Real-time occupancy detection system

1. Aim

To design and implement a real-time occupancy detection system using an Arduino Uno, PIR sensor, and 16x2 LCD display.
The system detects human motion and responds by turning on an LED and displaying the occupancy status on the LCD.

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2. Components Used

Hardware (Simulated):

- Arduino Uno
- PIR Motion Sensor
- 16x2 LCD Display
- Potentiometer (10k)
- LED
- Resistors (220 ohm × 2)
- Jumper Wires

Software:

- Tinkercad Circuits (for simulation)

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3. Circuit Description

The PIR sensor continuously monitors for motion in its detection range.
When it senses movement (a change in infrared radiation), it sends a **HIGH signal** to the Arduino.

The Arduino responds by:

- Turning **ON** the LED
- Updating the LCD to display **"Occupied"**

When no motion is detected:

- The LED is turned **OFF**
- The LCD displays **"Vacant"**

This forms a basic smart automation system that simulates occupancy-triggered control, suitable for energy-efficient applications.

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4. Arduino Code

```
#define PIR_PIN 2

#define LED_PIN 8

#include <LiquidCrystal.h>


// LCD pin connection: RS, E, D4, D5, D6, D7

LiquidCrystal lcd(12, 11, 5, 4, 3, 6);


void setup() {

  pinMode(PIR_PIN, INPUT);

  pinMode(LED_PIN, OUTPUT);

  lcd.begin(16, 2);

  lcd.print("System Ready");

  delay(1000);

  lcd.clear();

  Serial.begin(9600);

}


void loop() {

  int motion = digitalRead(PIR_PIN);

  if (motion == HIGH) {

    digitalWrite(LED_PIN, HIGH);
```

```
    lcd.setCursor(0, 0);
    lcd.print("Occupied");
    Serial.println("Motion Detected");
  } else {
    digitalWrite(LED_PIN, LOW);
    lcd.setCursor(0, 0);
    lcd.print("Vacant     ");
    Serial.println("No Motion");
  }
  delay(100);
}
```

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5. Simulation & Demo

This project was built and tested using **Tinkercad Circuits**, where:

- The PIR sensor was simulated using a heat source (moving blue circle)
- LED and LCD functioned according to motion detection

Demo Video Link:
https://drive.google.com/file/d/1tV0msZR5bMHGdyeYF2TE0YHzARyN-UxM/view?usp=drive_link

Tinkercad Circuit Link:
https://www.tinkercad.com/things/0Znb6Sq0CVW/editel?returnTo=/dashboard

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6. Results

- When **motion is detected**, the **LED turns ON** and LCD displays **"Occupied"**
- When **no motion**, the LED turns **OFF** and LCD displays **"Vacant"**
- The system mimics a real-time motion-triggered automation system and performs as expected in the simulation.

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7. Conclusion

This project demonstrates the application of basic sensors and microcontrollers for **occupancy-based automation**.
It is highly applicable in:

- Smart lighting systems
- Energy conservation setups
- Industrial safety and access control

It can be extended in real-world environments by replacing the LED with relays to control lighting, alarms, or even HVAC systems.

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