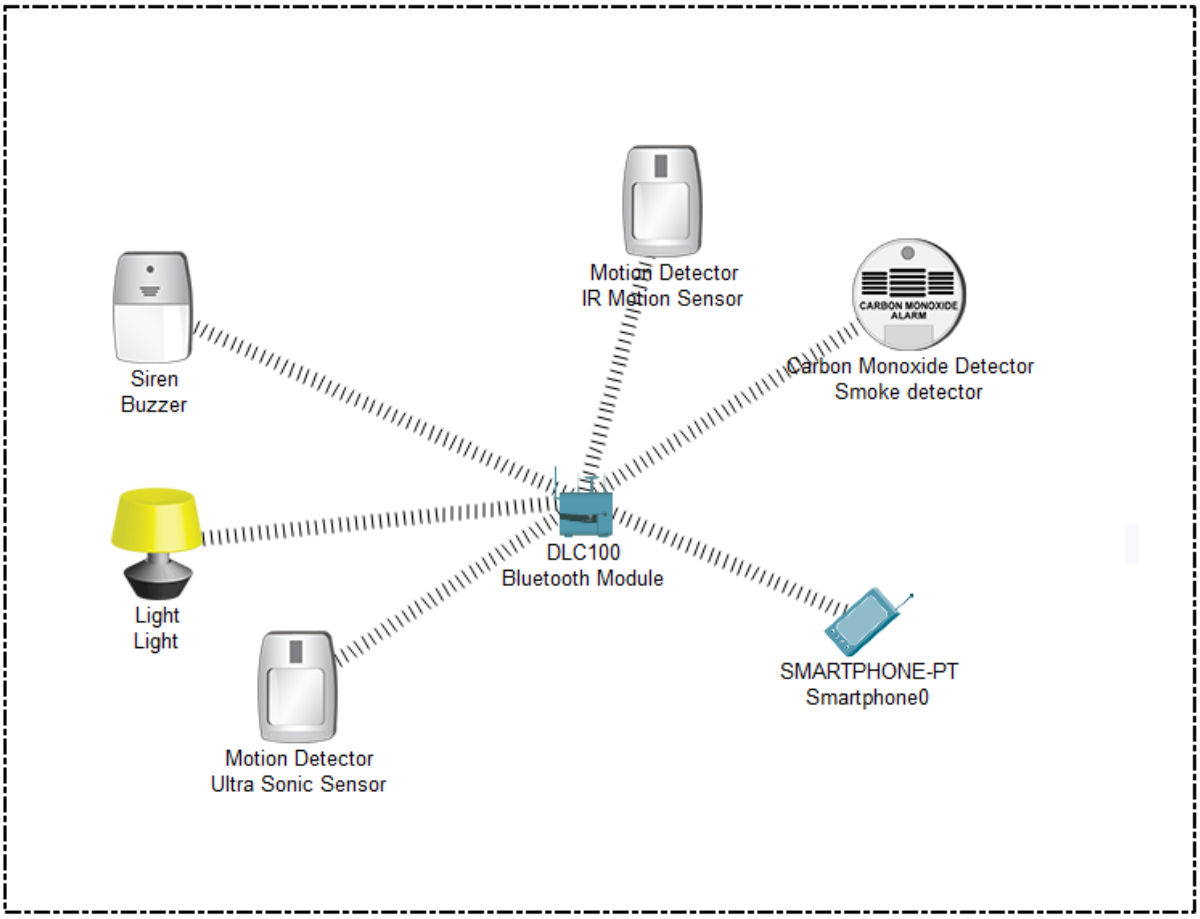
In the field of smart home technology and the Internet of Things (IoT), numerous research papers have made significant contributions to the understanding and development of automation, monitoring, and security in residential environments. The following summary provides an overview of the key insights derived from the literature review. One notable research paper, published in the Indonesian Journal of Electrical Engineering and Computer Science, focused on the prototype design of a smart home system using IoT. The paper highlighted the ability to remotely switch appliances on/off, showcasing the convenience and control offered by IoT based solutions. Similarly, the comparative analysis presented at the 9th International Conference on Research and Innovation in Information Systems (ICRITO) explored the monitoring and security aspects of IoT-based smart home automation. The study emphasized the importance of ensuring safety and security in residential environments. In the International Journal on Engineering Technologies and Informatics, researchers delved into the principles and applications of IoT sensors in smart homes. Specifically, the paper examined the utilization of "Industry 4.0" concepts and underscored the role of sensors in creating intelligent and responsive home environments. Furthermore, a comprehensive literature review provided valuable insights into the challenges faced by home automation systems. By analyzing existing research, the review shed light on key areas that require improvement to overcome these challenges and advance the field. Lastly, an OP Conference Series paper investigated home security and automation based on the IoT, with a particular focus on various face detection approaches. The study emphasized the importance of secure and reliable detection mechanisms for effective IoT-based home security systems. Collectively, these literature reviews contribute to the understanding and advancement of smart home technology. They provide insights into remote switching, monitoring, security, sensor principles, and face detection approaches, which are crucial for creating efficient, secure, and intelligent residential environments. The findings from these studies serve as a foundation for further research and development in the field of smart homes and IoT, ultimately enhancing the quality of life for homeowners.

