Smart Lighting and Motion Detection System using Arduino

**Objective:** To design and implement an intelligent lighting system that operates based on ambient light levels and motion detection using IR sensors. This project uses an Arduino UNO microcontroller to automate lighting with minimal power consumption and enhanced responsiveness.

**Components Used:**

1. **Arduino UNO R3** – Microcontroller board that processes sensor input and controls outputs.
2. **LDR (Light Dependent Resistor)** – Detects ambient light level.
3. **IR Sensors (x3)** – Detect proximity or motion in three different zones.
4. **LEDs (x3)** – Represent lights for three zones (left, center, right).
5. **Resistors** – Current limiting for LEDs and sensor pull-down resistors.
6. **Breadboard & Jumper Wires** – For circuit connections.

**Circuit Design:** A digital wiring diagram illustrates:

* LDR connected to pin 13 (digital input).
* IR Sensors connected to digital pins 7, 8, and 9.
* LEDs connected to PWM pins 3, 5, and 6.
* Ground and VCC rails connected from Arduino to the breadboard for consistent voltage.

Refer to the attached image: Smart\_Lighting\_Circuit.png

**Code Overview:** Written in Arduino C/C++ (.ino file), the code reads input from the LDR and IR sensors and adjusts the brightness of three LEDs using PWM (Pulse Width Modulation).

**Logic Flow:**

1. If ambient light is high (LDR = HIGH):
   * Check IR sensors:
     + If IR1 detects motion → Brighten LED1
     + If IR2 detects motion → Brighten LED2
     + If IR3 detects motion → Brighten LED3
     + If no motion → All LEDs glow dimly
2. If ambient light is low (LDR = LOW):
   * All LEDs remain off

**Code Snippet:**

#define ldr 13

#define led1 3

#define led2 5

#define led3 6

#define ir1 7

#define ir2 8

#define ir3 9

void setup() {

pinMode(ldr, INPUT);

pinMode(ir1, INPUT);

pinMode(ir2, INPUT);

pinMode(ir3, INPUT);

pinMode(led1, OUTPUT);

pinMode(led2, OUTPUT);

pinMode(led3, OUTPUT);

}

void loop() {

int sens = digitalRead(ldr);

int val1 = digitalRead(ir1);

int val2 = digitalRead(ir2);

int val3 = digitalRead(ir3);

if (sens == HIGH) {

analogWrite(led1, 0);

analogWrite(led2, 0);

analogWrite(led3, 0);

if (val1 == LOW) {

analogWrite(led1, 255);

analogWrite(led2, 10);

analogWrite(led3, 10);

delay(3000);

} else if (val2 == LOW) {

analogWrite(led1, 10);

analogWrite(led2, 255);

analogWrite(led3, 10);

delay(3000);

} else if (val3 == LOW) {

analogWrite(led1, 10);

analogWrite(led2, 10);

analogWrite(led3, 255);

delay(3000);

} else {

analogWrite(led1, 10);

analogWrite(led2, 10);

analogWrite(led3, 10);

delay(100);

}

} else {

analogWrite(led1, 0);

analogWrite(led2, 0);

analogWrite(led3, 0);

delay(100);

}

}

**Applications:**

* Smart home hallway or stairway lighting
* Energy-efficient outdoor garden/pathway lights
* Parking guidance lights for garages

**Future Improvements:**

* Add wireless communication (Bluetooth/WiFi)
* Use real-time clock for time-based lighting control
* Integrate voice control or mobile app interface

**Conclusion:** This smart lighting system demonstrates effective use of sensor data to automate lighting in real-world environments, reducing manual effort and improving energy efficiency.