

Hardware Integration Documentation

Module: Object Detection Using IR Sensor with Dual LED Indication

1.1 Objective

To detect the presence of an object using an IR sensor and provide visual indication through two LEDs.

The system is designed such that:

- Red LED glows when an object is detected.
- Blue LED glows when no object is detected.

This setup provides a simple visual representation of the object detection status.

1.2 Components Used

Component	Specification
Microcontroller	Sourya Board (3.3V Logic GPIO)
IR Sensor	Digital IR Obstacle Sensor (LM393-Based)
Red LED	Standard LED (3.3V Compatible)
Blue LED	Standard LED (3.3V Compatible)
Resistor	220 Ω Current Limiting Resistor
Power Supply	3.3V Regulated Output

1.3 Electrical Specifications

1.3.1 Voltage and Current

- Operating Voltage: 3.3V
- GPIO Input Voltage: 3.3V Logic
- GPIO Output Voltage: 3.3V
- IR Sensor Output Type: Digital
- LED Operating Current: Typically 5–10 mA

Important Design Constraint

Each LED must be connected through a current-limiting resistor to prevent excessive current flow and ensure safe GPIO operation.

1.4 Pin Assignment Summary

Function	STM32 Pin	Sourya Board Pin	Mode
IR Sensor Output	PA6	D0	GPIO Input
Red LED Control	PA7	D1	GPIO Output
Blue LED Control	PB0	D2	GPIO Output

1.5 Detailed Connection Description

1.5.1 IR Sensor Connection

Purpose

Detects the presence of an object and provides a digital output signal to the microcontroller.

Connections

IR Sensor VCC → 3.3V

IR Sensor GND → GND

IR Sensor OUT → PA6 (D0)

Signal Logic

- LOW → Object Detected
- HIGH → No Object Detected

Configuration

- PA6 configured as GPIO Input
 - No pull-up or pull-down required
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1.5.2 Red LED Connection

Purpose

Provides a visual indication when an object is detected.

Connections

PA7 (D1) → 220Ω Resistor → Red LED Anode (+)

Red LED Cathode (−) → GND

Operating Principle

- PA7 HIGH → Red LED ON
- PA7 LOW → Red LED OFF

Configuration

- PA7 configured as GPIO Output
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1.5.3 Blue LED Connection

Purpose

Provides a visual indication when no object is detected.

Connections

PB0 (D2) → 220Ω Resistor → Blue LED Anode (+)

Blue LED Cathode (−) → GND

Operating Principle

- PB0 HIGH → Blue LED ON
- PB0 LOW → Blue LED OFF

Configuration

- PB0 configured as GPIO Output
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1.6 Peripheral Configuration Summary

Peripheral	Setting
PA6	GPIO Input
PA7	GPIO Output
PB0	GPIO Output

1.7 Functional Operation Description

1. The IR sensor continuously monitors for objects.
2. When an object is detected:
 - PA6 reads LOW.
 - Red LED (PA7) is turned ON.

- Blue LED (PB0) is turned OFF.
 - 3. When no object is detected:
 - PA6 reads HIGH.
 - Red LED (PA7) is turned OFF.
 - Blue LED (PB0) is turned ON.
 - 4. The process repeats continuously to provide real-time object detection status.
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Code

In main.c file inside the while(1):

```
while (1)
{
    if(HAL_GPIO_ReadPin(GPIOA, GPIO_PIN_6) == GPIO_PIN_RESET)
    {
        HAL_GPIO_WritePin(GPIOA, GPIO_PIN_7, GPIO_PIN_SET);    // Red LED ON
        HAL_GPIO_WritePin(GPIOB, GPIO_PIN_0, GPIO_PIN_RESET);    // Blue LED
OFF    }
        else
        {
            HAL_GPIO_WritePin(GPIOA, GPIO_PIN_7, GPIO_PIN_RESET);    // Red LED
OFF    HAL_GPIO_WritePin(GPIOB, GPIO_PIN_0, GPIO_PIN_SET);    // Blue LED
ON    }
}
```

1.8 Known Limitation (Documented Clearly)

- Detection range depends on IR sensor characteristics.
 - Ambient light conditions may affect sensor performance.
 - Reflective and dark surfaces may produce different detection responses.
 - ✓ These behaviors are expected and acceptable for basic object detection applications.
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1.9 Safety and Reliability Considerations

- GPIO current remains within STM32 limits.
- Current-limiting resistors protect both LEDs.

- No floating inputs are present.
 - Common ground reference is maintained throughout the circuit.
 - Simple logic results in low failure risk.
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1.10 Readiness for Future Enhancement

This design can be upgraded to:

- Buzzer-based object detection alert
 - Distance measurement using ultrasonic sensors
 - Interrupt-based object detection
 - Wireless notification systems
 - Multi-sensor obstacle detection
 - IoT-based monitoring and logging
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Conclusion

The Object Detection Using IR Sensor with Dual LED Indication application successfully demonstrates real-time object detection on the Sourya Board using PA6 (D0), PA7 (D1), and PB0 (D2). The Red LED indicates object presence, while the Blue LED indicates object absence, providing a simple and effective visual monitoring system.