Literature Review			
Sr. No	**Paper Title**	**Name of the Conference, Year**	**Proposed Concept**
1	Prototype design of smart home system using Iot	Indonesian journal of Electrical Engineering and Computer Science	Remote switching on/off of appliances
2	Literature Survey for IoT-based Smart Home Automation: A Comparative Analysis	9th ICRITO in 2021	Monitoring and security of houses
3	Smart Home IoT Sensors: Principles and Applications	International Journal on Engineering Technologies and Informatics	Use of "Industry 4.0"
4	Literature Review on Home Automation System	Literature Review on Home Automation System	Challenges of home automation systems
5	Home Security and Automation Based on Internet of Things	OP Conference Series: Materials Science and Engineering, Volume 899	To overcome the different face detection approaches in the IoT

Methodology:

Block Diagram:





Sr. No	Component Name	Specifications if any	Purpose	Connected pins to Arduino
1	PIR Sensor	GND, OUT, VCC	Sense Motion using Infrared	P2
2	Ultrasonic Sensor	Trigger, echo, vcc, gnd	Sense Motion	Trig -P3 Echo -P4
3	Gas Sensor	A0, D1, GND, VCC	Sense Gas	A0 – PA0
4	Arduino Uno	14 Digital 7 Analog	Microcontroller	-
5	Bluetooth Module HC05	State, TXD, RXD,GND,VCC,Enable	Communication device – Gateway	Tx-RX
6	LED-Buzzer	Anode, Cathode	Alert using Light – Indicator / Sound	P5 P6 P7

Explanation

Hardware and Working - The working of our prototype can be explained as follows:

1. PIR Sensor and LED:

The PIR (Passive Infrared) sensor detects motion within its range. When motion is detected, the sensor sends a signal to the Arduino Uno board. The Arduino Uno processes this signal and triggers the LED sensor to turn on, indicating the presence of motion.

2. Gas Sensor and Buzzer:

The gas sensor continuously monitors the gas levels in the environment. If the sensor detects a hazardous gas concentration or a gas leak, it sends a signal to the Arduino Uno. The Arduino Uno then activates one of the buzzers connected to it, producing an audible alert to notify the occupants of the potential gas-related risks.

3. Ultrasonic Sensor and Buzzer:

The ultrasonic sensor measures the distance between itself and an object by emitting ultrasonic waves and calculating the time it takes for the waves to bounce back. The Arduino Uno processes this information to determine the distance. If the calculated distance falls below or exceeds a certain threshold, indicating an obstacle or an abnormality, the Arduino Uno triggers the other buzzer connected to it, generating an audible alert to alert the users.

4. Arduino Uno and Bluetooth:

The Arduino Uno acts as the central control unit of the prototype. It receives signals from the PIR sensor, gas sensor, and ultrasonic sensor, processes the data, and activates the corresponding output devices. Additionally, the Arduino Uno is connected to a Bluetooth module, enabling it to establish a communication link with a mobile device. This Bluetooth link allows users to remotely monitor and control the prototype using a smartphone or other Bluetooth-enabled devices.

In summary, the prototype utilizes the PIR sensor for motion detection, the gas sensor for monitoring gas levels, and the ultrasonic sensor for obstacle detection. The Arduino Uno processes the sensor data and triggers the respective LED and buzzers to provide visual and audible alerts. The integration of a Bluetooth module enables remote monitoring and control of the prototype through a mobile device.

Hardware Working Steps

Hardware Setup

1 Connect the PIR sensor to one of the digital input pins of the Arduino Uno.

2 Connect an LED to a digital output pin of the Arduino Uno.

3 Connect the gas sensor to another digital input pin of the Arduino Uno.

4 Connect one buzzer to a digital output pin of the Arduino Uno for gas alerts.

5 Connect the ultrasonic sensor to the appropriate pins of the Arduino Uno.

6 Connect another buzzer to a digital output pin of the Arduino Uno for obstacle alerts.

7 Connect a Bluetooth module to the Arduino Uno for wireless communication.

Software Configuration:

1. Install the necessary libraries and dependencies for the PIR sensor, gas sensor, ultrasonic sensor, and Bluetooth module.

2. Set up the appropriate digital input and output pins in the Arduino code to interface with the sensors and actuators.

Motion Detection:

1. Monitor the input from the PIR sensor using the Arduino Uno.

2. If motion is detected, the PIR sensor sends a signal to the Arduino Uno.

3. The Arduino Uno processes this signal and activates the connected LED, indicating the presence of motion.

Gas Monitoring:

1. Continuously monitor the input from the gas sensor using the Arduino Uno.

2. If the gas sensor detects a hazardous gas concentration or gas leak, it sends a signal to the Arduino Uno.

3. The Arduino Uno responds by activating the buzzer connected to it, generating an audible alert to notify the occupants of the potential gas-related risks.

Obstacle Detection:

1. Measure the distance between the ultrasonic sensor and an object using the Arduino Uno.

2. The Arduino Uno calculates the distance based on the time it takes for the ultrasonic waves to bounce back.

3. If the calculated distance falls below or exceeds a certain threshold, indicating an obstacle or abnormality, the Arduino Uno triggers the other buzzer, producing an audible alert to alert the users.

Bluetooth Communication:

Enable the Bluetooth module on the Arduino Uno for wireless communication.

Establish a Bluetooth connection between the Arduino Uno and a mobile device (e.g., a smartphone).

Use a mobile app or Bluetooth terminal to send commands or receive real-time data from the Arduino Uno.

This allows users to remotely monitor and control the system, receive notifications, and adjust settings using their mobile device. By following these steps, the implemented system using the PIR sensor, gas sensor, ultrasonic sensor, Arduino Uno, and Bluetooth module can effectively detect motion, monitor gas levels, detect obstacles, and provide remote control and monitoring capabilities through a mobile device.

Software used :

1. Arduino

2. Cisco Packet tracer

3. Arduino Bluetooth Controller

Code:

```
#define pir 2
#define trig 3
#define echo 4
#define gas A0
#define led1 5
#define led2 6
#define buzz 7

int sensorThres = 200;
int gas_sensor;
long duration;
int distance;

void setup() {
  pinMode(pir, INPUT);
  pinMode(trig, OUTPUT);
  pinMode(echo, INPUT);
  pinMode(gas, INPUT);
  pinMode(led1, OUTPUT);
  pinMode(led2, OUTPUT);
  pinMode(buzz, OUTPUT);
  digitalWrite(led1, LOW);
  digitalWrite(led2, LOW);
  digitalWrite(buzz, LOW);
  Serial.begin(9600);
}

void loop() {
  if (Serial.available() > 0) {
    char data = Serial.read();
    switch(data) {
      case '0':
        digitalWrite(led2, LOW); // Turn off led2
        Serial.println("LED2 Off");
        break;
      case '1':
        digitalWrite(led2, HIGH); // Turn on led2
        Serial.println("LED2 On");
        break;
      case '5':
        digitalWrite(buzz, HIGH); // Turn on buzzer
        delay(1000);
        Serial.println("Buzzer On");
        break;
      case '6':
        digitalWrite(buzz, LOW); // Turn off buzzer
        Serial.println("Buzzer Off");
        break;
      case '7':
        while(Serial.read() != '8') {
          gas_sensor = analogRead(gas); // Read gas sensor
          Serial.println(gas_sensor); // Print gas sensor reading
          delay(1000); // Delay to prevent flooding serial output
        }
        break;
      default:
        break;
    }
  }
```

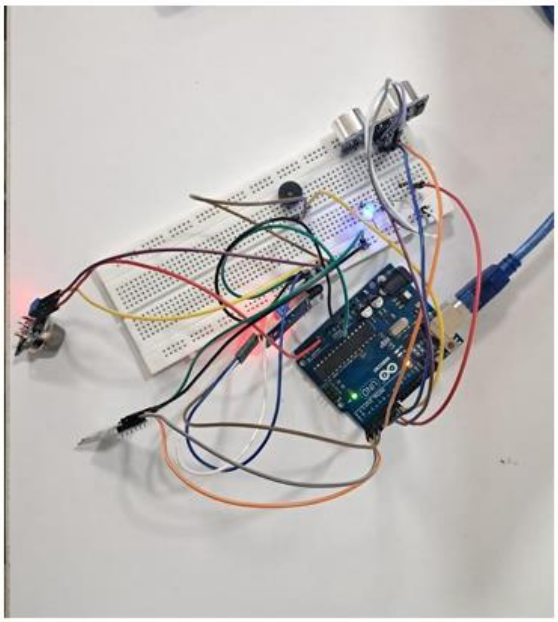
```
  // Ultrasonic sensor
  digitalWrite(trig, LOW); // Trigger off
  delayMicroseconds(2); // Wait
  digitalWrite(trig, HIGH); // Trigger on
  delayMicroseconds(10); // Wait
  digitalWrite(trig, LOW); // Trigger off
  duration = pulseIn(echo, HIGH); // Measure duration
  distance = duration * 0.034 / 2; // Calculate distance
  if (distance < 10) { // Near range
    digitalWrite(buzz, HIGH); // Fast beeping
    delay(200);
    digitalWrite(buzz, LOW);
    delay(200);
  } else if ((distance >= 10) && (distance < 150)) { // Mid range
    digitalWrite(buzz, HIGH); // Slow beeping
    delay(500);
    digitalWrite(buzz, LOW);
    delay(500);
  } else { // Long range
    digitalWrite(buzz, LOW); // No beeping
  }

  // Gas sensor
  if (gas_sensor > sensorThres) { // Above threshold
    digitalWrite(buzz, HIGH); // Continuous buzzing
    Serial.println("Gas Alert!");
  } else { // Below threshold
    digitalWrite(buzz, LOW); // Stop buzzing
  }

  // PIR sensor
  if (digitalRead(pir) == HIGH) { // Motion detected
    Serial.println("SAFE DOOR OPEN"); // Print message
  }

  delay(100); // Delay for stability
}
```

Results:



TERMINAL

```
Arduino > GAS SENSOR ALERT!!!
Arduino > GAS SENSOR ALERT!!!
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Arduino > GAS SENSOR ALERT!!!
Arduino > 21
> 1
Arduino > led2
> 0
> 3
Arduino > led1
> 2
> 5
Arduino > buzz
> 6
Arduino > SAFE DOOR OPEN
Arduino > SAFE DOOR OPEN
Arduino > SAFE DOOR OPEN
```

Conclusion:

In conclusion, the research paper successfully presents the design and implementation of a smart home system using Arduino Uno, PIR motion sensor, gas sensor, ultrasonic sensor, and Bluetooth communication. The developed prototype effectively enhances home security, ensures safety through gas monitoring, and provides automation and convenience to homeowners. By detecting motion, monitoring gas levels, and detecting obstacles, the system triggers appropriate alerts and notifications to keep residents informed and safe. The integration of Bluetooth enables remote monitoring and control of the system through a mobile device, adding an extra layer of convenience and accessibility. Overall, this research paper contributes to the field of smart home technology by showcasing the potential of IoT-based solutions in creating secure, safe, and intelligent residential environments.

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